REPORT

OF THE

INDIAN SURVEY COMMITTEE,

1904-05.

PART I.—THE REPORT.

SIMLA:

PRINTED AT THE GOVERNMENT CENTRAL PRINTING OFFICE.

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PART I.

CHAPTER I.

Preliminary.

Appointment of the Indian Survey Committee.

The appointment of a Committee to examine the methods and working of the Survey of India Department, with special reference to the preparation or revision and the reproduction of the Topographical maps of the country, was notified in Resolution No. 1581, dated 31st October 1904, issued by the Government of India in the Department of Revenue and Agriculture.

The Committee's instructions.

2. The instructions to the Committee were contained in paragraphs 2 and 3 of the Resolution, of which, for facility of reference, we quote the relevant portions :—

Among the more important points which the Committee will enquire into and report on are the following :—

I. The state of the maps in each province and the measures required to bring them up to date.—Under this head attention will be directed to the quality of existing topographical maps and the extent to which they serve the purposes of the general administration and of the different departments concerned, such as the Military, Revenue, and Public Works Departments; the future programme of topographical work; the scale or scales on which maps in different parts of the country or for different purposes should be published; the order of urgency of the maps required; and the arrangements for keeping up to date the topographical maps which exist or are to be prepared.

II. Methods and expense of survey.—Under this head information will be collected as to whether any standards of work have been fixed, and if not, whether it is possible to fix them, varying as they must do in different kinds of country; whether there is any systematic method of comparing the outturn and quality of work and the cost of different parties; and whether information so gained is made practical use of. It is also for investigation whether the cadastral survey in different provinces is carried on so as best to allow of its utilisation for topographical work, and if not, whether it would be advisable to adopt a different system, and whether such utilisation results in any substantial economy, as compared with a fresh topographical survey. The question of utilising professional agency for the supervision of cadastral work, and of how far the same agency could be employed for the maintenance of topographical maps will also be for consideration. And the degree of accuracy which is desirable in each class of survey will be defined.

III. Methods of reproduction.—Under this head an examination will be made of the present system under which the results of the field surveys are utilized in drawing the maps; of the methods of reproducing and publishing them at present adopted; of the accuracy and

style of the published maps; and of the relative cost and efficiency of the different processes employed.

IV. The organisation of the Department.—Under this head consideration will be given to the question which has been under consideration from time to time of the transfer of the head-quarters from Calcutta to Dehra Dun, and of arranging for outside agency to do the extra-departmental work which at present imposes such a burden on the Survey publishing offices. It will be for consideration how far, having regard to the volume of work expected from it, the cadre of the Department both in its Imperial and Provincial Branches is in need of being strengthened; whether its efficiency might not be increased by better organisation, and more especially by better arrangements for the local supervision of work in the field; whether the method of recruitment to the Provincial Branch is susceptible of improvement; and how far the larger employment of natives of India is possible. It will also have to be considered whether, with topographical work actively in progress all over India and on the frontiers, and in view of the necessity of maintaining the maps which will then be prepared by systematic and periodical revision, it would not be better to decentralise the administrative control of the Department, and to locate several head-quarters in different provinces in closer relationship with the Local Governments, and if so, it will be for decision whether each local centre should be responsible for survey and drawing only, or be provided with an equipment for the reproduction of maps also. Finally, the organisation of the drawing and publishing offices requires thorough investigation with the view of ensuring that the maps shall be published as soon as possible after the surveys on which they are based have been completed.

The Committee's recommendations will be framed with the strictest regard to economy and with the view of arranging that topographical maps shall be prepared only with such a degree of elaboration and on such a scale as may be absolutely essential in different parts of the country. Their report will include an estimate of the additional expenditure required to give effect to their proposals.

The Committee will formally assemble in Calcutta on the 15th November. In the prosecution of their investigations the members of the Committee will, besides examining the head-quarters offices at Calcutta, visit the other Drawing Offices, and inspect in the field, so far as possible, the work of the field parties employed in different parts of the country.

Composition of the Committee.

3. The Committee was composed as follows:—

President: Mr. J. O. MILLER, C.S.I., I.C.S., Secretary to the Government of India in the Department of Revenue and Agriculture.

Members:
- Col. SIR JOHN FARQUHARSON, K.C.B., R.E. (retired), late Director-General, Ordnance Surveys of the United Kingdom (nominated by the Secretary of State for India).
- Lieut.-Col. F. B. LONGE, R.E., Surveyor-General of India.
- Col. F. H. KELLY, Assistant Adjutant-General (nominated by the Commander-in-Chief in India).

Secretary: Mr. C. A. BARRON, I.C.S., Settlement Officer, Kohat.

The members of the Committee appointed in India met in Calcutta on the 15th November 1904. Sir John Farquharson joined the Committee on the 21st November. The Government of India had reported to the Secretary of State that the enquiry would probably last for about six months. The Committee finished its work, and dispersed on the 25th April 1905, and the subsequent completion and printing of the Report occupied the months of May and June.

During this period Colonel S. C. N. Grant, C.M.G., R.E., of the English Ordnance Survey, was associated with the Committee for the months of January and February, as special map expert, to advise upon the methods of reproduction followed in India.

The Committee's tour.

4. The Committee spent part of November and December, the whole of January, and practically the whole of March on tour. The places visited were:—Gauhati and Shillong in Assam; Katihar and Dinapore in Behar; Rangoon, Toungoo, Mandalay, Maymyo and Katha in Burma; the Presidency Town in Madras; Bangalore; Poona and Bombay; Badnera in Berar; Lucknow, Dehra Dun and Rajpur in the United Provinces; Lahore in the Punjab and Peshawar in the North-West Frontier Province. The President and Colonel Longe also visited Hyderabad, and the President paid a short visit to Rurki. As it was necessary practically to complete the Report before the end of April, it was impossible for the Committee as a whole to visit the Central Provinces, Central India and Rajputana, Sind and Baluchistan. Colonel Kelly, however, proceeded from Bombay to Karachi, Hyderabad (Sind), Indore and Ajmere, and subsequently went to Quetta; at these places he collected the usual information from the local officers regarding the condition of the maps of these parts of the country. In the end of March the Committee assembled at Simla to consider finally the terms of this Report.

Evidence taken.

5. In Calcutta, as well as at all the stations visited, the Committee recorded the evidence of such representative officers belonging to the Civil, Military, Public Works (including Railways) and Forest services as could conveniently be summoned to meet the Committee. Extracts from this evidence will be found in the papers forwarded with the Report. In Calcutta the Committee also inspected the various offices attached to the Head-quarters of the Survey, *viz.*, the Drawing and Engraving Offices, the Photozincographic and Lithographic Offices, the Mathematical Instrument Office, and the Bengal Drawing Office, and examined the Officers in charge of these offices.

Before starting on their tour, the Committee drew up lists of questions for Local Governments, Civil officers, Military officers and Engineers. The various Chambers of Commerce were also asked to forward the views upon topographical maps of any leading firms or associations interested in the subject. To these questions replies have been received from a very large number of officers. The more important of these answers are reproduced in Part II of the Report, but it has not been thought necessary to print a great deal of the evidence, written and oral.

Survey parties and offices visited.

6. On tour the Committee inspected in the field the cadastral work of No. 4 Party at Katihar in the Purneah District, the topographical work of No. 3 Party at Toungoo and No. 10 Party at Mandalay and Sagaing, and the work of the forest party on the 4″ scale at Tigyaing on the Irrawaddy River. At Madras they examined the special test survey made by the Topographical Forest Party of the mapping of the Madras Survey Department. At Bangalore the work of 8 Probationary Sub-Assistant Superintendents working in the Training Class was examined, and at Badnera an inspection was made of the work of the newly formed Berar Party for training Imperial and Provincial officers. In Burma the Committee interviewed the Officers in charge of No. 3 (Topographical), of No. 10 (Topographical) and No. 7 (Cadastral) Parties

and the Superintendent, Forest Surveys ; at Madras the Officer in charge of No. 19 Forest Party ; at Calcutta and Dinapore the Superintendent, Bengal Provincial Surveys ; at Lucknow the Superintendent of the United Provinces Provincial Surveys and the Officer in charge of No. 14 Topographical Party working in the United Provinces; at Dehra Dun the Superintendent, Trigonometrical Surveys and the Officer in charge of No. 1 Topographical Party working in the Central Provinces ; and at Lahore the Officer in charge of No. 18 (Punjab) Topographical Party. Colonel Kelly on behalf of the Committee discussed the work of No. 12 (Topographical) Party in Sind and No. 15 (Topographical) on the North-West Frontier, with the officers in charge.

The offices which were inspected outside Calcutta included the Shillong Drawing Office, the Head-quarters office of the Bengal Provincial Surveys, the Mapping Section of the Burma Government Printing Press, the Madras Survey Office, including the reproduction establishment, the Bangalore Drawing Office, the Poona Photozincographic Office, the Trigonometrical Surveys Office at Dehra Dun, and the Frontier Drawing Office at Rajpur.

Colonel Grant inspected the Madras and Poona Photozincographic offices, the offices at Dehra Dun and the Lithographic offices of the Rurki College, as well as the various reproduction offices at Head-quarters at Calcutta.

Limited time at Committee's disposal.

7. The Committee have been at some disadvantage in making their enquiries and compiling their report—(1) by the necessity of proceeding on tour within a week of their first meeting; (2) by the limitation of the time that could be devoted to their report, owing to the President's having to join another appointment on May 1st, and to Sir John Farquharson's being obliged to proceed to England at the same time.

The Committee have been in consequence unable to deal with some matters as fully as might be desirable, and on the other hand they are conscious that their report would have gained greatly in arrangement, in condensation and in the avoidance of repetition had more time been available. They have been obliged to prepare it in circumstances of great pressure.

CHAPTER II.

Historical.

A.—General.

Preliminary.

8. Before we proceed to deal with the questions on which we are required to report, it appears advisable to give a short account of the Survey Department, in order both that the manner in which its organisation has been evolved may be made clear, and that a general idea may be formed of the methods on which it has proceeded and of the work which it has up to the present accomplished. The historical materials for such an account are to be found chiefly in the annual reports of the Department, or in the Memoirs of Markham and Black on Indian Surveys, and in the article recently prepared for the Imperial Gazetteer. They are less complete in the case of topographical surveys than could be wished; and leave many points in doubt on which it would have been interesting to have definite information, such as the reasons which determined the adoption of the various scales—the $\frac{1}{4}''$ for the Indian Atlas, the 1″ for topographical surveys generally, and the 4″ for revenue surveys. The Trigonometrical Branch, with which we are less concerned, appears to have fuller materials for its history than the Topographical, and it may not be out of place here, at the very commencement of our report, to emphasize the advantage which the former branch has had, in having, at least up to 1882, a definite scheme or programme always before it, which it was left to carry out, undisturbed by the exigencies of the moment or the requirements of local authorities; while the topographical mapping of the country has never been carried out on any definite system, the maps being the result partly of early reconnaissances, partly of direct topographical surveys, partly of compilations from the surveys made by revenue or, in later days, by cadastral parties. The want of system (which has been imposed on the Survey Department by the varying requirements of different parts of the country,) has led to an immense amount of patchwork, and renders it difficult now to give a connected account of the topographical work accomplished. With some of the unfortunate results of this absence of method we shall deal more fully in chapter VI of the report.

Commencement of survey work.

9. The first official recognition of the necessity for a Survey Department in India appears to be the appointment about 1763 by Lord Clive of Major Rennell (subsequently known in Europe as the greatest geographer of his day,) as Surveyor-General; but though Rennell's surveys and those made by the route surveyors, who followed him, and who explored different parts of the country, as it was opened up by military expeditions, did much to advance the knowledge of Indian geography, it was not till the beginning of the 19th century that the survey was placed on a scientific basis, and the foundation securely laid of the great work which has since been carried out. The necessity for some such measure was not long in making itself felt in a country of the extent of India, and even so early as in the time of Rennell's immediate successor, many contradictions and absurdities were found in the various surveys which had been made, and enquiries were set on foot as to the best means of co-ordinating the work of surveyors in different parts of the country.

The Great Trigonometrical Survey.

10. Rennell's work lay entirely in Northern India, but it was in Madras that the earliest steps were taken to provide for the topographical surveyor a scientific basis on which to found his work, and to inaugurate, within 20 years of the commencement of a similar work in England, a Great Trigonometrical Survey of the country. Measures for the exploration of the country were at the close of the 18th century being energetically pushed on under the administration of Lord Wellesley; and proposals by Major Lambton, of the 33rd Regiment, for a "mathematical and geographical" survey of the peninsula received the support of Sir Arthur Wellesley, and were approved by the Government of Madras. Lambton's operations, which commenced in 1802 with the measurement of a base line in Madras, had, by the time of his death in 1823, extended over a large part of the south of the Peninsula, and their importance had been recognized by the transfer, in 1818, of their control, under the name of the "Great Trigonometrical Survey," to the Government of India. The 10th of April 1802, the day on which Lambton commenced the measurement of the Madras base line, is the date on which the survey of India was really begun, all the work executed before that time being of a scattered nature, unconnected except by astronomical observations and plotted without reference to the figure of the earth.

Topographical work commenced in Mysore.

11. About the same time another officer, Colonel Colin Mackenzie, who had already carried out some survey work in Madras, was appointed to conduct the topographical survey of Mysore, which he based on a triangulation of his own. In 1809 he was made Surveyor-General of Madras, and subsequently, like Lambton, was removed to Calcutta and became Surveyor-General of India. The two posts were thus at this time entirely distinct.

It was apparently on Colonel Mackenzie's initiative that the Madras Military Institute was founded, where many of the officers were trained, who conducted the surveys on which the Atlas sheets of that Presidency are still to a large extent based. The whole of India south of the Kistna, including Goa, Coorg and the Native States of Cochin and Travancore, was surveyed in the first quarter of the century in sufficient detail to allow of the publication of the results in a map on the scale of four miles to the inch, and the survey of Hyderabad, destined to continue with interruptions for forty years, was commenced. In Northern and Central India and in Bombay survey operations were also prosecuted, but as these have been completely superseded by later surveys it is unnecessary to mention them in detail.

The Surveyors-General of India.

12. The dates of office of the Surveyors-General and Superintendents of the Trigonometrical Survey up to the final amalgamation of the Survey Department, and of the Surveyors-General thereafter were—

Surveyor-General of Bengal.		Superintendent, Trigonometrical Survey.	
1763-1777	Major Rennell.		
1777-1788	Colonel John Call.		
1788-1803 (?)	Colonel Wood.		
1803-1810	Colonel Colebrooke.		
1810-1814	Colonel Garstin.		
1814-1816	Colonel Charles Crawford.		
1816-1821	Colonel Colin Mackenzie.	Colonel Lambton ...	1818-1823.
1821-1823	Colonel J. A. Hodgson.		

Surveyor-General of India.		Superintendent, Trigonometrical Survey.	
1823-1827	Colonel Valentine Blacker.	Sir George Everest ...	1823-1830.
1827-1829	Colonel J. A. Hodgson.		
1830-1843, Sir George Everest, K.C.B., R.A.		... ...	1830-1843.
1843-1861, Major-General Sir Andrew Waugh		... ...	1843-1861.
1861-1878, General H. L. Thuillier, C.S.I., R.A.,		General J. T. Walker, R.E.,	1861-1883.

Surveyors-General after amalgamation.

General J. T. Walker, C.B., R.E.	...	... 1878-1883.
Colonel G. C. DePrée, S.C.	...	... 1883-1887.
Colonel Sir H. R. Thuillier, K.C.I.E., R.E.	...	... 1887-1895.
Major-General C. Strahan, R.E.	...	... 1895-1899.
Colonel St. G. C. Gore, C S.I., R.E.	...	... 1899-1904.

In 1823 (Sir) George Everest became Superintendent of the Great Trigonometrical Survey, Colonel Valentine Blacker at the time holding the post of Surveyor-General, while Madras and Bombay had each a Deputy Surveyor-General of its own. In 1830 Sir George Everest became Surveyor-General, retaining the superintendence of the Great Trigonometrical Survey, and about 1834 the posts of the Deputy Surveyors-General of Bombay and Madras were abolished.

Sir George Everest's work.

13. Sir George Everest's most memorable work was accomplished in his capacity as Superintendent of the Trigonometrical Survey, in remodelling the system of triangulation, and laying down the lines on which for over half a century it was destined to proceed, and in completing the measurement of the great meridional arc extending from Cape Comorin to the Himalayas.

The historian of the Department states that in Everest's time, owing to the absorbing nature of the Surveyor-General's scientific work, "the progress of the geographical delineation of the country languished in some degree"; and though this statement requires some qualification, it appears to be in the main correct. It was found impossible to introduce in topographical work the same unity of system as was secured in the trigonometrical branch or to lay down a definite programme for the prosecution of the work. Revenue surveys on the large scale of 4" to the mile were undertaken in "the richer portions of British districts as an aid to the operations of the settlement surveys." They appear to have been commenced in what are now the Cis-Sutlej districts of the Punjab, and in the upper districts of the United Provinces, and to have been extended about 1837 to Bengal, where in many districts they still form the only basis of the existing maps. In the United Provinces after 1834 they were reduced to mere delineations of district boundaries, and in many cases they were without any scientific basis, as they preceded the trigonometrical survey.

Topographical surveys, of which little or no results now remain, were carried out in Bundelkhand, the Saugor and Nerbudda territories, Ganjam and Orissa, and Sylhet and Cachar. A number of districts in Madras were resurveyed, and the survey of Hyderabad was continued.

Separation of the Revenue Survey.

14. The revenue survey work eventually assumed so much importance that, during the Surveyor-generalship of Sir Andrew Waugh, it was placed under a separate Superintendent, Colonel Thuillier being appointed to this charge in 1847. Under his direction these surveys were vigorously prosecuted

during the remainder of Sir A. Waugh's time of office in many parts of the Bengal Presidency; and the existing maps of the present Province of Lower Bengal are in many districts based on surveys of this period. In the Punjab the country between the Jhelum and the Indus was topographically surveyed on the 1″ scale, and in Kashmir the triangulation was accompanied by a detailed survey, partly on the ½″ and partly on the ¼″ scale.

Separation of the Trigonometrical Branch.

15. In 1862 after Sir A. Waugh's retirement, the Surveyor-generalship was again separated from the superintendency of the trigonometrical survey; Colonel Thuillier being appointed to the former and Colonel Walker to the latter post. But the division of labour was not an absolutely clear one. The completion of the trigonometrical survey was now thought to be in sight, and surveyors of the trigonometrical branch were employed in exploring work, while in Kathiawar and Gujrat complete topographical surveys were conducted under the general control of the Superintendent of the trigonometrical branch.

Colonel Dickens' Report on the Survey Department of India.

16. In 1864 an elaborate report on the Survey Department was prepared by Colonel Dickens, R.A., apparently as the result of some application for increased establishments, and to this reference may be made, if necessary, for much information as to the early history of the department. His report gives indications of the idea that topographical surveys would soon come to an end, and might within British India be left under the control of Local Governments. His own views as to the organisation best adapted to the requirements of survey work are given in paragraph 53 of his report as follows :—

"The best organisation to meet the case seems to be one which shall place the Surveyor-General in the position of a consulting officer to the Government of India, in regard to all branches of the surveys, and charged with all general compilations of geographical materials, that the Great Trigonometrical and foreign topographical surveys shall have their Superintendent or Superintendents under the Government of India; and that the revenue and waste land surveys and such topographical surveys as are in British territory, shall be under a Superintendent attached to each local administration. This arrangement should include Madras and Bombay. For the supervising officers under the Local Governments, I would suggest the revival of the old name Deputy Surveyor-General. This I say is the best general scheme of organisation that I can suggest: but it cannot be fully carried out now. It may, however, be looked upon as the idea to which future changes of organisation should tend."

General H. L. Thuillier, Surveyor-General.

17. Between 1861 and 1878, under General Thuillier as Surveyor-General, revenue surveys were actively pushed on in Bengal, the Central Provinces, Oudh, Sind, Assam and Burma, while topographical surveys, generally on the 1″ scale, were in progress in various parts of the central hilly tracts of India (chiefly in Native States) from Central India and Rajputana to Orissa and Vizagapatam. The survey of Hyderabad was brought to a conclusion in the same period; surveys were prosecuted in Assam and reconnaissances carried into the hilly tracts of the North-Eastern Frontier. In 1874 the systematic re-survey of Mysore was commenced.

In the same period the Revenue Survey entered upon a new branch of work owing to the employment of professional agency upon the detailed settlement survey of the country in Northern India, thenceforward known as the cadastral survey. The commencement of this work by the professional

department dates from 1871-72, when surveys on the 16" scale were undertaken in the United Provinces, of the probable value of which the Surveyor-General expressed the following opinion :—

"I believe that an immense saving of expense will be effected in the end by doing away with the constant remeasurements for irrigation canals, railways, roads and other purposes, which are now perpetually being made in an irregular, unsatisfactory and expensive manner for emergent engineering objects."

Meanwhile in other parts of the country revenue surveys on the old system were in progress, and revenue survey parties were in many cases diverted to topographical work. Several districts of the Punjab were surveyed on the 4" scale, the survey of Bahawalpur was completed, and two revenue parties were transferred to undertake topographical work in Bombay.

Topographical work accomplished prior to 1878.

18. About this time it was assumed that the work of the Survey Department was approaching completion, and that the difficulty to be encountered after a few years would be not to find establishments for the work, but to discover work for the establishments. The actual steps taken in consequence of this policy and of the pressure of financial difficulties, we shall describe separately, but it may be convenient here to state how far the topographical survey of the country had progressed up to the time when financial pressure began to be applied, and all branches of the department were amalgamated, and also to give some description of the character and cost of the operations. The necessary information is to be found in General Thuillier's report on topographical surveys for the year 1876-77, the index map attached to which shows the whole of Madras (except part of Ganjam) as blank—"remaining for survey,"—as well as the southern part of the Bombay Presidency, the Konkans, the western half of Rajputana, the districts of the Doab and of the Benares Division in the United Provinces, and the Tenasserim Peninsula in Burma. The rest of the country is shown as having been surveyed as follows :—

(1) *Old or local surveys*—Hyderabad and Pegu.

(2) *By the Topographical Branch*—Eastern Rajputana and Central India; the southern and eastern parts of the Central Provinces; Baghelkhand and Chota Nagpur; a portion of the country between the Indus and the Jhelum; part of Mysore; the Garo, Khasia and Naga Hills and Manipur.

(3) *By the Revenue Branch*—Sind; the Punjab—practically all, except the area referred to above; Rohilkhand, Oudh and Bundelkhand; the central portion of the Central Provinces; Bengal, including Orissa and Chittagong and parts of Chota Nagpur; also apparently part of Ganjam; the Assam Valley; a portion of Bombay.

(4) *By the Trigonometrical Branch*—the north-west Himalayas (including Kashmir) from Baltistan to Kumaon inclusive; the greater part of Gujarat.

The amount of detailed survey accomplished during General Thuillier's connection with the department was indeed immense, and the Government of India, in acknowledging his services in their orders on this report, gave the following figures of the work carried out during his incumbency as

Surveyor-General since 1861 and as Superintendent of Revenue Surveys since 1847 :—

	Area. Sq. miles.	Cost including triangulation per sq. mile.
		Rs.
Topographical surveys from 1860-61 chiefly on the 1″ and ½″ scales	291,354	20
Revenue surveys since 1845-46 chiefly on the 4″ scale	493,293	32*

the total, with the addition of 12,000 square miles of cadastral work, approaching 800,000 square miles, or more than half the whole area at that time of India including Native States.

It is right to add that General Thuillier, in showing how much had been done, made it perfectly clear that the maps already prepared would not suffice for the growing wants of the country. Resurveys on larger scales and in more minute detail were certain in his opinion to be required. "The present generation," he said, "cannot possibly foresee any termination for the labours "of a skilled department like the one at present employed, and which has "been raised and trained with such infinite labour and expense."

Amalgamation of the three branches of the Survey.

19. On January 1st, 1878, the three branches of the Survey Department—the Great Trigonometrical, the Topographical and the Revenue—which had up to that time been virtually separate departments, each with its own cadre and establishment, were amalgamated. The reasons for the amalgamation, with a description of the duties of the various branches of the Survey, may be given in the words of the Surveyor-General which afford a clear indication of the want of system to which we have already referred :—

"Originally, when the three departments were first formed—which was at different times—the duties which each had to perform were essentially distinct. The Trigonometrical Survey was required to form the basis on which all surveys of interior details were to rest, and the framework within which they were to be connected and fitted together. The Topographical and Revenue Surveys were to furnish the interior details ; the former was to survey, by the method of plane-tabling, the whole country, including Native States and British territory, with the exception of the richer British Districts paying a large revenue; these districts devolved on the latter and were surveyed on a larger scale, and by a different *modus operandi*, which was better suited for the determination of exact areas, in order to meet the requirements of the Revenue and Settlement officers. In course of time, however, work which was originally intended to be undertaken by only one of the three Departments had come to be undertaken, to a greater or less extent, by the others. The Great Trigonometrical Survey was approaching completion, and for many years a large proportion of its surveyors and higher officers had been employed in topographical surveying on various scales * * * * The Topographical Department, though originally intended for the execution of the Primary General Survey of India, had similarly to undertake detailed surveys on large, as well as preliminary surveys on small, scales. The Revenue Department which was originally intended for surveying the rich British districts in the plains of India, leaving the delineation of all hilly country and difficult ground generally to the Topographical, had for some years past been largely employed in the topography of hill districts on a trigonometrical basis. Thus the duties of the three Departments had become gradually intermixed, and they were daily becoming more so ; so that of very much of the work now in progress it is a matter of indifference to which of the three branches, as originally constituted, the officer deputed to undertake it may belong."

The post of Superintendent of the Great Trigonometrical Survey was abolished, and its duties were undertaken by the Surveyor-General in addition to

* The rates varied from Rs. 69 in Assam and Rs. 45 in Oudh to Rs. 14 in Sind, where a large amount of 1″ topographical work was included.

his topographical work, while a Deputy Surveyor-General was placed in charge of revenue surveys. The report of 1877-78 also contains a memorandum on the nature and cost of the surveys carried out during the previous ten years, compiled from the annual reports from 1867-68 to 1876-77 from which the following cost rates, which being prepared from ten years' figures only, differ from those given by General Thuillier, are taken:—

	Rate per square mile. Rs.	
Topographical surveys, 1″ scale ...	22	The annual averages varied from Rs. 28 to Rs. 18 for all parties, and the rates for individual parties from Rs. 41 to Rs. 11.
Revenue surveys, 4″ scale ...	53	The averages varied as above from Rs. 59 to Rs. 47 and for individual parties from Rs. 102 to Rs. 39.
Cadastral surveys, 16″ scale ...	165	(Six years' average.)

General Walker was of opinion that the topographical survey on the 1″ scale was admirably adapted for the purposes of a cheap first survey of India, and as a basis for the engraved Atlas. The cadastral survey he thought to be, for the information given, the cheapest of all.

Completion of the Great Trigonometrical Survey, and diversion of the staff to cadastral work.

20. In 1882 the original programme of the Great Trigonometrical Survey was completed, and as topographical work was regarded as practically finished in India proper, and also rather as a luxury than a necessity, the policy was adopted of transferring parties, as far as possible, to cadastral work, or other operations, of which the cost fell on Local Governments. An important Resolution* on the subject was issued in 1882, in which Local Governments were invited to apply for the services of the Survey of India to conduct their cadastral operations, and rules were issued designed to place the conduct of cadastral surveys on a scientific basis, and to co-ordinate the work done by topographical and cadastral surveyors.

The effect of this policy was that the energies of the Department were gradually diverted to forest and cadastral work. For a few years, however, there was no marked change and topographical work continued to be prosecuted in the Deccan, the United Provinces, Gujarat and Central India, Assam, Baluchistan, Burma and the Andamans, while a party was sent to the Punjab to utilize the village maps for topographical purposes.

Recent enforced curtailment of topographical work.

21. In 1883-84 there were eight topographical parties and several detachments at work. In 1886-87 the number of topographical parties was the same, but reductions were now insisted on; the transfer of parties to cadastral work began, and in 1889 it was decided that the Department should be reduced by the strength of one party every five years. In that year there were only five topographical parties at work, and in 1890 only four. Since that date the number has risen and is now nine, but during the last 17 years topographical work has been almost at a standstill except in Burma, Baluchistan and Sind. The survey of Sind has been practically completed, and surveys in Baluchistan and Burma have been pushed on on a fairly continuous and satisfactory programme; in Bombay some work has been done, chiefly for forest purposes; in Madras the topographical survey of something less than 1,000 square miles

* Revenue and Agricultural Department Resolution No. 45 (Surveys), dated 4th September 1882.

has been accomplished; four standard sheets have been published as the result of surveys in the Lushai country; and three districts in the United Provinces, which were entirely without topographical maps, have been surveyed. From 1883 to 1900 a party has been employed in the Punjab hills, but its mapping work has always been in arrears, and its contributions to the standard maps of the country are of comparatively small importance. In Burma and Baluchistan better progress has been made, but the programme in the former country has lately been disarranged by the transfer of a party in compliance with the requisitions of the military authorities to the North-West Frontier, while the Baluchistan party has undertaken much miscellaneous work, such as surveys of cantonments, and in Kashmir.

Unsatisfactory state of topographical maps and consequent appointment of present Committee.

22. From time to time the Survey Department has called attention to the impossibility of carrying out work that ought to be done, owing to the enforced diminution of its topographical strength; and in 1901 the Surveyor-General, Colonel Gore, made a special representation regarding the necessity of some scheme for keeping maps up to date, while the Punjab Government complained of the delay in the supply to that province of topographical maps. In 1903 the Viceroy directed attention to the matter, and a Departmental Committee was appointed, which reported that the bringing up to date of the maps of India generally was a task of considerable magnitude, and would cost at least an additional sum of 9 lakhs for 15 years on survey parties alone. It was decided before undertaking so large a programme to have the matter more fully examined, and the present Committee was appointed for the purpose. The figures and estimates of the former Committee's report were supplied by Colonel Gore, and, after examining the maps of all parts of the country, we desire to express our appreciation of the general accuracy of Colonel Gore's estimate of the work to be done. We have modified his estimates to some extent, and we propose to deal with the programme on more comprehensive lines than the former Committee did; but that does not prevent our recognising the general soundness of the advice given and of the estimates prepared by Colonel Gore, and we have been greatly assisted by them.

Appointment of a similar Committee in 1892 in the United Kingdom.

23. In our report, and more especially in that portion of Part II which describes the condition of the existing maps of the country by provinces, it will be clearly proved that topography has been sadly neglected in the recent past, and that the 1″ maps of the greater part of India are obsolete. But we think it right to point out that the Survey of India is not unique in having such charges levelled at it. It is only thirteen years since the Ordnance Survey of Great Britain was subjected to similar criticism by public opinion. Owing to the complaints then made about the delay in producing up-to-date 1″ and larger scale maps, a Departmental Committee sat in 1892 to consider what steps should be taken to expedite the completion and publication of the revised 1″ map of the British Isles, what permanent arrangements should be made for the continuous revision and speedy publication of the 25″, 6″ and 1″ maps, and whether the maps then issued satisfied the reasonable requirements of the public in regard to style of execution, form, information conveyed and price. On the subjects of revision and speedy publication, the report of that Committee (published in 1893) recommended

the revision of the 1″ maps of the country within four years, independently of the maps on the larger scale and a subsequent constant revision of the maps within periods of 15 years. For cadastral maps it was recommended that they should be revised and brought up to date within 10 years, with subsequent periodical revision every 15 years. The Board of Agriculture agreed in the main proposals, though it declined to bind its successors to the fixed intervals of 15 years for revision, and it directed the immediate commencement of the work. The result was most advantageous to the Survey inasmuch as funds were provided for the necessary work both of bringing the maps up to date, and of carrying on the future work of the Survey in a uniform and systematic manner, and we understand that since then all adverse criticisms upon the maps from the public have ceased. The size and circumstances of India preclude our making suggestions for revision at anything approaching this rapid rate of progress, but we have considerable satisfaction in referring to the Home Committee's report for confirmation of many of the proposals which follow.

B.—Financial.

General effect of financial policy of the Government.

24. The financial history of the Department during the last forty years is one of constant schemes of retrenchment, which have seriously affected from time to time the prospects of the officers employed, have led to great reductions in the superior staff, and have, without effecting any other than temporary reductions in the gross expenditure on surveys, prevented the expansion that would no doubt otherwise have taken place, and obliged the Department to devote its energies and resources to other than topographical work.

Reductions in expenditure imposed in 1870 and 1875.

25. Colonel Dickens' Report of 1864, to which allusion has already been made, contained suggestions for the better organisation of all branches of the Survey, which would have involved an increase of about 6 lakhs of rupees in the expenditure of the Department. No practical effect appears to have been given to his proposals, but the expansion of work led to increased outlay and the cost of the Department rose from 17½ lakhs in 1865-66 to nearly 24 lakhs in 1868-69, while the estimates for the following year reached, according to one set of figures, the large sum of 26 lakhs and according to another 29 lakhs. A time of financial pressure was, however, approaching : reduction of expenditure was insisted on, and in 1870 the best terms that the Department could obtain were that expenditure should for the future be restricted within a sum of 24 lakhs. For two years this limit was observed, but from 1872-73 to 1875-76 the expenditure, apart from subsidies received from the settlement department for cadastral surveys, was over 24 lakhs of rupees, and further financial pressure obliged Lord Northbrook's Government to decide in 1875 that the total grant for the Department should be limited to £200,000 or 20 lakhs of rupees, the reduction to be effected by 1878. The policy of making these continuous reductions was seriously questioned by the Secretary of State, but the famines in Bombay and Madras increased the financial difficulties of the Government of India, and unfortunately prevented any reconsideration of the matter. One of the measures for effecting the necessary economies was the amalgamation of the three Branches of the Depart-

ment—the Trigonometrical, Topographical and Revenue—and a revision of posts and salaries was made which was expected to produce a saving of $2\frac{1}{4}$ lakhs of rupees a year. The number of officers in the Senior Division, corresponding generally to the present Imperial Service, was reduced from 75 to 62 and their monthly salaries from Rs. 74,500 to Rs. 57,500, while the number of officers in the Junior Division was reduced from 171 to 163. In 1878-79 the budget was in consequence but little over 20 lakhs, but in the following year it rose to $21\frac{1}{2}$ lakhs, and a discussion followed as to the classes of work for which the grant of £200,000 (treated as the equivalent of 20 lakhs of rupees,) was intended to provide. It was eventually agreed that the charges for cadastral surveys should be treated as outside the grant, a decision which was reaffirmed in 1883. But while the position was thus eased to some extent, it was considered that the staff absorbed too large a proportion of the grant, and the Senior Division was further reduced in 1879 from 60 officers (exclusive of the Surveyor-General and the Deputy Surveyor-General of the Revenue Branch,) to 50.

The Survey Resolution of 1882.

26. The Resolution issued by the Government of India in 1882, and referred to in paragraph 20, was designed to secure the more extended employment of professional agency on cadastral work, which was in many cases at the time undertaken by non-professional agency. One result of these orders was that the 20 lakhs limit of expenditure disappeared, because it had been ruled that charges for cadastral surveys were outside the grant. So large a part of the establishment, however, was employed on such work that when its cost was deducted, and when the complicated adjustments* of expenditure in which the Survey Budget deals were made, the net charge to the Imperial Government under the head of surveys was reduced far below the prescribed limit, which it has never since reached. The net expenditure has been as low as 11 lakhs, and has never been higher than $17\frac{3}{4}$. During the last five years the average has been under $17\frac{1}{2}$ lakhs, though the limit fixed in sterling in 1875 would now admit of an annual expenditure of 30 lakhs of rupees.

Expansion of cadastral and forest surveys at the expense of topographical.

27. But while the net expenditure chargeable to the grant of £200,000 was thus kept within very moderate limits, the gross charges owing to the expansion of cadastral and forest work steadily mounted. In 1882-83 the Budget provided for an expenditure of 25 lakhs; in 1885-86 the amount had risen to $28\frac{1}{2}$, and the necessity of retrenchment was again discussed. The only remedies that presented themselves were the further employment of parties on cadastral or forest work, the cost of which would fall, in whole or part, on local Governments, combined with further reduction of topographical operations, though it may be noted that this policy did not affect the gross budget of the Department, or modify the figures from which the higher authorities drew their conclusions as to the possibility of effecting retrenchments. Thus it was that, while topographical work was further cut down, and was almost stopped outside of Burma and Baluchistan, the gross estimates of the Department continued to increase. In 1886-87 they amounted to nearly 28 lakhs, in 1888-89 to 31, and the average during the last five years has been over 32 lakhs, owing chiefly to the prosecution and

* NOTE.—We do not profess here to criticise the adjustments by which these results are arrived at. We give the actual figures, as taken from the estimates accepted by the Government of India.

extension of cadastral surveys in Bengal. The ruling that cadastral work was outside the grant of £200,000, appears in practice to have been lost sight of: and the actual outlay of the Department, apart from work not chargeable to the grant under the interpretation of the orders in earlier years, has, during the recent years of development and prosperity of the country, scarcely exceeded one-half of the amount to which its expenditure was reluctantly cut down in a time of great financial stress and difficulty.

Reductions in the superior Staff.

28. Other measures affecting the Department were the admission of natives of India to the Junior Division in 1884, and the reduction of the Senior Division in 1895 by ten posts which were transferred to the Junior Division, the Imperial Service, as it was now called, being fixed at 40 posts only for the future. These continuous reductions must have had a disheartening effect on the staff. Not only were the personal prospects of officers affected and their future rendered uncertain, but they knew that the work done by their predecessors was falling more and more out of date, and that the reputation of the Survey of India was endangered. It may be that the Department has not always taken the best means to utilise its resources, but if we seem anywhere in our report to impute blame, we wish it to be understood that the original cause of defects is to be found in the measures, (no doubt inevitable,) taken in pursuance of the policy of retrenchment. We have shown that the net expenditure has in recent years been kept far below the figure to which it was reduced in time of famine and financial stress, and we may conclude by referring to the objections taken by the Secretary of State at the time to the retrenchments proposed, and quoting his statement of the value of surveys in the development of the country.

Secretary of State's recognition of the importance of survey work.

29. In a Despatch of February 1876, the Secretary of State expressed* his reluctance to sanction the reductions then proposed except on general financial grounds or because of some recent undue growth of survey expenditure, and he pointed out that:—

"The efficient organisation of a surveying party, and the acquirement of the necessary qualifications by the individuals who compose it, are the work of time. By breaking up such a party there is a certain saving in the budget of one particular year, and a proportionate loss in the amount of work done. But when such a party is once broken up, the powers of the department to meet the demands upon it are permanently decreased, and work, which must at some time be done, remains undone, to be completed at a future date under less favourable circumstances. It seems possible, therefore, that the breaking up of several surveying parties, although the measure will cause a saving at the time, may prove to be far from economical in the end."

He considered† that the data furnished by the Government of India in support of the proposed reductions gave—

"no indication of any enlargement of these establishments, which may not be regarded as a reasonable result of the increased desire for improved information, such as that which it is the function of the Survey Department to furnish to other branches of the administration."

and he went on to say:—

"I continue to attach much importance to the steady progress of the construction and publication of good maps of all parts of the British provinces in India, feeling sensible

* Geographical Despatch No. 3 of 24th February 1876. Quoted in Black's Indian Surveys, p. 39.

† Geographical Despatch No. 1 of 4th January 1877.

that without them serious obstacles are necessarily interposed in the way of the acquisition of that complete statistical knowledge of the country, the absence of which has so long been a discredit to our administration, and the application of which is so requisite for the purpose of progressive government.

"I should therefore be glad if, when the time comes for considering the details of the budget for the ensuing year, Your Lordship should find yourself in a position to avoid further reduction in the grant to the Survey Department."

The financial difficulties of the time rendered it impossible for the Government of India to meet the Secretary of State's wishes, and reductions were insisted on, but we invite attention to the correspondence to show how completely the possible drawbacks of the proposed economies were realised at the time by the Secretary of State.

CHAPTER III.

Explanation of Survey methods and of some terms used in this report.

The Trigonometrical Survey—Principal and Secondary Triangulation.

30. The basis of all surveys executed by the Survey of India is the Great Trigonometrical Survey which was started at the commencement of the last century, and which, owing to the extension of the frontier, is still incomplete. This survey has fixed a number of points all over India by means of many series or chains of triangles starting from and closing on most carefully measured bases, the sides of the triangles supplying a vast number of bases from which to start the detailed surveys. This framework confines the errors of all subsequent work within small limits, and is called the principal triangulation, while closely allied to it, and almost its equal in accuracy, is secondary triangulation which emanates from and supplements it where necessary. As the lengths of the sides of the triangles are checked from time to time by measured bases, so their direction or azimuth, is checked by careful astronomical observations at a large number of the trigonometrical stations. Tidal observations have supplied the means of fixing the heights of points on the coast above mean sea level; these points have been connected by careful levelling with the triangulation; thus the heights above sea level of the various triangulated points have been deduced. By means therefore of the Great Trigonometrical triangulation, combined with the tidal and astronomical observations, a great number of bases have been provided all over India of which the length and direction have been accurately determined, as well as the height of their ends above sea level.

Having thus supplied a number of well marked points throughout India of which the latitudes, longitudes and heights are known as well as their mutual bearings or azimuths, the work of the Great Trigonometrical Survey with regard to the resultant maps ceases, and the less scientific work commences.

The operations throughout demand the highest care and great scientific ability. The memorandum* which Colonel Burrard has prepared for us on the scientific work of the Department explains more fully the character of the operations in India, and compares the precautions taken to ensure their accuracy with those adopted in other countries. It shows also the extent to which the scientific operations of the Department, the astronomical, the magnetic and the pendulum observations contribute to the great end of securing the accuracy of the framework on which the surveys are based.

Tertiary Triangulation.

31. The Index Map attached to the Survey Report of 1902-03 shows the extent to which the position of places in India has been fixed by the Trigonometrical Survey. Chains of stations traverse the country from south to north roughly parallel to the great meridional arc from Cape Comorin to Mussoorie; and these are crossed at intervals by transverse chains. More irregular chains extend through Burma on the east down the Tennasserim Peninsula, and stretch out on the west into Baluchistan. The chains occasionally approach within a few miles of each other, but are often over 100 miles apart. They are sufficiently close to prevent any serious error in the mapping of the country as a whole, but the work of the actual surveyor requires

* *Vide* section VII of Part II of the Report.

to be tied within much narrower limits, and the first operation necessary when any area has to be surveyed is to throw out from the bases supplied by the Great Trigonometrical Survey a number of points, by means of less rigid triangulation, over the whole area to be dealt with. This operation is called tertiary triangulation and is carried out by the staff of the topographical or other party told off to make the detail survey, the object being to provide the detail surveyor with fixed points sufficiently close together to enable him to carry out his survey correctly. This triangulation has, frequently in undulating wooded country, and invariably in the plains where cadastral surveys are to be made, to be supplemented by theodolite traverses, which are carried at close intervals all over the country, generally following approximately the village boundaries and fixing all the village trijunctions. The traverses are connected with the triangulation, the angles at all the traverse stations are measured with a theodolite and the distances between the stations by means of chains. From these angular and chain measurements, corrected with reference to the triangulated points, the correct position of each traverse station is computed. By these methods sufficient fixed points are provided to enable work on any scale being carried out.

Triangulation stations.

32. The principal and secondary triangulation stations are substantially built, carefully marked and described, and generally have been kept in fair repair, but some have in course of time disappeared. The tertiary stations are carefully described, marked by a sunken stone and covered by a cairn of stones, or by a circle (⊙) cut in the rock itself where such exists. Intersected points, though shown in the map, are not necessarily permanently marked on the ground. Traverse stations or a sufficient number of them are marked by stone prisms, or cylinders of pottery or of corrugated iron, sunk partially in the ground. The preservation of all these stations is of the greatest importance.

Detail surveying.

Planetabling.

33. From the data thus supplied the topographical surveyors prepare their maps in the field by planetabling, cutting in their positions on the planetable, on which the trigonometrical and traverse points have already been plotted, by rays drawn from such points after the table has been placed perfectly north and south. From the positions so fixed they sketch in the surrounding country, fixing each point or feature by three or more intersections from different planetable stations. They also fix the height above sea level of their position by means of observations taken from it with a clinometer, (of which the Survey of India has a special pattern,) to surrounding trigonometrical points, the heights of which are known, and in this way they are able to fix the heights of other surrounding objects. Thus the approximate heights of a great number of points are obtained and approximate contouring at 50 feet intervals is carried out. This system of contouring was only introduced between 1880 and 1890. Very few of the existing maps have the hill features and undulations shown by even these approximate contours, hill sketching or hachuring having been up to

Clinometer.

Contouring.

that time considered quite sufficient. The clinometer now enables a surveyor easily to fix an altitude within 10 feet, and with even much greater accuracy where trigonometrical heights or levels are numerous.

Scales of survey.

34. Topographical surveys have, as a rule, been made on the scale of 1 inch = 1 mile, but in considerable areas, for example in Bombay, the scale employed was 2″ = 1 mile.

Cadastral surveys carried out by the Survey of India have all been made on the scale of 16 inches = 1 mile, and are purely chain surveys. In former days revenue surveys, as they were then called, were made on the 4-inch scale of large areas, each village being surveyed separately, but the maps were never published on that scale.

In some of the more remote parts of India, or where the country was at the time of little importance, surveys were conducted on the scales of 2 miles and even 4 miles to the inch.

From the surveys so made the existing maps of India have been prepared, the standard scale for topographical maps being 1 inch = 1 mile.

Standard sheets.

35. Topographical maps are now issued in "standard sheets," each of which measures a quarter of a degree of latitude by half a degree of longitude, and covers roughly 540 square miles of country; they have been prepared by one or other, or by a combination of two or more, of the following methods:—

(1) by enlargement from surveys on the $\frac{1}{2}$″ scale (in very rare cases and for special purposes);

(2) by reproduction from surveys on the 1″ scale;

(3) by reduction from—

(*a*) topographical surveys on the 2-inch scale;

(*b*) old revenue ,, ,, ,, 4-inch scale;

(*c*) forest ,, ,, ,, 4-inch or other scales;

(*d*) cadastral surveys on the 16″ scale, or from locally made revenue surveys on larger scales.

The maps have all been reproduced by photo or helio-zincography and are published generally on the 1″ scale, but in special cases on the 2″.

Different classes of revisional operations.

36. The result of the employment of so many different methods of preparation is a want of uniformity and completeness in the existing maps of India. But it follows, as a natural corollary, that the amount of work now necessary for the revision of the maps, and the production of an up-to-date series, will vary with the quantity and quality of the materials already available. The expenditure now required will also vary with the value of the old surveys, and for the purpose of our estimates we divide the work to be done into the following four classes:—

Survey—Where there are no maps on the one-inch scale, or where there are not sufficient triangulation or traverse data, and a new survey will thus be necessary, we class the work as "Survey."

Resurvey—Where the actual field survey must be newly made, but trigonometrical data are available, we class the work as "Resurvey." In many of the areas so classed the existing maps may be expected to afford a certain amount of assistance.

Revision—Where the existing maps have been prepared on more modern lines, and no great amount of change need be anticipated, we class the work as "Revision." In this case it is hoped that specially printed copies may be found capable of being actually revised in the field, all additions and corrections being shown on them and the hill shading being converted to contouring. If, however, it is decided to print the maps in colours it will probably be necessary to redraw the great majority of the sheets.

Supplementary Survey—Where maps have been, or can be prepared from reductions of cadastral maps, we consider that, before final adoption as topographical maps, they require examination on the ground: this work we call "Supplementary Survey." Maps so prepared require considerable examination in the field, as the surveyors, working on large scales for revenue purposes, do not always show the topographical features with sufficient distinctness to enable the compiler of the reduced map to distinguish between the features which should be shown and those that should be omitted.

It will be found in chapter VI that the areas, which fall under these four heads, have been calculated after a careful scrutiny of the existing maps of the country. The estimates of the cost of the revisional operations are based on these areas.

CHAPTER IV.

Present Organisation of the Survey of India.

Organisation in 1879.

37. When the Survey Department was reorganised after the amalgamation of 1878, the superior staff was divided into a Senior and a Junior Division, the former consisting of the Surveyor-General and a Superintendent of Revenue Surveys, with a fixed number of Deputy and Assistant Superintendents ; and the latter of Surveyors and Assistant Surveyors of European parentage. The officers in the Senior Division drew fixed pay at rates from Rs. 500 upwards, the old system of " staff pay " in addition to Military pay and allowances, having been abolished in 1874. In the Junior Division the Assistant Surveyors drew from Rs. 120 to Rs. 250 per month, and the Surveyors from Rs. 300 to Rs. 500.

Admission of natives of India to the Junior Division.

38. In 1884 the question of the admission of natives* of India to the Junior Division was raised. Strong objection was made to the proposal by the heads of the Department for the reason that while natives were quite fit for the subordinate work of actual survey, they were unsuited for the duties required from the supervising staff, which involved energy, physical endurance, tact, and initiative. The Government of India decided,† however, on grounds of economy and of the necessity of testing the competence of natives in higher posts, that in future one appointment in every four made should be reserved for natives of India, who should receive the same pay as other officers of the Junior Division, and should be recruited by examination to which no candidates should be admitted who had not passed the Universities' Entrance Examination. The Surveyor-General was also authorised to promote deserving sub-surveyors, provided they were sufficiently well educated, and passed the examination to which other native candidates were subjected ; and it was left to him to decide whether the examination should be strictly competitive or whether a power of selection among the passed candidates should be reserved. This decision, with the reasons for it, was referred to, with approval, by the Public Service Commission of 1886-87 three years later.

Organisation in 1886.

39. The sanctioned organisation of the Department at the time was described by the Commission as consisting of the following staff :—

		Number of officers.	
	Administrative Staff	3	Surveyor-General and two Deputies (Revenue and Topographical Branches).
Senior Division	Deputy Superintendents	32	in four grades.
	Assistant ,,	17	in two grades.
Junior Division	Surveyors	50	in four grades.
	Assistant Surveyors	85	in three grades.
	Sub-Surveyors, about 500 on Rs. 10 to Rs. 110 per mensem.		

* By natives we mean persons of Indian descent, as distinguished from persons who are natives under the statutory definition only.

† Revenue and Agricultural Department letter No. 683-S., dated 11th December 1884.

The officers of the Senior Division were partly military and partly civil in the proportion of 3·2 to 1. Out of 46 officers actually employed in 1886-87, 39 were non-domiciled Europeans, 6 were domiciled Europeans and one was a Eurasian. Of the officers of the Junior Division five were non-domiciled Europeans, 93 were domiciled Europeans, 33 were Eurasians and two were natives, both promoted for special services in connection with the Afghan Boundary Commission.

Recommendations of the Public Service Commission.

40. The Commission did not feel at liberty to deal with the question of number of Royal Engineer and other military officers to be employed in the Survey, but suggested that they, along with such specialists as might be recruited from England, should be regarded as forming a distinct branch of the service, with pay, furlough and pension adjusted to the requirements of a service so recruited. A further suggestion made was that the posts then held by the Junior Division should be amalgamated with some posts surrendered by the Senior Division, so as to provide sufficiently attractive prospects for a service locally recruited, the pay, furlough and pension rules applicable to which should be adjusted on the principles indicated by the Commission in respect of other services recruited in India. The Commission was led to the conclusion that the objection to the employment of natives in the Junior Division was not based on their inability to perform the technical duties devolving on the officers of that division, but arose from the doubt whether natives could be found with the requisite qualifications for controlling subordinates and exercising sound discretion in the expenditure of funds and in the dispensing of patronage. This doubt the Commission did not share, and recommended that admission to the Junior Division (or Local Service) should not be confined to special classes of Her Majesty's subjects in India, and that it should be regulated by competition among selected candidates, and exceptionally by promotion from the Subordinate Service.

Reorganisation of 1895.

41. The views of the Commission were generally accepted by the Government of India, but it was not till 1895, that orders* were issued to give effect to them. The staff of the Department was by these orders divided into three distinct services :—

(1) The Imperial Service ;
(2) The Provincial Service ;
(3) The Subordinate Service.

The Imperial Service was to consist of officers who had been either transferred from the Army or recruited directly from England, and future appointments to it were to be made by selection only. The Provincial Service, on the other hand, was to be recruited exclusively in India, appointments being made by examination in India. Ten appointments in the existing Senior Division were transferred to the Provincial Service, and the remainder of that Division, together with the administrative appointments at the head of the Department, constituted the new Imperial Service. The line between the Provincial and Subordinate Services was drawn immediately below the existing Junior Division, which, with the ten appointments transferred from the Senior Division, formed the new Provincial Service. The Subordinate Service remained, as regards appointments, grades, pay and recruitment, in every respect on the same footing as before.

* Resolution No. 6-64 (Land Surveys), dated 27th March 1895.

The effect of the reorganization was as follows :—

—	—	—	Old strength.	New strength.
			Rs.	Rs.
Imperial Service.	Surveyor-General	.....	1 at 3,000	1 at 3,000
	Deputy Surveyor-General ...	.....	1 „ 2,200	1 „ 2,200
	Superintendents	1st grade ...	3 „ 1,600	3 „ 1,600
	Ditto	2nd „ ...	7 „ 1,300	6 „ 1,300
	Deputy Superintendents ...	1st „ ...	9 „ 1,000	7 „ 1,000
	Ditto ...	2nd „ ...	9 „ 850	7 „ 850
	Assistant Superintendents ...	1st „ ...	10 „ 600	7 „ 600
	Ditto ...	2nd „ ...	10 „ 500	8 „ 500
	Total ...	.....	50	40
Provincial Service.	Extra Deputy Superintendents ...	1st grade ...	*Nil*	2 at 800
	Ditto ...	2nd „ ...	*Nil*	3 „ 650
	Extra Assistant Superintendents ...	1st „ ...	3 at 550	3 „ 550
	Ditto ...	2nd „ ...	5 „ 500	6 „ 500
	Ditto ...	3rd „ ...	7 „ 450	8 „ 450
	Ditto ...	4th „ ...	10 „ 400	13 „ 400
	Ditto ...	5th „ ...	15 „ 350	15 „ 350
	Ditto ...	6th „ ...	20 „ 300	20 „ 300
	Sub-Assistant Superintendents ...	1st „ ...	22 „ 200—10—250	22 „ 200—10—250
	Ditto ...	2nd „ ...	24 „ 160—8—200	24 „ 160—8—200
	Ditto ...	3rd „ ...	26 „ 120—8—160	26 „ 120—8—160
	Total ...	.....	132 at an average pay of Rs. 272 per mensem.	142 at an average pay of Rs. 293 per mensem.

Financially the result was that, while the total number of appointments remained at 182, the monthly cost was reduced from Rs. 82,727 to Rs. 80,626, thus effecting an annual saving of Rs. 25,200.

We have given the above figures in detail because the sanctioned strength of the Imperial Service still remains at 40, though there are actually at present 42 officers employed, as the process of transfer of 10 posts to the Provincial Service is not yet complete. Some additions have been made to the Provincial Service, the sanctioned strength of which is now 159. The officers of this Service in the two grades of Extra Deputy Superintendents and the six grades of Extra Assistant Superintendents are gazetted; those in the three grades of Sub-Assistant Superintendents drawing from Rs. 120 to Rs. 250 are not gazetted.

42. The method of recruiting officers of the various classes is as follows :—

Recruitment—Imperial Service.

Imperial officers are recruited from the Royal Engineers, the Indian Army and in special cases from England, by direct appointment by the Secretary of State. There are also in this branch of the Service at the present time four officers transferred from the Bombay, Madras and Forest Survey Departments.

Royal Engineer officers are eligible for appointment after their arrival in India, provided they have less than five years' service in the corps, and are not senior to any Royal Engineer officer already appointed.

Indian Army officers are eligible after final admission to the Indian Army, and are appointed on probation for one year, at the end of which time they must pass a departmental examination before they are finally admitted to the Department.

Royal Engineer officers can revert to military duty at any time, but Indian Army officers cannot revert to military duty after 10 years in the Department. There is no definite rule as to the proportion of such officers.

Recruitment—Provincial Service.

43. The Provincial Service is recruited after examination in India. Candidates receive permission to sit for the examinations (which are held simultaneously at centres convenient to the candidates,) from the Surveyor-General. They were at one time, if natives, required to have taken a degree at an Indian University, but the educational standard has recently been reduced to the passing of the First Arts examination. Europeans (Statutory natives) must have passed the High School Pass examination or the First Arts examination, and must be between the ages of 18 and 22, while for natives the age limit is 24. The examination is not strictly competitive, but the appointments are almost invariably given to those who qualify in order of seniority, *i.e.*, in accordance with the marks obtained; the Surveyor-General, however, has the right to select from those qualified, the candidates who, he considers, for other than actual book knowledge, are likely to prove the more valuable officers. On the 1st of January 1905 there were in the Provincial Service 25 natives. The highest of these were in the 5th grade of Extra Assistant Superintendent on Rs. 350 per month. Of the twenty-five, twelve had been promoted from the subordinate ranks into the Provincial Service, and thirteen appointed to it direct, but of these thirteen, six are still on probation. There is only one graduate in the list, and the educational qualifications of the men appointed by promotion are not as a rule high.

All Provincial officers are appointed on probation in the first instance, and none are permanently appointed until they have been one year in a field party or similar position, and have been well reported on by their immediate superiors.

Recruitment—Subordinate Service.

44. The Subordinate Service is purely native and is not a fixed establishment as the Imperial and Provincial Services are. It consists of men who have been as a rule recruited, under the orders of the Surveyor-General, by officers in charge of parties and trained by them as sub-surveyors, computers, draftsmen, etc. There is no fixed rate of pay for such men, but it is recognised that Rs. 100 per mensem is the maximum; they are all brought on as temporary hands in the first instance, but after some years, if they prove competent, they are made permanent. The regulation of pay within the limit of Rs. 100 is entirely in the hands of the Surveyor-General.

According to the evidence given to us, men of the subordinate service are usually enlisted as apprentices by the officer in charge of each party and are trained in the party, and this is probably as good a method of enlisting and training men for the peculiar work of survey as can be devised. Some years ago

orders were issued for the training of all such men at Dehra under the supervision of the Superintendent, Trigonometrical Surveys, and officers in charge of parties were directed in the first instance to indent on him for trained men, or to send to him for training men whom they had themselves enlisted. The local enlistment and training of apprentices were not allowed, except in special circumstances, and with the sanction of the administrative officer. These orders, we are informed, are no longer in force, and we refer to them to point out our objection to any such restrictive system. If an extended programme of work is sanctioned, it must be part of the policy of the Department to enlist surveyors locally as far as possible, and we have observed with satisfaction that to some extent this is now done, a certain number of Burmans being employed in Burma, of Madrassis in Madras, and so on. We are in favour of giving officers in charge of parties a free hand to enlist the best men they can obtain and to employ them on the temporary list, training them in the parties on drawing work during the recess and in the field thereafter. Whether the establishment of training centres may eventually be necessary is a question we would leave for the future. At present we do not find that any elaborate organisation for the purpose is necessary, and would leave the present system of recruitment by each party in force.

Distribution of present staff.

45. The distribution of the Imperial and Provincial Staff and also of surveyors and sub-surveyors on January 1st, 1905, was as follows :—

—	Imperial Officers.	Provincial Officers.	Surveyors and Sub-Surveyors.	
			Permanent.	Temporary.
Head-quarters (including Drawing Office, but excluding Superintendents of Trigonometrical Branch and Forest Surveys).	5	17	...	...
Trigonometrical Survey ...	8	15	2	4
Cadastral Surveys	5	38	42	111
Forest Surveys	4	18	91	109
Frontier and Military Surveys ...	6	13	29	18
Topographical (other than frontier)	7	31	56	66
Under instruction	2	20	...	...
On leave	4	1	...	...
Vacancies	1	6	...	...
Total ...	42	159	220	308

An account by the Surveyor-General of the duties of the different officers of the Department, and of the system on which survey parties are organised, will be found in Appendix A to this report.

CHAPTER V.

Cadastral, Forest and Miscellaneous Surveys.

Preliminary.

46. Before discussing the future programme of topographical work, it will be convenient to state our views on the subject of the conduct of cadastral and forest surveys, on which at present a considerable part of the staff of the Department is employed.

As regards cadastral work, we have been asked to report whether it is so carried on in different provinces as best to allow of its utilization for topographical work, and, if not, whether it would be advisable to adopt a different system; whether such utilization results in any substantial economy as compared with a fresh topographical survey; whether professional agency should be utilized for the supervision of cadastral work, and how far the same agency could be employed for the maintenance of topographical maps. We have also to consider how far the demands made by Local Governments for the services of the Survey of India for cadastral purposes are likely to affect the topographical programme.

There is at present no uniform system for the conduct of cadastral work; the arrangements vary from province to province, and range from complete dependence upon the Survey of India to entire independence of that Department. It is necessary, therefore, to refer to the different systems in force before setting out our conclusions.

Cadastral surveys in Madras.

47. Madras has its separate Survey Department which has undergone some reduction in recent years, and which may be further changed in connection with measures for the reorganisation of the Land Records staff. The establishment is controlled by a Superintendent, who works under the Board of Revenue in the Settlement Branch, and has under him 3 Deputy and 12 Assistant Superintendents.

The gross cost of the Department in 1903-04 was Rs. 6,60,000, and the net cost after deducting recoveries on account of the survey of proprietary estates and of work done for District Boards, was Rs. 3,80,500.

The Department undertakes the cadastral survey or re-survey of districts coming under settlement. The work is based on scientific lines, and is carried out with a minuteness not found elsewhere. Each field is plotted on a separate page in a register, the scale of survey being 80″ to the mile for fields under 5 acres in area, 40″ for fields between 5 and 20 acres, and 16″ for larger fields. The results are compiled into village plans on the 16″ scale for reduction by photography, and issue to village officers on the 8″ scale. From the village plans taluk maps on the 1″ scale, and district maps on the $\frac{1}{2}$″ or $\frac{1}{4}$″ scale are prepared, and reproduced locally. Notwithstanding the care taken in the preliminary operation, there must be many opportunities of error in the process of building up field plans into village maps, and of compiling the latter into taluk or district maps, and such attempts as have been made to utilize the Madras maps by the Survey of India have not hitherto been successful.

The cost of survey is frequently high, as might be expected, and reached in Ganjam the high figure of Rs. 406 per square mile. On an average of 20 districts the cadastral survey has cost Rs. 162 per square mile, apart from Rs. 84 per square mile for demarcation. In four districts which have been re-surveyed the average cost has been Rs. 62 per square mile.

The Madras Survey which is entirely independent of the Survey of India affords advice and assistance in the revenue surveys of the Native States in the Presidency. It does not appear probable that any demand for the services of the Survey of India will be made for cadastral work in this Presidency.

Cadastral surveys in Mysore and Hyderabad.

48. In both these States there are Survey Departments in connection with the settlement; but we have not enquired particularly into their methods of working. In Mysore the existing topographical maps are quite good enough for direct revision without reference to cadastral maps; in Hyderabad the cadastral maps, while useful for revenue purposes, are admittedly not prepared with such accuracy as to be of any assistance in connection with a topographical survey.

Cadastral surveys in the Central Provinces.

49. All cadastral work in the Central Provinces is performed by local agency, working on traverses made by professional parties. Apart from the traverses, the work is done entirely independently of the Survey of India, though some members of the Provincial branch of the Survey Department have been placed at the disposal of the Administration for its assistance in the operations. The traverse work was practically finished a few years ago. Since then the detachment engaged on it has been gradually replaced by a small topographical party, which is now employed in compiling topographical from cadastral maps and supplementing them by actual survey in the field. The local maps are utilized with benefit to the economy of the operations, but the country is not one in which cadastral work can greatly facilitate a topographical survey.

Cadastral surveys in Bombay.

50. The Presidency of Bombay formerly had a separate Revenue Survey Department which, after some discussion, was finally broken up in 1901, after having been employed since 1847. During that period the survey extended to the whole Presidency, except to lands that were wholly or partially revenue-free, and as the same Department was responsible for both survey and assessment work, the maps (on the scale of 8″ or 16″ to the mile) were prepared so as to give every assistance to the assessing officer, and particular attention was paid to a careful and elaborate classification of soils. The Land Records Department is now responsible amongst its other duties for the maintenance of the maps, and the Director has, as his Assistants for the purpose, four Superintendents, three of whom are former officers of the Bombay Survey Department. Under these again are District and Circle Inspectors, but the organisation of the Land Records Department in this Presidency, as in Madras, will probably require further modification or strengthening.

In 1873-75 an attempt was made to utilize the cadastral maps of Bombay for topographical purposes, and was most carefully and thoroughly prosecuted for two years, but without success. The cadastral work was found very

defective outside the culturable area; the village maps could not be correctly joined together, and it was agreed that the expense of the operations was greater than the making of a new survey. The existing topographical maps in this Presidency were in consequence prepared, and they can now be revised without reference to the work of the former Bombay Survey Department.

Cadastral surveys in the Punjab and North-West Frontier Province.

51. In the Punjab and North-West Frontier Province all cadastral work is carried out by the Settlement Departments without any assistance from the Survey of India, except in some cases where the work has been preceded by a professional traverse. Great attention has always been paid to the training in survey of local establishments, and to utilising for survey purposes the services of patwaris, who are a well paid and, on the whole, intelligent set of men. A method known as the "square system" of survey has been developed, which, it is claimed, has the advantage of enabling a close check to be kept on the work of the non-professional surveyors and of restricting any errors they may make within narrow limits. The system is not a professional one, but the village maps have been found sufficiently accurate in unbroken ground in the plains for utilization in the preparation of topographical maps after a traverse picking up the trijunctions and base lines has been made to ensure the plotting of the reduced plan of each village in its correct place on the general map. Without this it would be impossible to make a general map of any large area that would be reasonably accurate. As a rule, this traverse has hitherto followed the cadastral operations which it ought to precede. One advantage of the square system appears to lie in enabling a comparatively simple and inexpensive traverse to suffice. The cost of cadastral surveys in the Punjab cannot be disentangled from the total cost of settlement operations in each district. The figures given us shew rates varying from Rs. 208 to Rs. 15 per square mile, exclusive of the pay of the patwaris, but they are obviously and admittedly unreliable.

Cadastral surveys in the United Provinces.

52. In the United Provinces there have been more variations of system than elsewhere. In earlier times cadastral surveys were, as in the Punjab, carried out by the Settlement Department, but no attempt was made to train the patwaris, the work being done by *amins*. At a later period after 1870, a large number of districts were cadastrally surveyed by the Survey of India, and the maps made over to the Settlement officer. In the Benares settlement the procedure was carried a step further, and the Survey Department charged itself with the preliminary preparation of the record of rights. The last districts in the plains surveyed on this system were Basti and Gorakhpur from 1883 to 1888, where the cost of the cadastral survey with the record of rights and statistical statements fell at Rs. 226 and Rs. 173 per square mile respectively, the cost of the cadastral survey and record of rights, excluding statistics, being in the Basti district Rs. 184.

Before these settlements were finished, the question of devising means both to simplify and to cheapen the operation of reassessment, had been under consideration, and the assistance of the Survey Department was dispensed with in most of the other districts under settlement, while in a few the experi-

ment of using patwaris as the survey agency under the supervision of the Survey of India was introduced. In some districts of the Meerut Division, and in the whole of Southern Oudh, no general resurvey was attempted. The old maps were corrected by the village agency, and were found to be sufficiently accurate for assessment purposes. Some years later, however, a reaction began in favour of greater strictness; the services of an officer of the Survey Department were obtained to assist the Land Records Department in the more efficient training of the local agency; the old maps were subjected to a more rigorous test, and in most, if not all, the districts coming under assessment, a new survey was made, the patwaris being now trained to act as surveyors. The cost rates of such surveys, from which the pay of patwaris is excluded, have varied in recent years from Rs. 28 to Rs. 76 per square mile, and the average cost of the traverse has been Rs. 27-8-0 per square mile.

The maps prepared in the course of these surveys have been utilized satisfactorily in the compilation of topographical maps, though a slight amount of supplementary survey is necessary. The officer of the Survey Department lent to the Local Government is now styled Superintendent of Provincial Surveys; he carries out traverse surveys of which the Imperial Government meets the cost, and he is in charge of an Imperial Drawing Office in the Provinces, where reductions of cadastral maps are made for topographical purposes. Under him are Provincial officers of the Survey of India, who are now employed more on Land Records work than in carrying out new surveys. The cadastral work of these Provinces has, however, for the present come to an end, and in districts now coming under re-settlement it has been found sufficient to use the old maps without a resurvey. The retention of the services of an Imperial officer and of some of the Provincial officers will, we understand, not be insisted on by the Local Government.

Cadastral surveys in Bengal.

53. Bengal is the only Province in which original cadastral surveys are now being prosecuted on a large scale. The operations are directed by an officer of the Survey of India under the title of Superintendent of Provincial Surveys, and the establishment is entirely recruited by and officered from the Survey of India. The Board of Revenue settle the programme and the Superintendent is responsible to them for carrying it out, and to the Surveyor-General for keeping the work up to professional standards. A large Drawing Office at Calcutta under his control prepares reductions of the cadastral maps for issue as preliminary editions of standard sheets on the 1″ scale, and has presses attached to it for the reproduction of the cadastral plans by the Vandyke process. (In one district in Bengal a cadastral survey is being carried on under the supervision of a Settlement officer, but that procedure could not be extended to the large programme which is in contemplation.) By careful administration and minute attention to details, the Superintendent of Provincial Surveys in Bengal has reduced the cost rates to a comparatively low figure. The survey of Orissa cost Rs. 181 per square mile, and that of Durbhanga Rs. 201, while the outlay on the more recent operations in Bhagalpur was only Rs. 82, of which Rs. 58 was for survey proper and the balance for record-writing. One of the advantages of working on an extended scale and with a settled programme, is that the whole organisation is gradually improved, and work is done both more cheaply and more efficiently.

The arrangements for meeting the cost of cadastral work are peculiar in Bengal. Elsewhere the Local Government is liable for the outlay (except for the cost of traverse surveys) ; but in Bengal, while the arrangements vary somewhat in their details, it may be said generally that the cost is shared between the land-holders and the Imperial Government.

Cadastral surveys in Assam.

54. In Assam cadastral surveys have been carried out by local agency with the assistance latterly of Provincial officers of the Survey of India. For the present, however, such surveys are practically at an end, and no further cadastral operations on a large scale are likely, unless it be decided that the districts of Cachar and Sylhet should be surveyed. A small Drawing Office is maintained at the expense of the Imperial Government at Shillong for the preparation of topographical from cadastral maps ; but the cadastral surveys in this Province are frequently so fragmentary that the standard sheets prepared from them are useless, and the retention of the office at Imperial expense appears to be unnecessary. The Vandyke process has recently been introduced for the reproduction of village plans.

Cadastral surveys in Burma.

55. Original cadastral surveys in Burma are carried out by the Survey of India, and one of the Imperial parties, No. 7, is at present placed at the disposal of the Local Government for that purpose, its expenditure being charged to the Local Government. It is now engaged in the survey of the Pakokku district, of which some 3,000 square miles remained for completion in 1904. The estimates of the time required for this work vary, and there are some large tracts still to be surveyed in Thayetmyo and elsewhere, for which the services of the professional party may be required; but unless the programme is extended, it would seem probable that in five or six years the work will come to an end.

No record-writing is done by the Survey of India in Burma. The maps alone are prepared; they are printed as a rule at Calcutta, and the copies made over to the Revenue authorities in Burma.

Owing to the nature of the country, the work is much more expensive in Burma than in Bengal. We have no figures of the cost per district, but the following rates for the work done in 1901-02 appear not to give an excessive estimate of the outlay :—

Upper Burma.—Traverse survey Rs. 57, Cadastral survey Rs. 115 ... Total Rs. 172.
Lower Burma.— Do. , 172, do. 209 ... do 381.

Some simplification has since been introduced into the procedure, but where scattered blocks are made over to the Department for survey, the cost must necessarily be high when worked out on the area actually surveyed in detail. Last year we are informed that in one district, where distant and scattered blocks alone had to be surveyed and connected by traverses, the rate rose to over a rupee an acre.

The maintenance of maps and the survey of extensions of cultivation (known in Burma as "Supplementary" survey,) are amongst the most important of the duties of the Land Records Department. Annual surveys of cultivation are required in Burma for assessment purposes, and the Land Records Department is more strongly organised for survey work than in any other

Province; while suitable arrangements have been made to give the staff an extensive training in actual survey work. The Director of Land Records has an assistant, who was formerly a Provincial officer in the Survey of India, and under him are 32 Superintendents, of whom 8 are seconded Survey of India officers. Below these again is a strong staff of Inspectors and Surveyors. Burmans are employed both in the lower grades and as Superintendents, and appear to give satisfaction. Application has recently been made to increase the staff and improve its prospects, as it is insufficient to cope with all the work involved in both maintaining existing maps and records, and completing the survey of the rapid extensions of cultivation.

The division of the work of new survey between the Imperial establishment and the Land Records staff is made on the principle that "when such surveys are extensive, the work should ordinarily be left to the Survey of India parties, while the Land Records Department should limit itself to such small extensions as can be undertaken by the regular staff under the supervision of the Director and his Assistant." But in 1889-93 surveys on a very large scale were made by the Land Records Department over an area of apparently some 6,000 square miles in Thayetmyo and neighbouring districts, survey parties being organised on the model of Imperial survey parties, and Burman surveyors being freely employed.

Extent of future cadastral programme.

56. These accounts show sufficiently for our purposes the arrangements made in different Provinces for the prosecution and keeping up to date of cadastral surveys. It does not appear, as far as we can gather, that any serious demands are likely to be made on the Survey of India for cadastral work in the near future except in Bengal. In Burma the programme of original cadastral work on an extensive scale, for which alone it is desirable to employ professional parties, will be completed in a few years, and in other Provinces such work as remains to be done, is small in extent or is of a character for which the Local Government is itself prepared to arrange independently of the Survey of India.

Comparison of the various systems of cadastral surveys.

57. The question of utilizing cadastral maps made in the future for topographical purposes is therefore not one of great importance, but we may state our own view briefly regarding the various systems in force. Where there is a large amount of original survey to be done, where there is no question of training a local agency in surveying, and where a continuous programme of operations can be carried out, uninterrupted by the exigencies of settlement, we have no hesitation in saying that the Bengal system is the best. It ensures that the work is up to the best professional standards, and it allows of the gradual perfecting of the organisation in all its details, a most important matter from the standpoint of economy. It stands to reason that a trained establishment, moving on regularly from district to district, must gain a facility in execution on the part of subordinates, and an experience of organisation on the part of supervising officers, that are lacking when the greater part of the establishment has to be trained, as each new district is taken up. The excellence of the arrangements now made in Bengal, is an example of what can be done, and we think that the rates of survey there compare very favourably with those of the United Provinces and the Punjab, when the exclusion from

the accounts in these Provinces of the pay of patwari-surveyors is taken into consideration. It is only, however, in Bengal that the conditions we have referred to above apply fully; and while we are decidedly in favour of utilizing professional agency in the supervision of cadastral work in such conditions, we recognise that circumstances are very different elsewhere, and would leave Local Governments a free hand in deciding whether to utilize such agency or not.

With reference to the organisation of Land Records Departments, we may also state that by far the most complete and efficient, in so far as survey work is concerned, is that of Burma, and its efficiency is no doubt largely due to the extent to which it is officered from the Survey of India. The Local Government would greatly regret to see this source of supply interfered with.

Utilization of cadastral surveys for topographical maps.

58. As regards the utilization of cadastral work for topographical purposes, it has been assumed up to quite a recent date that, when surveys were conducted on the large scale of 16″ to the mile, no further survey operations for topographical, or indeed for any purposes would be required. In the Punjab, where these maps were made by non-professional parties, it was recognised from the beginning that some slight amount of supplementary survey was requisite, but elsewhere this was not the case; in the United Provinces from an early date, and in Bengal from the date of commencement of cadastral work, reductions of the professionally prepared maps on the 16″ scale were used for the preparation of standard sheets without any further examination in the field. The experience of Burma seems to have first originated doubts on the subject, and these were confirmed when it became possible to compare cadastral compilations with previous topographical surveys of one and the same tract as in the district of Meerut. The course was then adopted of publishing maps reduced from cadastral surveys as "preliminary editions," the production of a final edition being indefinitely postponed. We do not find it possible to lay down definitely any criterion by which to determine the stage at which a cadastrally prepared map is of so little use to the topographical surveyor that it is superfluous to go to the cost of making a reduction, and we can only indicate in general terms the advantages and disadvantages of relying on cadastral maps. It will be understood that, even if no direct use can be made of cadastral maps, the fact that an accurate traverse survey has been made, will always be of material assistance to the topographer owing to the number of fixed points which it gives him for his work.

Advantages of making use of cadastral maps.

59. The advantages of using reductions from cadastral maps are two—

(1) *Economy.*

When a cadastral survey has been made, (the cost of making it is for our present purposes irrelevant,) the further process of reducing the results and combining them into a 1″ map in level districts is very cheap. Major Crichton in Bengal puts the cost at Rs. 2·2 per square mile in a well-organised establishment, and does not think it should in any case exceed Rs. 3·9. Captain Coldstream's calculations point to Rs. 3 as a fair rate in the United Provinces and Captain Tandy gives Rs. 2·6 for the Punjab. In flat level

country the details on these reduced maps require little further correction; and it is in such a country that an original topographical survey is apt to be expensive owing to the difficulty of working merely from triangulated points and the consequent necessity of traversing. At the outside, allowing for a very careful supplementary survey, it should be possible to produce a map on the 1″ or 2″ scale at a cost not exceeding Rs. 15 per square mile, and probably much less, whereas an original 2″ survey would cost considerably more.

(2) *Fulness of detail.*

It is admitted on all hands that a map on the 1″ scale prepared by reduction from any reasonably good survey on the 16″ scale is better than one prepared from direct survey on the 2″ scale; and much better than one prepared from a 1″ survey. All the officers we have met, who were using cadastral reductions, considered that their work was both facilitated and improved; but one important point to be remembered is that it is impossible for any compiler to know from a cadastral map which are the features of primary importance to be shown on the final topographical map. The additional work required we have already indicated in our definition of "Supplementary Survey."

Disadvantages of making use of cadastral maps.

60. Against these advantages have to be set various drawbacks—

(1) *Incompleteness*, which is of two kinds—

(*a*) *General.*—Cadastral surveys do not extend beyond the boundaries of some administrative unit—usually the district. Every sheet, through which the boundary of the district passes, has an unsurveyed portion; either this must be filled up from old material if the adjoining district has been previously surveyed, or a topographical survey must be carried out up to the margin of the sheet—a very serious task in many cases,—or the sheet must remain blank till some indefinite time, when the adjoining district is surveyed. It is impossible fully to realise the force of this objection without considerable experience of the almost hopeless state of incompleteness of many of the standard sheets compiled from revenue or cadastral surveys.

(*b*) *Special.*—Cadastral surveys do not necessarily extend beyond the culturable area. Hilly country, for instance, may be marked as such—"Hill" or "Pahar"—in the middle of a blank space, with various streams flowing from it, the earlier course of which is not delineated. In older times ravines and other rough ground were often omitted. The supplementary surveyor must make a new survey of these, and, if they are extensive, it is as easy and cheap for him to survey the whole ground as to use the cadastral map in his operations.

(2) *Delay in publication.*—This again is of two kinds. To some extent delay is inevitable. In some Provinces each village takes two years to survey, and a further time must elapse before the cadastral maps can be made over to the topographer. In Bengal the maps are not made over till revised by the settlement authorities, but it is hoped to avoid this objection and to expedite the work. More serious is the delay that ought to be preventible, but that

seems at present to be incidental to the system. The delays in the Punjab have been referred to frequently; in Bengal some topographical maps were issued 15 years after the cadastral survey had been made; in the United Provinces the Superintendent tells us that it will take his Drawing Office five years to overtake the arrears. This delay may be a mere defect of system, but as it is universal, we must take it into account.

(3) *Distinctive nature of the two classes of survey.*—Lastly, there is the fact that the revenue or cadastral surveyor has not the same eye for the physical features of the country as the trained topographer. This point may be best illustrated by quoting the remarks of Dr. Stein, the explorer. Dealing with Trans-frontier sheets, which include portions of British districts, he says:—

"I can recognise a considerable superiority as regards ampleness and accuracy of topographical detail in those portions which have been surveyed by Officers of the Survey Department of India during the Frontier expeditions from 1895 to 1898. I can trace the superiority of these surveys, *e.g.*, to portions of the Peshawar District mapped on the basis of revenue surveys, not merely in the more careful delineation of the natural features of the ground (hill slopes, streams, etc.), but also in the marking of inhabited sites and minor lines of communication. Considering that the time and opportunities available for correct surveying during those expeditions, were far more limited than in the case of the old District Survey over adjoining ground inside the border, I can attribute the superiority of those trans-border surveys only to the fact of the true purposes of a topographical survey having been more carefully kept in view in their case."

This drawback is of comparatively little importance in the plains of Upper India, but elsewhere it affects the maps detrimentally.

Assistance to be derived from cadastral maps in the topographical revision.

61. We have clearly indicated in our programme of operations, and in the map* attached to our report, the extent to which we consider that cadastral maps will be of assistance in the revision of the topographical maps of the country. In the greater part of the plains of Upper India we are of opinion that the cadastral maps will be of the greatest use, and that a slight and inexpensive examination of the reduced maps in the field should suffice to allow of the production of excellent topographical maps. But in the rest of the country the maps cannot be used in the same simple fashion, and it must be left to the Surveyor-General to say how far in each case and in what manner they can best be utilized. As to the utilization of the professional agency employed in supervising the preparation of cadastral maps for the maintenance of topographical maps, the question is not likely to arise under our proposals, as we do not contemplate any intermediate arrangement for revising such maps.

Control of cadastral surveys.

62. From the account given above it will appear that cadastral surveys are in almost every case conducted at the expense of Local Governments, that the programme is always, even if carried out by the Survey of India, controlled by the Local Government, and that in most cases the surveys are executed by local agencies entirely independent of the Department. We are in favour of maintaining the most complete measure of decentralisation in the conduct of such surveys subject to the following remarks.

Necessity for a scientific basis for cadastral surveys.

63. It is essential that all cadastral surveys should be accurately and scientifically connected with the geodetic survey of India, and we are in complete agreement with the orders issued by the Government of India in 1882 that

* *Vide* the map opposite page 115. Provincial maps will be found in Section I of Part II of the Report.

cadastral surveys should be preceded by a skeleton, or as it is now called a traverse survey, made by a professional agency. We think that this principle should be insisted on; its non-observance at the outset in the Punjab has led to considerable difficulty in the compilation of topographical maps in that province; and is amongst the causes of the delays in mapping, of which complaint has been made. The Survey Department should, we think, supply the necessary officers for making the traverse. For the detail survey we think that Local Governments should have complete control of the arrangements, whether the work is undertaken by Survey of India parties, or is carried out under professional advice or not. The system followed in Bengal, where a strong staff of Imperial and Provincial officers is employed under the general control of the Local Government, is, we think, admirably adapted to extensive programmes of cadastral work. Under existing arrangements, however, no officers of the Imperial Department can be employed on the cadastral work of Local Governments without weakening the cadre available for topographical work and interfering with the topographical programme, as their places are not filled up. The requirements of cadastral work are uncertain; in the future they will probably be limited outside Bengal, and we would not suggest that any additional officers should be added to the cadre so as to be available for such work, if wanted. But we think that all appointments made for this work, whether of Imperial or Provincial Officers, should be treated as outside the regular cadre, and the Surveyor-General should be authorised to employ other officers in place of those deputed. If, owing to the return of the latter, the cadre should be over strength, the excess would be but temporary, as vacancies could be absorbed on the earliest opportunity.

Loan of Survey of India officers for cadastral work.

64. It has been suggested to us that too long a course of service under a Local Government, free from the discipline of the Department, is apt to lead, in the case of Provincial officers, to some falling off from the high standard of professional accuracy insisted on by the Survey of India. To meet this difficulty it could be arranged that after a definite time such officers should either return to ordinary departmental work or lose their lien on the Department altogether. Such arrangements have not been uncommon in the past, and the prospect of obtaining employment under Local Governments is likely to add to the attractions of the Department for candidates. Many officers, who are unable to stand the strain and exposure of topographical work, are often perfectly suited for the conduct of cadastral operations. While we think that Local Governments would be well advised to employ professional survey officers to train their establishments and supervise cadastral work, and that the Survey of India should endeavour, as far as its resources admit, to meet demands for such officers, we do not recommend any hard and fast rule in the matter. The Local Governments are themselves the best judges whether in the circumstances with which they have to deal, it is or is not advisable to employ professional assistance, if it can be made available, in their cadastral and Land Records work.

Expenditure on cadastral surveys.

65. The expense of all cadastral operations should, we think, as a matter of principle, be borne by the Local Government concerned, from the traverse to the preparation of such compilations from the cadastral maps as are required

for local purposes. We recognise that owing to the financial arrangements made with Local Governments, it may not be possible to give immediate effect to this principle, but its adoption would serve to mark the point at which a distinction can best be drawn between—(1) maps required for purely local purposes; and (2) topographical maps required for general purposes. For the latter the Imperial Department should be entirely responsible, and the expenditure on what we call supplementary survey should be taken as a charge to Imperial Funds. It is anomalous, under existing arrangements, to take only one instance, that the whole of the charges incurred on No. 7 Party in Burma should be debited to the Local Government, while the outlay on the Drawing Office in the United Provinces, where reductions of cadastral maps are made, should be an Imperial charge. It should always be open to the Surveyor-General to bring to the notice of the Government of India cases in which the basis of a cadastral survey is not a scientific one, and, where officers of the Survey of India are employed, they should be responsible to him for the professional accuracy of the work. But apart from this the arrangements should be completely decentralised and the Local Governments have full control both of the budget and the programme.

Standard of accuracy of cadastral and topographical maps.

66. We have been asked to report on the degree of accuracy desirable in each class of survey. On this point we consider that whatever is shown on a map should be shown accurately; and that in no case should anything be shown on a map issued by the Survey of India, for the accuracy of which it is not prepared to make itself responsible. It may be, however, that by accuracy is meant fulness of detail, and we would leave it to Local Governments to determine in the case of cadastral maps to what extent the survey of details is to be carried. For example there is no necessity, unless the Local Government so desire, that local survey agencies, such as patwaris, should be obliged to survey ravines or hills when the mere indication of their position on the map would suffice for all revenue purposes.

Forest surveys.

67. A separate Forest Survey Branch under the administration of the Forest Department was first started in 1872, and in 1873, in order that its work might be available for geographical purposes, it was brought under the general control of the Survey Department (exercised temporarily through the Superintendent of Trigonometrical Surveys). Apart from the surveys carried out by this Special Branch, some forest surveys were executed by the Imperial Department and others by local Forest officials. Orders as to the class of work to be undertaken and as to the adjustment of its cost were issued in 1888,* and were supplemented or explained in further orders issued from time to time. In 1899, when there were four parties engaged in forest work, three of which were directly under the Surveyor-General and one under the Inspector-General of Forests, it was decided to amalgamate them and place them all under the Superintendent of Forest Surveys. In the following year an officer of the Survey of India was appointed to that post, and in 1904 the whole establishment for forest surveys became an integral part of the Survey of India, and it was laid down that its charges should be debited as

* Revenue and Agricultural Department Circular No. 16-F., dated 2nd July 1888.

follows :—30 per cent. to the Survey of India in consideration of the topographical value of the work, and 70 per cent. to the Forest Department.

Scale of forest surveys.

68. The ordinary scale of forest maps is 4″ to the mile, but larger maps have at times been asked for by the Forest Department, and the scale has been the subject of considerable discussion. In Bombay maps on the 16″ and 8″ scales are still occasionally prepared, though all other Provinces are now content with 4″ maps. We saw some reason to doubt whether even this scale was always necessary, and we therefore made enquiries on the subject. The Board of Revenue in Madras and the senior Conservator in Bombay are strongly in favour of the retention of the 4″ scale, as a smaller scale would not, they consider, meet their requirements. On the other hand in Burma we have evidence that Forest officers in some cases actually prefer the smaller scale maps, and the Inspector-General, who has had personal experience of that Province, has informed us that 4″ maps are probably not actually necessary for more than one-fifth of the area still left for survey ; and that for the remainder the 1″ maps will be preferable. The Lieutenant-Governor of Burma also attaches more importance to pushing on the topographical survey of the country on the 1″ scale than to the provision of 4″ maps of forest areas. In Bengal a 4″ map appears to be considered advisable.

Survey requirements of the Forest Department.

69. The following approximate statement of the areas likely to require survey for the Forest Department after the end of the present field season has been given us by the Superintendent of Forest Surveys. It must be remembered that these areas are always liable to increase as new forests are reserved :—

Province.	Area in sq. miles.	Probable date of completion.
Bombay	2,200	1908
Madras	3,500	1909 or 1910
Assam	550	1910
Bengal	3,200	
Berar	700	
Burma	5,050	
	15,200	

When this programme is completed, the Superintendent expects that further demands for 4″ surveys will be made, so that it is impossible to fix any final date for the completion of forest work under existing arrangements. The forest surveys provide detailed and admirable topographical maps for the difficult country they deal with; but their value to the country at large for topographical purposes is greatly reduced by the extremely scattered character of the forest blocks with which they deal. No separate block is surveyed by the Survey Department, unless it has an area of at least 10 square miles, but even with this limitation, the work is of an extremely patchy character, and we think it a matter for the serious consideration of the Government of India, whether the large expenditure now incurred on forest surveys, amounting to over three lakhs of rupees a year, could not be more usefully laid out with no serious detriment to the work of the Forest Department.

Recommendations regarding forest surveys.

70. We are ourselves very strongly of opinion that all special forest surveys should be brought to a close as soon as possible, in order to admit of the concentration of the full strength of the Survey Department on its topographical programme. The surveys in progress are very expensive, and absorb a considerable part of the strength of the Department. Should they be stopped, a large number of surveyors will be available for topographical work at once; while if they are continued on the present scale, not only will the total expenditure of the Department be much increased, but there will be much greater delay in organising the parties required to carry out the topographical programme. Should the Government of India, however, be unable to accept our recommendation, we would suggest that the present method of adjusting the cost of such surveys should be simplified and the following principles be observed:—

(1) The cost of all surveys of forests, executed on a scale not exceeding 2″ to the mile in the course of the ordinary topographical programme, should be borne by Imperial revenues as part of the general topographical survey of the country. If it is so desired, a skeleton boundary survey of forest blocks, on the scale of 4″ to the mile should be supplied by the same agency and at the same expense.

(2) The cost of all surveys of forests on a larger scale than 2″ to the mile, or made to meet the requirements of the Forest Department, otherwise than in the course of the topographical programme, should be charged entirely to the Forest Department.

Municipal and cantonment surveys.

71. The perusal of any of the Survey Reports will afford instances of the diversion of part of the strength of parties for the survey of cities, towns or cantonments, places often of very little importance. It is most undesirable that work of this description should be allowed to interfere with the continuous execution of the topographical programme, and we think that it should for the present be entirely excluded from the work of the Department. The operations are of a character that can be undertaken by surveyors of the Public or Military Works Department, or by those of the Land Records Department, or by retired officers, and we recommend that in all cases the local bodies concerned be left to make their own arrangements, and the Survey Department be not called on for either the personnel or the expenditure involved. Exceptions to this rule, where unavoidable, can always be made by the Government of India; but we think that the Survey of India should not, without orders from that Government, undertake any large scale town or cantonment survey.

CHAPTER VI.

Revision of the Topographical maps of India.

Preliminary.

72. In criticising the existing Topographical maps of India it is necessary to make a brief allusion to their earlier genesis and history—a history which in some respects we consider an unfortunate one. We have already at the beginning of Chapter II indicated generally the marked difference between the conditions under which the trigonometrical and the topographical surveys of India were carried on. But it is convenient that in this place we should explain more precisely what a fatal influence that difference has exercised upon the topographical maps of India down even to the present time.

Concentration of strength in the early period of the survey.

73. Like the maps of all modern nations those maps are dependent upon a Geodetic system of triangulation. The history of that triangulation forms an episode in the history of Indian science and Indian topography, of which all Indian public servants and especially all Survey officers should be proud. It is an example of concentration, energy, and persistence in the face of a tropical climate, physical obstacles, and pestilential tracts of country, extending over more than two generations, which has never been surpassed, if indeed it has been equalled, in the records either of surveying or of science generally. Nor were the conduct and liberality of the Indian Governments, beginning with that of Madras in 1802, less admirable in granting funds for this great work. Their patience was remarkable. We have seen in the Historical Chapter that some revenue and topographical surveys were carried out as early as from 1823 to 1837, but the area covered by them was very small compared with the total area of India, and most of them did not depend on Lambton's and Everest's work at all; so that from 1802 to 1843 the Indian Governments were supplying funds for scientific and geodetic work, with little or no practical return in the shape of maps of any kind. This in brief is the history of the first period of the Indian Survey; it is the history of concentration with one definite object.

Division of strength in the second period.

74. We come now to the second period. It was the period in which revenue and topographical surveys, especially the former, became largely developed. It may be said to have begun when Colonel Waugh in 1843 succeeded Sir George Everest in the combined offices of Surveyor-General and Superintendent of the Trigonometrical Survey of India, which the latter had held since 1830, and to have continued until Sir Andrew Waugh retired in 1861. Waugh seems to have had the same predilection for geodetic work as his predecessors, Lambton and Everest, and to have prosecuted it with equal energy; and this may have been the reason that Major Thuillier was in 1847 appointed, under him, Deputy Surveyor-General for Topographical and Revenue Surveys, in addition to the fact that the demand for such surveys was increasing.

It was in this period, namely, between 1843 and 1861, that what appears to us to have been a fatal step was taken. This was the separation of the trigonometrical and topographical and revenue surveys, and the failure to introduce a system under which, as soon as a survey of any province or

district was begun, that province or district should for survey purposes be treated as a whole instead of by patchwork, and should have its topographical survey completed, whether by trigonometrical, or by cadastral, or by topographical surveyors, as nearly as possible simultaneously. We will suppose that a Local Government had decided to carry out a revenue survey of the whole or part of the province. If the full powers had been simultaneously employed, on the survey of the district, of all the surveyors who were at the disposal of the Government, namely, the trigonometrical (if necessary), and the revenue, and the topographical surveyors, it is impossible to suppose that a complete topographical map of the district could not have been made within a very short time after the cadastral surveys had been completed. What was done, under the system of separation, on the other hand, was that the trigonometrical branch, being left independent, confined itself solely to geodetic objects; the revenue survey, being left independent, confined itself solely to the large scale survey of culturable patches; and the topographers, also independent, were scattered over the country doing separate bits of surveying of their own, and when they did encounter any areas which had been surveyed by revenue parties, those revenue surveys were found either to be obsolete and useless, or a patchwork small-scale map was compiled, half of which had been surveyed ten years before.

Incomplete sheets and fragmentary surveys.

75. Thus in the second period of the Indian Survey separation or division of strength was substituted for that concentration which was the rule in the first period. It is useless, and would be unprofitable, at this distance of time, to speculate as to why this false step was taken, and as to who may have been responsible for it. Suffice it to say that its effects have continued down to the present day. For the first defect in the existing 1-inch maps of India, which strikes every one who examines them, is that a large, if not the larger, number of them are incomplete, that is, they are not filled up to the sheet lines; that others consist of two or more different surveys, dating perhaps ten or twelve years apart; and that others consist of mere fragments of cadastral surveys scattered over the entire sheet, some of them only one or two square inches in area, which are entirely useless for any purpose. We are not aware that any other country has ever published its topographical maps in so fragmentary a condition. The same anomaly occurs in the sheets of the more modern forest surveys: on one sheet there may be patches of forest work, patches of cadastral work, and patches of topographical work, all surveyed at entirely different times.

Numerous illustrations of these defects will be found in the accounts which we have drawn up of the condition of the maps in each Province or State, and of the manner in which they can best, in our opinion, be brought up to date. We have noticed in the provincial accounts, not only the state of the topographical maps prepared by the Survey of India, but the measures taken by some Local Governments to provide independently the maps or plans, required for local administrative purposes. The accounts themselves extend to some length and have therefore been transferred to Part II of the Report. Here a summary of the results will be sufficient.

Summary of provincial accounts of topographical maps.

76. In Madras there are practically no Survey of India maps other than the $\frac{1}{4}$" sheets of the Atlas of India which are based on material provided by very old surveys, and though well executed, are now out of date. Mysore has

an excellent series of 1″ maps based on surveys made not much over twenty years ago, covering the whole area of the State and prepared in the course of a continuous and systematic programme of operations. Coorg is in the same position as Madras. In Hyderabad the surveys, from which such 1″ maps as exist were prepared, began long before the middle of the last century, and the maps are hopelessly out of date, besides being in other respects incomplete, and the same is the case in Berar, though the surveys there were in parts somewhat more recent. In Bombay the 1″ maps are practically complete for the whole Presidency and the Native States adjoining it; but being based on surveys of varying dates by different parties they are less regular than the maps of Mysore; and they are also, except in the Southern Mahratta country, more out of date. The survey of Sind has been undertaken in recent years, and is now nearly complete. In Rajputana a large tract of country has never been surveyed, and in the rest of the States there and in Central India the maps, though fairly complete, are out of date. In the Punjab and North-West Frontier Province the 1″ maps, except in a very few districts, where compilations from cadastral material have recently been prepared, are all much out of date, the sheets are in many cases fragmentary, and much cadastral material that might have been utilized for the preparation of new maps is unused. In the United Provinces a few districts have recently been surveyed topographically, for a few others good topographical maps that only require to be brought up to date were prepared about twenty years ago, but for the greater part of the Provinces the maps are based on cadastral or revenue survey work. They are compilations made in office which have never been tested in the field, and which in some cases are too much out of date to be of much assistance in the preparation of new maps, but the majority will, it is believed, require nothing more than an inexpensive correction in the field to bring them up to date and allow of the correct delineation of topographical features, omitted or inadequately represented by the cadastral surveyors. In the Central Provinces large tracts, including three important districts, have maps only on the $\frac{1}{2}$″ scale. Throughout the rest of the Province, except in a few districts where revising parties have recently been at work, the maps are seriously out of date, and the sheets are in many cases fragmentary, one portion having been prepared at one date by a topographical party, another at a different date by a revenue party. In Bengal and Assam the maps vary to an extent that defies all attempts at brief description. In many cases they are based on surveys sixty years old and are completely out of date: almost everywhere, except where recent cadastral material has been utilized, the sheets are fragmentary and cannot be published in a complete form except by the compilation of the results of surveys of different dates, the material of which is as a rule too much out of date to justify the cost of the operation. In Burma surveys are being actively pushed on on a continuous programme, and the new maps prepared there are thoroughly satisfactory, but the greater part of the country has still to be surveyed, and some of the older maps are already getting out of date.

Tabular statement of estimated cost of revision.

77. The results of our examination of the state of the maps in each Province, and of the character and cost, as conditionally estimated by the Surveyor-General, of the measures necessary to produce or bring up to date a modern topographical map on the scale of 1″ to the mile, for the whole

country are shown in tabular form in the following statement and are illustrated in the accompanying maps. The cost-rates here given are those given in Lieutenant-Colonel Longe's note (Appendix A) and adopted in the provincial sections in Part II of the report, and they are subject to a very important qualification. They represent merely the cost at which the Surveyor-General estimates that the work could be carried out by thoroughly trained and organised parties working uninterruptedly on a continuous programme; and they do not allow for the greater expensiveness of the work while surveyors are being trained and parties organised. The estimate represents the minimum cost at which the work might be done, and as we are anxious to avoid any under-estimating, we base our final proposal on a higher figure:—

Province.	Class of survey.	Area.	Rate per square mile, and scale of survey.	Estimated cost.
		Square miles.	Rs.	Rs.
Madras ...	Survey	27,000	(2″) 40	10,80,000
	Re-survey	103,200	(2″) 30	32,46,000
	Revision	16,500	(2″) 5	82,500
	Total ...	151,700	...	44,08,500
Mysore ...	Revision	29,400	(1″) 12	3,52,800
Coorg ...	Survey	1,600	(1″) 30	48,000
Hyderabad ...	Survey	82,700	(2″) 30	24,81,000
Berar ...	Survey	17,700	(2″) 30	5,31,000
Central Provinces	Survey	23,300	(2″) 30	6,99,000
	Re-survey	80,600	(2″) 18	14,50,800
	Not requiring immediate revision ...	12,000	...	...
	Total ...	115,900	...	21,49,800
Bombay and Baroda.	Survey	2,700	(2″) 12	32,400
	Revision	141,100	(2″) 12	16,93,200
	Total ...	143,800	...	17,25,600
Sind ...	Survey	18,100	(1″) 15	2,71,500
	Revision	34,900	(1″) 2	69,800
	Total ...	53,000		3,41,300
Baluchistan ...	Survey	31,260	(2″) 75*	23,44,500
		98,300	(1″) 40	39,32,000
	Not requiring immediate revision ...	2,740	...	...
	Total ...	132,300	...	62,76,500
Central India and Rajputana.	Survey	52,400	(1″) 15	7,86,000
	Re-survey...	156,600	(2″) 30	46,98,000
	Total ...	209,000	...	54,84,000

*This rate is taken from information furnished by the Officer in charge No. 15 Party. It includes the cost of the military and tribal escorts necessary in Baluchistan. Baluchistan is not included in Lieutenant-Colonel Longe's estimates in Appendix A.

Province.	Class of survey.	Area.	Rate per square mile, and scale of survey.	Estimated cost.
		Square miles.	Rs.	Rs.
Punjab ...	Survey	6,000	(1") 40	2,40,000
	Re-survey	12,900	(2") 45	5,80,500
	Supplementary, ...	44,100	(2") 15	6,61,500
		14,500	(2") 10	1,45,000
	Revision	24,600	(2" and 1") 10	2,46,000
	Not requiring immediate revision ...	31,600*	...	95,000
	Total ...	133,700	...	19,68,000
North-West Frontier Province.	Survey—Tribal area	25,000†	...	...
	Re-survey	13,700	(2") 45	6,16,500
	Total ...	38,700		6,16,500
Kashmir ...	Survey	80,900	(1") 80	24,27,000
United Provinces	Survey	4,200	(1") 30	1,26,000
	Re-survey	(hills) 13,700	(1") 30	4,11,000
		(plains) 19,400	(2") 25	4,85,000
	Supplementary	48,300	(2") 12	8,17,200
	Revision	19,800		
	Not requiring immediate revision ...	6,800	...	...
	Total ...	112,200	...	18,39,200
Bengal ...	Survey	26,400	(2") 40	10,56,000
	Re-survey	49,700	(2") 35	17,39,500
	Supplementary	120,300	(2") 10	12,03,000
	Total	196,400	...	39,98,500
Assam ...	Survey	38,200	(1") 40	15,28,000
	Re-survey	21,500	(1") 30	6,45,000
	Supplementary	9,400	(1") 20	1,88,000
	Not requiring immediate revision ...	2,200	...	...
	Total ...	71,300	...	23,61,000
Burma ...	Survey	141,500	(1") 40	56,60,000
	Re-survey	2,700	(1") 30	81,000
	Supplementary	29,700	(1") 20	5,94,000
	Not requiring immediate revision ...	83,300	...	...
	Total ...	257,200	...	63,35,000
Andamans ...	Survey	3,100	(1") 40	1,24,000

Grand total for all India.

Class of survey.	Area.	Estimated cost.
	Square miles.	Rs.
Survey	655,360	2,33,66,400
Re-survey	479,000	1,39,53,300
Supplementary	266,300	33,71,100
Revision	266,300	26,81,900
Not requiring immediate revision	138,640	95,000
Survey—Tribal area N.-W. F. P.	25,000	.....
GRAND TOTAL ...	1,830,600	4,34,67,700

* But for 19,000 square miles in the Kangra, etc., hills, a provision of Rs. 5 per square mile must be made to bring out 1" maps.

† An estimate of the cost of surveying the tribal area in the North-West Frontier Province can obviously not be given.

Expenditure required for revision.

78. The total area, for the mapping of which provision has to be made in the immediate future, if a complete programme for the country is to be drawn up, is according to these figures 1,685,960 square miles, and the estimated cost of the operations is Rs. 4,34,70,000 which gives a rate of Rs. 26 per square mile for work of all kinds that is done by the survey parties. That is to say, the estimate is intended to include the cost of all operations up to the time at which the fair drawn maps are sent to the reproducing office for publication, but for the reasons given in the previous paragraph some addition requires to be made to it, and we have decided to accept, for the purposes of our recommendations, a higher estimate of Rs. 5,62,50,000 which will be referred to in the next chapter. We have now to decide whether the Government should be advised to undertake this expenditure for survey and drawing work apart from additional charges for reproduction and administrative supervision, and, if so, over what period it should be spread.

Reasons for incurring this expenditure.

79. On the first point we have no hesitation in recommending that the work should be undertaken. The expenditure which the Government of India has incurred on its maps in the past has been enormous, but the value of the work done is rapidly being lost owing to what we cannot but regard as the unfortunate policy of recent years. Already over the greater part of India there are no topographical maps with any pretensions to being up to date, and year by year the area is increasing in which revision or resurvey is urgently called for. The great and successful efforts made by General Thuillier to complete the preliminary mapping of the country appear indeed to have had an unfortunate effect upon the future operations of the Department. The impression that the Survey had practically done its work gained ground, and it is common knowledge that in a time of financial stress there was a danger of the Department being broken up, unless work other than topographical surveys was found for it. Its energies were therefore diverted to cadastral and forest surveys which were differentiated from topographical work as being remunerative, and which had, at all events, the advantage of removing expenditure from Imperial to Provincial funds. It is not surprising that in these circumstances the Department itself based even its topographical programme to some extent on the expressed wishes of local authorities rather than on any well considered scheme of the requirements of the country at large. Only in this way can we explain the fact that topographical parties should have been employed on such partial surveys as were carried out with great difficulty and at great expense of the tin-mines district in Mergui and of the remote hills of Lushai, when the districts of Allahabad and Cawnpore were absolutely without modern maps. From a topographical point of view the policy has certainly not been economical, and we are strongly disposed to think that it has been wasteful in every sense. Elaborate forest surveys have been made on the 4″ scale without, so far as we can ascertain, sufficient enquiry in every case whether they were necessary. We have now the evidence of the Inspector-General that a 1″ survey would in many cases be quite sufficient for his purposes, and yet unless definite orders on the subject are issued, it appears probable that all forests will be surveyed on the 4″ scale as a mere matter of course. The forest blocks are so scattered that it is only in rare cases that their surveys have been actually used in the

compilation of topographical maps, though they are all intended to be so used at some indefinite date.

The case of cadastral maps is somewhat different, but here also we are disposed to think that the expenditure might have been more usefully incurred. If a cadastral survey is necessary over a large area, as in Bengal at present, we do not consider that it can be carried out more economically than by the Survey Department, while the results are of course immeasurably superior to any attainable by the use of local agency. But it does not necessarily follow that this is the case when survey parties have to be moved about to undertake the work in distant districts as the time for settlement approaches, and we are impressed by the fact that in the United Provinces, which has had more experience of professional cadastral work than any other part of India, it is now found sufficient for revenue purposes to base assessments on the old unprofessional village maps, and not to incur the expense of a new professional survey. For topographical purposes the cadastral maps have been more valuable than the forest maps, as they cover larger continuous areas, but their value for this purpose is in no way proportionate to their cost, and the attempts to make use of them are among the causes of the patch-work which has brought the maps of the country into their present disorganised condition.

Requirements of different Departments, civil, military and public works.

80. The evidence which we have received as to the extent to which the absence of good maps is felt varies greatly in character. For many purposes of civil administration the absolutely essential minimum is rather a plan than a map—something which shall show the boundaries of all administrative units from the village upwards, shall indicate the means of communication, and shall show or leave room for the insertion of the position of tahsils, police stations, schools and other information necessary to the District Officer. Consequently we find many cases in provinces without good maps where officers express their ability to dispense with them: or show from their replies that they attach little importance to their provision. Some indeed prefer the rough maps issued by the local authorities to those of the Survey Department as being more convenient for their purposes, and in some provinces it is only the exceptional officer who takes the trouble to provide himself with a good map. But we find that, the better the Survey maps are, the more are they used, and it is where the maps are best that we have received the most intelligent suggestions for their further improvement.

From officers of the Public Works Department of all classes we have received the most convincing evidence of the value of the maps of the Survey Department, and indeed of their absolute necessity. In the Railway and Irrigation Branches especially the maps are in constant use, and we have been told over and over again that they are indispensable. In the Forest Department the case is the same, but for the convenience of that department special arrangements at a great cost have been made. We can see no reason why the requirements of other departments and of the public should not be equally considered, and these can be met only by the issue of uniform maps for the country as a whole.

For military purposes the necessity of accurate maps of any ground over which troops may at any time be called to operate hardly requires to be stated; and the condition of almost all the existing maps is absolutely

insufficient for military purposes. To take one instance, and a very important one, the maps of the country round Peshawar are worse than useless for the guidance of troops on the ground. Roads are shown that do not exist; roads that exist are not shown; the different classes of roads are not distinguished; canals for the most part are conspicuously absent, and there are other defects which have been pointed out in detail.

Provision of accurate maps an important function of Government.

81. Apart from the special requirements of different departments of the administration, we think it is hardly likely to be disputed that the provision of accurate maps is one of the functions which every Government must undertake, and we quote the following remarks from a Bulletin issued at Washington in 1904 on "The United States Geological Survey":—

"The uses of topographic maps are many. For the purposes of the National Government and the State they are invaluable, as they furnish data from which may be determined the value of projects for highway improvement, for railways, for city water-supply and sewerage, and for the sub-division into counties, townships, etc., etc. They serve the military departments of the Government in locating encampment grounds, in planning practice or actual operations in the field, and, during war, in indicating the precise situations of ravines, ditches, buildings, etc. The Post Office Department utilizes them in considering all problems connected with the changing of mail routes. * * * * As the outlines of wooded areas are to be indicated on those maps, National and State Foresters will find them invaluable as a base for classifying the wood lands, and recording the nature and quantity of the various trees and the relation of the wooded areas to highways of transportation, as railways, streams, etc. These maps are of course essential to detailed geologic studies and to investigations concerning mineral resources, water-power and land reclamation.

A good topographic map renders unnecessary a special survey for each new need. Prior to the existence of such maps every city was obliged to spend large sums in water-supply surveys. At far less cost the topographic map shows not only these important local features, but also the relations between the artificial features in the immediate neighbourhood, and the topography and culture of the surrounding country, and thus broadens the scope of every such investigation."

Present maps not inaccurate, but out of date.

82. With these remarks we fully agree, and if they are accepted as stating a sound principle in regard to a new survey, they seem to us to apply still more strongly to the necessity for keeping up to date the work done by our predecessors before the stress of financial difficulties led to its curtailment. There is hardly any part of India that has not been surveyed on some scale; by far the greater part has been mapped on the 1″ scale. If it was, as we believe, a sound policy to incur a large expenditure in surveying and mapping the wildest parts of the country half a century ago, it is a mistake to lose the fruits of that expenditure by not keeping these maps up to date, and we advise that they be not only kept up to date, but improved up to the standard which the rapid development of the country requires. We must express our strong conviction that in the present state of its maps the country has already lost much of the value of the expenditure incurred, and much more is likely to be lost unless action in the direction of revision is taken at as early a date as possible.

Of the general accuracy of the maps provided by the Survey Department, apart from their not being up to date, there can be no question. We have received the most conclusive evidence on this point from all sides. Generally speaking, the accuracy of the survey is regarded as above all suspicion; and

no comparison is possible in this respect, or is anywhere attempted, between the work done by the professional department and by any other agency.

Economy of thorough professional revision.

83. In deciding on our recommendations we have always had before us the injunctions we received with regard to economy. We have considered therefore in every case the cheapest method of producing sufficiently good maps, but we think it useless to undertake the work unless it is done thoroughly. It appears often to be thought that revision is a very simple process, and that all that is required is to take the existing map into the field, or even to have it taken out by some local non-professional officer, and have any new roads or other changes marked on it. This is very much the procedure that has been attempted by the Survey Department owing to the impossibility, with its present staff, of making any examination or revision in the field, with results that are most unsatisfactory. Enquiry is made as to changes that have occurred, the best information regarding them is obtained, the map is altered, and a new edition issued as showing changes made up to a certain time. But, as we have frequently found, the maps show only some of the changes up to that date, and the entry of changes from non-professional surveys is frequently far from accurate. One case is on record where three separate surveys of a railway line were sent to the Department for insertion on a map, and each showed a different alignment. The insertion of such work must tend to a deterioration of the standard maintained by the Department, and should not be allowed. The maps issued by the Survey of India should contain only information verified by its staff; and complete revision cannot be effected until a survey officer of the Department goes over the ground himself.

Importance of adhering to definite programme.

84. The present procedure, under which parties are transferred from one part of the country to another before they have finished their work, and programmes are altered as soon as made, is most wasteful. A party employed in a particular tract of country acquires, after a year or two, a familiarity with the class of work to be done, with the best means of recruiting, and with the arrangements best adapted to the climate. Its transfer to another part of India involves the loss of all these advantages; the conditions, climate and people are changed, the whole benefit of previous local knowledge is lost, and a period of disorganisation is a necessary consequence. Only last year a party was transferred from the Shan States to the North-West Frontier—a transfer which must have involved much expense not only to Government, but also to the men composing the party. Not many years ago No. 18 Party was transferred from the hills to the plains of the Punjab before it had completely mapped the surveys already made in the hills. There were strong reasons for the transfer, but the result has been that many of the maps of the hills surveyed have not been published at all, and comparatively few have been published in standard sheet form, while the new work of the party is now impeded by the necessity of bringing the old work up to date; and its affairs are in a state of considerable confusion. The transfer to forest work, of a party sent to Madras in 1886 for topographical survey involved the loss of the triangulation work which the party had completed preparatory to a topographical survey in Madura, Travancore and Cochin, and a similar waste occurred in the proceedings of the Mergui Survey owing to change in its

programme. Another fertile source of confusion is the diversion of a portion of a party to work outside its proper duties at the request of local authorities, civil or military. Advantage is taken of the proximity of a party to have municipal or other local surveys carried out ; the intended work of the party is interfered with, although in many cases the surveys are of a class for which it appears to be entirely unnecessary to employ the agency of the professional department.

In future, whatever plan may be adopted, we recommend that a definite programme allotting to each party its own area be laid down and adhered to, and that no change and no diversion of the party, or any portion of it, to miscellaneous work be allowed without the sanction of the Government of India—a sanction which should, we think, be given only for the strongest reasons.

Period required for revision.

85. As regards the period of survey, we think that in view of the estimate of cost that we have accepted, the period allowed for the revision of maps or the survey of the country, as the case may be, must be extended to 25 years. A shorter period will involve a greater outlay than we think the necessity of the case requires; and as additional parties would be required, it would throw a greater strain on the organisation of the department.

Order of urgency.

86. In paragraph 2 (1) of the Resolution appointing the Committee the last two points referred to are :—

(1) the order of urgency of the maps required, and (2) the arrangements for keeping up to date the topographical maps which exist or are to be prepared.

The proposals which we shall make render it unnecessary for us to go into these matters in any great detail. There can be no question that military considerations must take precedence of all others ; and the military authorities have confined their requisition to tracts on the North-West Frontier. For these tracts we propose to make special arrangements. Throughout the rest of India we propose to proceed on a more comprehensive plan than was suggested by the former Committee, and to begin work at numerous different centres simultaneously, allotting to each party a definite area so as to finish the whole programme in about 25 years. There is no part of the country, which we consider it so absolutely unnecessary to survey, that we recommend its omission.

The area in which survey and revision are considered urgent by the military authorities lies near the North-West Frontier, and is roughly bounded on the south by the Karachi-Hyderabad-Sukkur-Bhatinda-Delhi Railway. For this work we recommend the adoption of the procedure outlined in paragraph 17 of Sir John Farquharson's scheme (Appendix B). The concentration of six parties in this area should ensure the preparation of new maps for it in from four to six years—a rate of progress which we understand will fully satisfy military requirements. Operations should commence in the tracts nearest the frontier, and should be gradually extended over the Punjab and then towards Dir, Chitral, and Kashmir. The revision of the maps of the southern part of Baluchistan, the United Provinces, Rajputana and Central India will be delayed for about five years, but, in view of the importance of military considerations on the North-West Frontier, this is unavoidable.

Intermediate revision unnecessary.

87. As regards the revision of maps existing or to be prepared, our plan is that all maps should be brought up to date in the course of the next 25 years. The parties employed will work regularly across the country. Where maps are good enough for simple revision they will revise them, where the maps require supplementary survey, such survey will be arranged for, where there are no maps, or where they are obsolete and useless, a new survey will be made. When the programme has been completed, that is in 25 years' time, a fresh revision will be necessary, but we do not think that any second revision should be undertaken till then. In England the period for revision is 15 years in the case of topographical, and 20 years in the case of cadastral maps, and we cannot think that the adoption of the longer period will lead to any considerable inconvenience in India. The only exception we would allow is in the case of the construction of a new railway or canal. We make no similar exception in the case of rivers, though in some Provinces importance is attached to the frequent survey of riverain changes, since we regard it as hopeless for the Survey of India to keep topographical maps up to date in this respect. A revised map may in one season become as inaccurate as the one it superseded. The carrying out of any intermediate survey required in the interests of any special department should be arranged for by that department.

It has been suggested in some quarters that the revision of maps should be dependent on the number of changes that have occurred since they were prepared. With this opinion we are unable to agree. It prevents systematic work, and system is essential to the satisfactory and economical employment of the Survey Department.

There are orders, which are carried out with varying degrees of carefulness, as to the reporting of all changes to the Survey Department. We think that these should be maintained in respect of railways and canals, but that they are unnecessary in regard to other changes, the insertion of which in the maps must be postponed until the present programme is complete and a new and systematic revision is undertaken.

CHAPTER VII.

Organisation for the work of revision.

Necessity for uniformity in the system of revision.

88. If our proposals for the provision of uniform maps for the whole country are accepted, the most important matter for consideration is the method in which the resources of the Department should be organised and controlled for carrying out the work. The former Departmental Committee proposed to employ additional survey parties in Provinces where there was much survey and resurvey to be done, and at the same time to organise smaller parties called "revising units" to be employed in bringing up to date maps that were fairly good. These revising units were admittedly experimental, and it was impossible to frame any definite estimate of the amount of work which they might accomplish, or of the number of them that would ultimately be required. On these detachments the task of keeping the new maps up to date, when the period of revision (which was put by the Committee at 15 years) came round, would have fallen ; and their number or strength would presumably have been increased as the regular survey parties approached the completion of the new work allotted to them.

Under this system there might be two methods of working in adjoining tracts. In one the maps would be dealt with by the revising unit, in the other the regular survey party would be at work. The revision of work would ordinarily be by districts, and a single standard sheet would frequently depend for its completion on the progress of both the revising unit and the regular party, whose operations might not harmonise in respect of time. Our enquiries have satisfied us that this system would not be so satisfactory as one under which each division of the country is made over to one regular party working steadily across it, sheet by sheet. To some parts of the area under its charge, where there is little work to be done but the rapid correction on the ground of existing maps, a small staff might be detached, while the bulk of the party was employed on the more difficult work of survey elsewhere, but all the operations must be under undivided control, and be directed to the bringing out of new and uniform maps in complete sheets of the whole of the tract allotted to the party. We recommend therefore that the whole of India should be divided into tracts, and that each tract should be allotted to a single party, the tracts to be so arranged that each party may be expected to complete its work in the time fixed for carrying out the programme.

Two schemes for carrying out the revision.

89. As regards the number and strength of the parties required and the methods to be adopted for the organisation and control of the work, two schemes have been laid before the Committee, one by the Surveyor-General (Appendix A.) and one by Sir John Farquharson (Appendix B.). It would have been more satisfactory if the Committee could have incorporated a definite scheme in its report, but as the expert members are not in agreement as to the arrangements to be adopted for the control of the work, it has been thought better to place their proposals before the Government of India exactly as drawn up by them.

There is a substantial agreement as regards the staff required for the actual work of survey, and as to the general lines on which the parties are to be dis-

tributed. Under the scheme in Appendix A fifteen parties, some of less strength than others, with two detachments, would be required for India, exclusive of Baluchistan and the North-West Trans-frontier: under the other scheme fifteen parties of full strength would be employed for all work, including the frontier. The first scheme contemplates the completion of the programme in 20 years; the latter allows 25, but this difference is due merely to the more cautious estimate of progress adopted. The only substantial difference between the two proposals has reference to the control and supervision of the parties. Colonel Longe proposes to divide all India into four groups, each in immediate charge of a Superintendent, while Sir John Farquharson, following the practice observed in England, contemplates the placing of all the parties, except those on the frontier, under the immediate supervision of the Surveyor-General himself, assisted by an officer of high rank, in charge, under the Surveyor-General's immediate direction, of all the duties of the Department.

The change in the system of control will affect other matters such as the recruitment and training of surveyors, but as we have appended the full schemes to our Report, in place of incorporating in it the one approved by the Committee, it is unnecessary for us to discuss such matters, and we proceed to deal with the main point of difference—the manner in which the operation should be controlled.

Inexpediency of proposed decentralisation of control.

90. The proposal to divide India into groups or circles for survey purposes was brought into prominence by the report of the previous Departmental Committee, and we were furnished with papers on the subject when we commenced our enquiries. The question of the necessity for such a scheme or of its advantages has been constantly before us, and it was with regard to schemes of this nature that the following reference was made to the Committee in the Resolution appointing it :—

> It will also have to be considered whether, with topographical work actively in progress all over India and the frontier, it would not be better to decentralise the administrative control of the Department, and to locate several head-quarters in different provinces in closer relationship with the Local Governments.

We are all agreed that if a great work, such as the bringing up to date and completion of the topographical maps of India on a uniform plan, is to be undertaken, the direction of the operations must be strictly Imperial. We have been much impressed by the dislocation of effort and waste of energy that have occurred in the past owing to the endeavours of the Survey Department to meet the wishes of local authorities, and we consider it absolutely necessary that the survey programme should not in future be liable to such intervention. The question of decentralisation for the purpose specified in the Resolution, that is to say, to bring the Survey into closer relationship with Local Governments, does not, therefore, appear to arise.

Supreme responsibility to rest with the Surveyor-General.

91. The main question then is whether the supervision of the various parties operating in different parts of India is too heavy a charge to be placed directly under the Surveyor-General. At the present time the Surveyor-General takes the administrative control of four topographical parties (including two on the frontier), and of all frontier work; the Deputy Surveyor-General has

the charge of four topographical and one cadastral parties, the Superintendent of Forest Surveys has four forest parties under him, and the Superintendent of Trigonometrical Surveys controls one topographical party. The placing of fifteen parties under the Surveyor-General direct would therefore seem under Indian conditions to involve a greater amount of supervision than that officer can exercise, but we consider that the necessary assistance can be given in a manner that is both more likely to conduce to efficient work and to be more economical, than the location of quasi-independent Superintendents in four different divisions of the country.

Deputy Surveyor-General and Assistant to dispose of routine work.

In the first place the Surveyor-General must have a senior officer of the Department to relieve him of all routine work, and to deal in the first instance with all returns coming from the parties. This officer, whether styled Deputy Surveyor-General, as in India, or Executive Officer, as in England, would deal with business of all kinds coming to the Surveyor-General's office, distribute it, if necessary, to the departments of the office concerned, and dispose of all routine matters, referring to the Surveyor-General only such as required his orders. He should be allowed an officer as assistant.

In the next place we would draw a distinction between frontier and

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Dissent by Lieutenant-Colonel Longe regarding the Committee's views on supervision.

I disagree with the statement made in paragraph 91, that the main question is whether the supervision of the various parties operating in different parts of India is too heavy a charge to be placed directly under the Surveyor-General. Such a statement would lead one to suppose that the Surveyor-General would have nothing to do but to supervise the topographical work, excluding as the Committee do the frontier work of the department. This is far from being the case, and the main question before the Committee appears to me to be, how to increase vastly the area to be topographically surveyed, without putting an end to the other work of the department, in the most efficient and economical way.

The duties of supervision are of very great importance, and the best method of carrying out these duties in any particular country, can only be realised by people who have a thorough knowledge of the work to be performed in all its branches. My proposal, to divide India into groups or circles for survey purposes, is one based on a most serious consideration of the work before me, as Surveyor-General. I am in no way influenced by the previous report of the Departmental Committee, and I consider, as I have said elsewhere, that some such scheme is essential to efficiency in the future. There may be no necessity for the immediate appointment of all four Superintendents. It is quite possible that two even might, during the working out of the reorganisation, including the enlistment and training of the necessary staff, be sufficient, and I have asked in my reorganisation scheme to nominate in the first instance but *one* Senior Imperial officer to work out the details of the scheme, and one Imperial and from four to eight Provincial officers to commence enlisting and training the necessary staff. I regret that my proposed partial decentralisation, if it can be so called, does not fall in with the intentions of Government, as conveyed in the Resolution appointing the Committee; but I would wish it to be placed on record that such decentralisation, as I have suggested, will, in my opinion, tend to economy, uniformity and efficiency in every direction. The position and authority of the Surveyor-General can, in *no* way, be raised by his being converted into a mere inspecting officer, such as he would necessarily become, were he placed in the position suggested for him by the Committee, nor will it in any way be lowered by the appointment of Superintendents of Circles, and the fact that the proposals for the formation of circles for the better execution of the work may have varied in detail from time to time since they were first put forward, and before the nature and extent of the operations were decided on, should not be used as an argument against them.

The 28th April 1905. F. B. LONGE, *Lieut.-Colonel, R.E.*

other surveys and place the former in the immediate charge of a Superintendent, on the same footing as the Superintendent of Trigonometrical Surveys. His head-quarters would be at Simla, where the Frontier Drawing Office should also be located. Frontier surveys can be differentiated with advantage from all other classes of survey. If within the border, special arrangements have to be made to deal with them as urgent; if beyond it, they are more of the nature of reconnaissances than surveys, and in either case they must be kept distinct from the ordinary topographical programme. That programme we regard as the most important work now before the Department, and the work which must come most closely and directly under the immediate supervision of the Surveyor-General; and all our proposals are made with the object of increasing his authority for dealing with it. We have already, in chapter V, given our reasons for holding that cadastral and special forest work should be decentralised, and their control left entirely to Local Governments.

Superintendent of Frontier Surveys.

92. We recognise, however, that the inspection of the different parties scattered over the country may require more time than the Surveyor-General can give, even if he is relieved of office work in the manner we propose, and we

Proposed appointment of an Inspecting Officer.

Note on the proposed appointment of an Inspecting Officer on the Staff of the Survey of India.

I do not dissent from the recommendations of the Committee on this head, but would offer the following suggestion, *viz.* :—

That, as the Surveyor-General will have under him at least 12 officers of Field rank, all so far as the Committee have been able to observe, capable officers of great experience, some of those officers might occasionally be employed to relieve him of part of his duties of inspection. It might be a welcome change for those officers, and would probably sufficiently carry out the object in view.

As to this subject of staff generally, I think there is some tendency to exaggeration on the part both of the Surveyor-General and of the Committee, as to the amount of work which will be involved in the revision of the 1-inch maps of India. I say nothing of the difficulties of the work, and the great distances involved; these are fully admitted; I allude only to the *amount* of the work.

As to this I observe that the Surveyor-General of India has furnished two maps, one about 12 inches by 8 inches representing on the $\frac{1}{64}$" scale the area of the United Kingdom, and the other about 42 inches by 42 inches, representing on the same scale the area of India; the object no doubt being (at least, if that is not the object, it is impossible to understand what is the object,) to convey the impression that the work done by the Ordnance Survey of the United Kingdom is as to the work done by the Survey of India in proportion to the size of those two maps.

If the Surveyor-General of India had to make all the cadastral as well as all the topographical maps of India, *i.e.*, all the large scale maps of Bengal and Bombay and Madras, the proportion of work as indicated by the two maps would no doubt hold good, and would be a just comparison. But that of course is not the case; and the Surveyor-General must either not have known, or must have forgotten that the Ordnance Survey does in fact prepare all the cadastral as well as all the topographical maps of the United Kingdom.

The result was that when, in 1894, estimates were prepared for the first revision of the maps of Great Britain, it was found that the work to be faced involved the revision and correction of about 50,000 maps, cadastral and topographical, covered with fences and houses, and of about the same size as the full standard 1-inch present maps of India, which the Surveyor-General has now to revise.

The latter maps are 3,500 in number.

The 24th April 1905.

J. FARQUHARSON.

would allow him an Inspecting Officer, whose duty it would be to be constantly on tour, visiting such parties as the Surveyor-General might direct, assisting them with advice, securing uniformity in the work, and carrying from one party to another suggestions for improvement in organisation or methods. The employment of such an officer would not prevent the officer in charge of each party from feeling that he was working directly under the eye of the Surveyor-General; and we cannot but think that an organisation on these lines, admitting of development, if necessary, is immensely superior to one that would commit the Government of India to the division of the country into several survey circles, each with its own head-quarters and offices, on which considerable expenditure would probably be found necessary in the end. The proposals for the formation of circles have varied in details from time to time, since they were first put forward by the late Surveyor-General, and there is no guarantee that any arrangement that may now be decided on will prove the most suitable eventually.

Scheme of revision recommended.

93. Sir John Farquharson's scheme, which we have decided to recommend for adoption, is explained in his note (*vide* Appendix B), and is illustrated in the map opposite page 125. It is proposed that fifteen parties should be employed on the work, each being allowed two Imperial officers, and being recruited on this account to a strength of 50 per cent. in excess of the average existing strength of parties. At present the average cost of a party is approximately a lakh a year; under the arrangements proposed it would be a lakh and a half; the annual expenditure would be Rs. 22,50,000, and the total for 25 years Rs. 5,62,50,000. A comparison of this estimate with that given in chapter VI will sufficiently show how fully we have provided against any danger of under-estimating.

The difficulty of making any exact estimate of the progress of survey parties on the data available is such that we do not accept the figures and estimates in Sir John Farquharson's scheme as anything more than a general guide. The arrangements may require some modification as experience is acquired, and the areas allotted to each party may require alteration in detail; but we unhesitatingly recommend the proposals for acceptance as the basis of a programme for the Survey Department, and they should be taken, subject to the above qualifications, as part of our report.

The scheme now proposed has the following advantages:—

(1) It is based on a very safe estimate of outturn.

(2) It provides fully for the requirements of the military authorities to which we attach the greatest importance.

(3) It is simple and involves the minimum of dislocation of existing arrangements; and

(4) It can be put in force at once, the staff for a commencement of the operations being available.

It is part of the intention of the proposals that all parties should recess in a suitable place in or in the neighbourhood of the tract allotted to them; and that additional surveyors and draftsmen should, as far as possible, be recruited and be trained in the party. We think that more satisfactory results will be obtained in this way than by any attempt to collect candidates for surveyorships in a central school or schools.

Lieutenant-Colonel Longe dissents from these recommendations for the reasons given in his note at the end of this chapter.

Increase in the staff of officers.

94. For the carrying out of this programme a considerable increase in the staff of officers, both in the Imperial and Provincial Services, will be required.

Head-quarters.

We would, as already stated, increase the head-quarters staff by giving the Deputy Surveyor-General an Assistant, and we think that, as is suggested by Colonel Grant, an Assistant should be appointed in the Photographic and Lithographic Office. An Inspecting Officer will also be required, but there will be no further necessity for the Assistant Surveyor-General in charge of the head-quarters office.

The staff at head-quarters would then consist of seven officers in place of five, namely :—

Surveyor-General.

Deputy Surveyor-General.

Assistant to the above, who might be called Assistant Executive Officer.

Inspecting Officer.

Officer in charge of the Engraving and Drawing offices.

Officer in charge of the Photographic and Lithographic and Mathematical Instrument offices.

Assistant to the above.

Increase in the staff, Trigonometrical Surveys.

95. Proposals have been put before us for increasing the strength of the Trigonometrical Branch of the Survey Department. We are not specially concerned with the work of this branch, except in so far as it affects the topographical survey of the country; and it is a question for the decision of Government whether funds and officers can be spared for the astronomical and other observations that are carried on, as well as for the enlarged topographical programme. There are, however, two classes of work in the trigonometrical branch that are closely connected with the mapping of the country, namely, triangulation and levelling. It has not been possible recently to push on the triangulation so rapidly as is desirable, and measures should be taken to complete the work in Burma, and to keep it well ahead of the topographical work in Baluchistan, and a definite programme should, we think, be called for as early as possible. If the triangulation and levelling operations are extended, an extra officer for each will be required in this branch. We recognise the value to science and geodesy of the observations of different classes carried out in this branch of the Survey Department, and we are aware that the work has been done so as greatly to add to the reputation of the Department. The necessity for curtailing the scientific work now undertaken would be a matter for regret; but if there should be any difficulty about raising the strength of the staff so as to enable it to carry out all its duties efficiently, we are of opinion that the prosecution of purely scientific work must give way to the necessities of triangulation and levelling, and we would suggest that the advisability of transferring the work connected with tidal operations to the local bodies concerned should be considered.

On the assumption, however, for the present, that scientific work continues to be undertaken on the existing scale, the trigonometrical branch should receive an addition of two to its present staff of eight officers.

96. We consider that each topographical party should be allowed two officers, on the understanding that the average strength of each party is increased by 50 per cent. above the present average. In this case twenty officers would be required for the ten ordinary parties.

Increase in the staff, Topographical Surveys (non-frontier).

97. For the five parties to be placed under the Superintendent of Frontier Surveys, we would allow three officers each, so as to provide a reserve, the necessity for which has been strongly pressed on behalf of the military authorities, for any special trans-frontier work or explorations. We consider that the provision of such a reserve is preferable to the proposal of the military authorities that a small special party should be maintained in intimate connection with the Intelligence Branch at Army Head-quarters. Thus 15 officers would be required in addition to the Superintendent of Frontier Surveys himself.

Increase in the staff, Frontier Surveys.

98. The total requirements of the Department, *apart from cadastral or similar work*, would therefore be :—

Total strength of officers required.

Head-quarters Staff ...	...	...	...	... 7
Trigonometrical Surveys	...	...	...	... 10
Topographical Surveys—				
(1) Non-Frontier	...	...	...	... 20
(2) Frontier ...	...	...	...	... 16
			Total	... 53
Add one-fourth for leave and training at Chatham ...				... 13
			Total	... 66

The work of the Trigonometrical Branch of the Survey of India.

On this subject I do not dissent from the recommendations of the Committee, and merely offer a suggestion.

The Committee recommends a certain addition or additions to the staff of the Superintendent of the Trigonometrical Branch. I agree, but would go further, and would make the following more precise recommendations :—

1. That the Pendulum and Magnetic operations should meantime be suspended.
2. That the Tidal observations should be entirely handed over to the local Port or Harbour authorities, the only service to be required of the Survey of India, under this head, being that they should depute an officer to make an annual tour of inspection, for the purpose of advising or directing those authorities as to the best methods of carrying on the work.
3. That the funds thus saved on Pendulum, Magnetic, and Tidal work should be devoted to a more vigorous prosecution of the Geodetic work remaining to be done in Burma and Baluchistan, in which countries the Government of India cannot tell how soon they may want new surveys to be carried out, and in which geodetic progress has recently been slow.
4. That the Surveyor-General of India should call upon the Superintendent of the Trigonometrical Branch to submit a definite plan and estimate for proceeding as rapidly and energetically as possible with the above-mentioned geodetic work.

The Indian Government has always been very liberal as to the prosecution of scientific work ; but it appears to me that those branches of that work, which are only remotely connected with the progress of geographical knowledge, can at the present time very well afford to wait, until the more pressing needs of India for an extension of her surveys eastward and westward are satisfied.

The above proposal would combine science with utility ; and is not in opposition to the representation from the Royal Society, dated 25th February last, which has been forwarded to India by the Secretary of State.

The 24th April 1905.

For cadastral or similar work as many officers would be employed in addition as were required by Local Governments. At present the number (omitting the Superintendent of Provincial Surveys, United Provinces, whose services are, we understand, no longer required,) is four, namely, three in Bengal and one in Burma. The total strength of officers required under our proposals is therefore 70, as compared with a present sanctioned strength of 40. We consider (the President dissenting*) that these should all be officers of the Imperial Service.

Requirements in the Provincial Service.

99. Allowing seven Provincial officers per party, the total number required is 105 for topographical work. The number employed on 1st January 1905 in all topographical work, including Forest Surveys, was 62, and there were 38 employed on cadastral or similar work. Omitting from our calculations, as in the case of the Imperial officers, all those required for cadastral work, we think that the number of Provincial officers required for all other purposes should be fixed at 165, and that, when any officer is deputed to service under a Local Government, the Surveyor-General should be authorised to fill up his place. A cadre of 165 would allow of the employment of 32 officers at head-quarters and on trigonometrical surveys as at present, and of 105 on topographical work, and would leave a reserve of 28 for men under training and on leave. The Surveyor-General estimates that 55 officers are required for cadastral work or other work under Local Governments. Should this prove to be the actual number so employed at any time, the total strength of Provincial officers including those deputed would be 220.

If the number of Imperial and Provincial officers is increased, as proposed, some change in the existing system of recruitment and grading will be necessary in order to prevent the block in promotion that must eventually result from the addition of a large number of officers in the lower grades.

Recruitment for the Imperial Service.

100. We would draw special attention to the remarks on the appointment of young officers made by Sir John Farquharson in paragraphs 15—17 of his statement† of the 23rd February 1905. We fully agree with what he says as to the advantage of limiting the first term of service of an officer in

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* *Dissent by the President regarding the number of Imperial officers required.*

In estimating the number of Imperial officers required, I consider that a deduction should be made in accordance with the policy under which ten posts were transferred to the Provincial Service in 1895. The intention of that measure was that ten superior posts should be held by Provincial officers, and until it is conclusively shown by actual experience that the latter are unequal to the responsibilities of such posts, I cannot recommend any change of policy. Five of the transferred posts were in the grades of Extra Deputy Superintendents, and these five should, I consider, be deducted from the total number of Imperial officers. I would therefore place the number of Imperial officers required as follows :—

Total officers required		53
Deduct five		48
Add one-fourth for leave, etc.		12
	Total ...	60
Add four for cadastral work		4
Total at present required ...		64

24th April 1905.

J. O. MILLER.

† *Vide* Section II of Part II of the Report.

the Survey, in the interests both of the Department and of the officer himself. We do not overlook the disadvantage of losing an officer after he has gained experience, and has become accustomed to the working of a survey party, but the advantages much more than compensate for this drawback, especially at a time when an extensive programme, necessitating the recruitment of many additional officers, is being undertaken. If, as the programme draws to a close, some reduction of survey establishments is necessary, there will be no difficulty in effecting it, if the system now proposed is adopted. Officers already on the permanent cadre of the Department must of course retain all the rights they have acquired, but we deprecate any increase of the permanent cadre, and are of opinion that the Government may well consider whether all future appointments, and not only those in excess of the numbers at present sanctioned, should not be for a term of five years only, with power reserved to the Surveyor-General to extend the term with the sanction of Government to seven years in individual cases. The new system would apply only to the first appointment of officers to the Department. As to the remuneration of officers so employed, the simplest arrangement would probably be to pay them a suitable staff salary in addition to military pay, as was done previous to 1874. It is true that the system had then to be abandoned in favour of consolidated salaries, but the difficulties that were experienced, owing chiefly to inequalities in military promotion, seem to have occurred in the higher grades of the service, and to have been due to the fact that the service was continuous and also to the existence of three distinct branches in the Survey in each of which promotion was separate and different in rate of speed. The difficulties would not be so serious in the case of officers serving for five or seven years only at a time.

We think that all officers should, before selection, have passed the Higher Standard Examination either in Hindustani or in the language of the part of the country where they are to be first employed.

It is occasionally necessary to make appointments to the Survey of civilians having special qualifications. In such cases we think that the rate of pay should be fixed in each case by agreement, as is done in the case of experts brought out from home in other Departments.

Recruitment for the Provincial Service.

101. The Provincial Service of the Survey of India, though constituted in accordance with the recommendations of the Public Service Commission, is on a different footing from other similarly named Services. Its members are not recruited for work in any particular Province, but are liable to serve in any part of India, and it is doubtless partly owing to this cause and partly to the history of the Department that the majority of the posts are reserved for Europeans or Eurasians. The former Junior Division of the Survey of India was originally recruited entirely from these classes, and only two natives had been admitted to it at the time of the Public Service Commission's enquiry in 1886. It consisted of two sections—Surveyors and Assistant Surveyors—the former drawing pay from Rs. 300 to Rs. 500, and the latter from Rs. 120 to Rs. 250, and the proposals of the Commission improved the prospects of the higher section by adding to it ten appointments taken from the Imperial Service on rates of pay rising as high as Rs. 800. At the same time both sections were treated as forming parts of one Provincial Service.

The accounts we have received of the general capacity of members of the Provincial Service to undertake independent and responsible charges are not satisfactory, but it does not appear that there has been much opportunity of trying them in such posts since the Service was reconstituted, and under existing arrangements such officers, by the time they reach the higher grades of the Service, are well advanced in years, and cannot be expected in all cases to retain the energy required for the efficient direction of topographical operations.

The Departmental Committee which reported in 1904 felt some doubt whether the number of Provincial officers could be greatly increased without a lowering of the standard of qualifications. On that point our enquiries show that there need be no apprehension. A sufficient number of candidates is likely to be forthcoming with qualifications similar to those of the men now recruited; and if the service is retained on its present footing, no substantial change in the method of recruitment is necessary. It is, however, highly advisable that steps should be taken to make the service attractive to men of a still better class, and it is indeed necessary to do this, if Provincial officers are to rise to a position of trust and responsibility at a reasonably early period of their service. The terms should be such as to attract the very best men who can be obtained in this country, and the arrangements of the service should be such as to draw a clear distinction from the start between the men who may hope for eventual employment in the higher posts, and those who cannot hope to rise beyond the subordinate classes of work on which the majority of Provincial officers are now employed. These conditions are not complied with at present. No other branch of Government service, so far as we know, in which officers can attain to so high a rate of pay as Rs. 800 per mensem, begins at so low a rate as Rs. 120, and we cannot think it advisable that officers intended for the higher duties of supervision should be required to pass through all the existing grades.

We do not propose to interfere in any way with the prospects of those who have been admitted to the service, as at present constituted, but the Provincial Service should, we think, in future be divided into two classes with separate regulations for their recruitment, the upper alone being termed the Provincial or Indian Service, and the lower forming a Junior Service. The pay of the former might begin at the rate which is customary in many other branches of Government service—Rs. 250 a month, or at least Rs. 200, and should rise to the highest rate at present allowed—Rs. 800 a month. In the latter we think that the grades might run from Rs. 80 to Rs. 400. The methods and conditions of recruitment involve many questions of detail which must, we consider, be left for the Surveyor-General to determine under the orders of Government, but we think that the following general principles should be observed, and we offer, at the end of this chapter, some suggestions as to the detailed arrangements to be made for recruitment :—

(1) The conditions and prospects of the higher branch of the service should be such as to secure to Provincial officers at the outset the same pay as is granted in other branches of Government service.

(2) Provided that candidates possess the qualifications laid down by the regulations to be made, the Surveyor-General should be

given a free hand in selecting men for employment. We do not consider a competitive examination to be necessary, nor do we think that such an examination can be relied on to furnish the men best fitted for such work as that of the Survey. Should, however, examination be resorted to as the best means of deciding between the claims of rival candidates, who have been provisionally accepted by the Surveyor-General, the decision should follow the results of the examination. In practice this is the existing procedure, but a sentence in the regulations for examination, that "the most suitable who qualify will be selected," has given rise to some misapprehension, and should, if the examination is retained, be omitted.

(3) All candidates should go through a period of probation, and should be finally admitted to the service only after being well reported on and passing a qualifying examination in survey duties.

(4) The preliminary qualifications required of candidates should be as high as is compatible with the securing of a sufficient number for the posts to be filled. The existing qualification for natives, the passing of the First Arts Examination is too low for such a service as we suggest, and the standard for Europeans should also be raised, if possible.

Employment of natives of India.

102. In regard to the larger employment of natives of India, we suggest no change in the composition of the higher Provincial service. There has not yet been time for natives to rise to the higher grades of the Provincial service, and it still remains to be seen whether the improved prospects that we propose will attract native candidates of the requisite qualifications, who are willing to accept the conditions of hard out-door service in any part of the country.

In the Junior service, however, we think that the proportion of natives who may be admitted may be increased to one-half. The reports that we have received on the men now employed in the lower grades of the Provincial service are on the whole very satisfactory, especially as regards those who have been promoted from the class of surveyors. Such men are not of a class who could be employed with confidence in the higher and more responsible posts to which members of the Provincial service may attain; but they are perfectly capable of performing efficiently the duties that will fall on such a junior service as we propose to create; and an addition to the number of natives admitted to this service would probably have a good effect on the recruitment for the Subordinate service also, which is composed entirely of natives.

Suggestions regarding future recruitment for the Provincial Service.

If our recommendations on the subject of improving the qualifications and prospects of the present Provincial or Indian service, and of constituting a separate Junior service are accepted, we would suggest that in place of the present rules—that candidates for admission must, if Europeans or Eurasians, have passed the English High School Examination and must be under 22; that natives must have passed the First Arts Examination and be under 24; and that all, when appointed, draw Rs. 120 a month at once;—revised regulations should be substituted on the following lines.

2. Appointments to the Provincial or Indian Service should be made:—

(1) in exceptional cases and subject to the approval of the Government of India, by promotion from the Junior service;

(2) by selection from candidates who have graduated (taking mathematics as a subject for their degree) or have passed as Bachelors of Engineering, or possess the Rurki engineering certificates, or other equivalent qualification. Such candidates should be under 24 years of age, should serve on probation for one year on Rs. 100 a month, and after that period, if found fit, should be placed in the Rs. 250 grade;

These two categories would apply to Europeans, Eurasians and Natives;

(3) by selection from European or Eurasian candidates who have passed the English High School examination, taking the following amongst the optional subjects in the examination:—Vernacular, Geography, Algebra, Euclid, Mensuration and Drawing. Such candidates should be between 19 and 21, should serve on probation for three years on Rs. 100, and should then be admitted, if fit, to the lowest grade on Rs. 250.

It may be objected that men of the last class with inferior educational qualifications will have some advantage over those who enter under class (2), but it would be impossible to restrict recruitment to the latter class at first. It should, however, be possible to limit recruitment under class (3), if not at once, at least in time, to candidates who have passed the English High School examination either with distinction or in the first class.

Subject to the possession by the candidate of the necessary qualifications, the arrangements for the selection of individuals should be left to the Surveyor-General. By putting himself in communication with schools and colleges the Surveyor-General would find that he had a large field to select from, and selection might be made by a comparison of school and college reports in the first instance, followed by a personal inspection of the most promising candidates.

3. Appointments to the Junior Service should be made:—

(1) by promotion of surveyors, who have done specially good service. At present such men are allowed to be promoted to the Provincial service as the only method of rewarding exceptionally good work. They have rarely, however, the educational qualifications that should be insisted on for admission to such a service;

(2) by selection from amongst—

(*a*) Europeans or Eurasians who have passed the Middle examination for European schools, and who have passed in the following optional subjects:—Vernacular, Geography, Algebra, Euclid, Mensuration and Drawing;

(*b*) by selection from natives who have passed the School Final or Entrance examination, qualifying in mathematics and such other subjects as the Surveyor-General may specify.

In both cases the candidates should be under 20, and if possible, the age should be reduced to 18. Candidates selected should serve for three years as probationers on Rs. 50 and then, if found qualified, should be given an appointment on Rs. 80. It may be necessary to give the Europeans a higher pay during the probationary period than natives, but it is advisable, if possible, to avoid such distinctions.

4. It might also be advisable to obtain from the Army on special terms a number of candidates for this service, who would be useful especially in frontier parties, and we think that this is a matter which the Surveyor-General should consider.

5. For the grading of the two services we would suggest the following rates of pay :—

(1) The Provincial Service—Rs. 250—300—350—400—500—600—700—800.

(2) The Junior Service—Rs. 80—100—150—200—250—300—350—400.

At the commencement of these services the grading must be regulated entirely by length of service, and a suitable arrangement would appear to be that three years should in each case be spent in each of the first three grades, and five years in each of the next five; promotions from grade to grade being always subject to such examination or other test as the Surveyor-General may decide on to test the proficiency of his staff.

6. The introduction of new conditions of service cannot be effected without some anomalies and complications. Europeans and Eurasians with the same qualifications as are required now will receive much better terms in the proposed new Provincial service than they do under existing rules, and others with but slightly inferior qualifications will find themselves in a less promising career in the proposed Junior service. Such difficulties are inevitable at the outset, and we do not think that in practice they need prove serious.

7. As regards the numbers, we would restrict the Provincial service to 80 appointments, apart from any required for cadastral work or other work under Local Governments, the Surveyor-General being given full power to fill up all vacancies caused by the deputation of men for such purposes. The number of posts in the Junior service would then be 85.

8. By reducing the age for European and Eurasian boys from 22 to 20 and doing away with all special examinations in survey subjects at the outset, some of the drawbacks of the present system would be avoided. It has been pointed out to us that "few boys can afford to spend more than 18 months after the schools final examination preparing for actual work. There are no colleges for Europeans in Upper India, and a boy who stays on at school does not as a rule do much good for himself when he has got beyond the school curriculum."

Dissent by Lieutenant-Colonel Longe from the scheme for the reorganisation of the Department as put forward by the Committee.

1. The number of parties is practically the same under my scheme and that proposed by the Committee.

2. The main points of difference between what I consider necessary for the proper conduct and supervision of the future work of the department, and the opinion of the Committee, are as follows :—

(1) I ask for four Superintendents of circles to supervise under the Surveyor-General the field surveying and during the recess season the mapping of four groups of parties, while the Committee recommend that the Surveyor-General should himself *directly* carry out this work, except that they supply one Superintendent to supervise the frontier work and one Inspecting Officer to assist the Surveyor-General in inspection duties alone.

(2) I wish to decentralise the present Map Record and Issue Offices by establishing four such offices in different parts of India, each dealing with the area supervised by a Superintendent, *i.e.*, one office for each of my circles.

(3) I would have but four or possibly five recess quarters for field parties, whereas the Committee recommend that each party should have its own recess quarters.

(4) I wish to have the recruitment and training of the surveyors carried out under the eye of four Superintendents, whereas the Committee would make each officer in charge of a party recruit and train his own men.

3. As regards point (1), I would submit with all respect to the Committee, that I alone of that body have had experience of survey work in India, or even of work executed in the

manner in which topographical surveys are carried out in that country, with the exception of Colonel Grant who has personally executed a certain amount of similar topographical work in South Africa and elsewhere. Sir John Farquharson may have had experience, but it has not come out in evidence. My experience, and I have been for 25 years in the Survey Department, has convinced me that up to date the supervision has been most insufficient, and that for the sake of ensuring uniformity in the quality of the field surveying as well as of the mapping which is carried out by the field parties during the recess season, constant and close supervision is necessary, and this opinion is shared by all the senior officers of the department.

I would point out that up to date there have been always three, and latterly four, inspecting officers—the Surveyor-General, the Deputy Surveyor-General, the Superintendent, Trigonometrical Surveys, the Superintendent, Forest Surveys,—each having certain parties to inspect. We are now greatly increasing the area to be surveyed each year, and are also increasing the number and strength of the field parties, but the Committee recommend that the number of inspecting officers should be reduced to two—one the Surveyor-General, and the other a special officer working as his assistant; while they recommend the appointment of a special Superintendent for Frontier surveys. I own they recommend that the Surveyor-General should be relieved of many of his present duties, which will in future be performed by the Deputy Surveyor-General, but they have not, I think, taken into sufficient account the elements of time and space, and I do not think that a system that may work well in England can work equally well in a huge country like India.

I have enumerated in my scheme the duties which the Superintendents would have to perform, and that of inspection is but one of them, and I consider that their time would be fully and most advantageously employed; and considering the area to be mapped each year, the extra expenditure involved by having four Superintendents instead of one Superintendent and one Inspecting Officer will be insignificant, while I feel convinced that their employment will prove in every way satisfactory and economical.

4. *Frontier Surveys.*—I object to the appointment of a Superintendent of Frontier Surveys, as I do not consider such an appointment necessary. The work on the frontier is urgent, and, the idea is to complete the more important areas within five years, after which some of the parties will return to their proper spheres of action in Kashmir and elsewhere. The nature of the country and inhabitants will not admit of survey work being carried out in the same methodical way as in India, and there is not the same necessity for supervision in the field, especially as there are three officers for each party.

The frontier surveys require constant references to the Foreign Department and Military Authorities, and deal with many confidential and often secret matters, and I am of opinion that the direction of such surveys should be in the hands of the Surveyor-General himself, and not of a subordinate officer who would not have the same weight with other departments. Work on the frontier is also regarded as the one prize of the department, and the nomination of officers to accompany military and other expeditions within and beyond our frontiers should rest entirely with the Surveyor-General.

I consider that any change of control in this direction would seriously weaken the position of the Surveyor-General in the eyes of the Survey of India and of other Departments, and of the public generally.

5. *Inspecting Officer.*—I do not consider that the appointment of a special Inspecting Officer will be entirely satisfactory; he will merely be able to report to the Surveyor-General cases that come under his notice during inspection and which call for orders or correction, and will not have power to decide things.

I claim for my scheme of four circles, each under a Superintendent :—

(1) That the Surveyor-General will be able to treat the whole of the topographical parties as four parties, each with a number of detachments.

(2) That he will issue his orders to four Superintendents instead of to fifteen or more officers in charge.

(3) That he will be able to see the whole work of all the topographical parties each year during recess by visiting four or five centres.

(4) That in addition he will be able to occasionally inspect parties in the field.

(5) That there will be considerable economy in having four or five recess offices instead of fifteen or more.

(6) That the concentration of parties during recess will in every way tend to efficiency and uniformity in the work.

(7) That the pay and promotion of surveyors will be better regulated.

(8) That by close association with other parties there will be a stimulus given to the work and a spirit of emulation encouraged.

(9) That the recruiting and training of the surveyors will be better carried out than if these duties are delegated to each party separately.

(10) That the personnel of the parties can be better regulated.

(11) That there will be a permanent drawing office in each circle, together with a map record and issue office, and but four depôts for the instrumental equipment of the parties instead of one for each party.

(12) That there will be an enormous saving of correspondence in the head-quarters offices which would deal with four circle officers instead of fifteen or more party officers.

(13) That any difficulties that arise, and which the officer in charge of a party cannot solve, could be at once referred by him to the Superintendent who will be always, as it were, on the spot, whereas it might take a long time to get orders direct from the Surveyor-General if he were on tour.

6. *Decentralisation of Map Records.*—With regard to point (2). At present the head-quarters offices at Calcutta contain the whole of the records and maps of the department and the number of these is enormous. If we are to make use of existing data in the preparation of our new series of maps, the records will have to be gone through and sorted by circles or parties, as the case may be, and either handed over to or copied for the officers in charge. I am of opinion that it will be better to hand them over to the officers in charge of circles who will also be in charge of the circle drawing and record and map office at which, according to my scheme, the parties will recess, and he will thus be in a position to know exactly what exists and the party or parties that should use it: he would also see that it was used to the best advantage. The maps of his circle being also stored in his office, they would be far more readily obtainable than maps are at present (Calcutta being the only map issue office), and their existence would be brought more prominently to notice: Calcutta would thus have to deal only with old maps and records no longer required for topographical purposes and with general and special maps.

This system will not involve a large staff; it will give employment to some of the senior Provincial officers, and to others attached to the topographical parties of the circle, who may not be fit for active work in the field.

7. *Recess quarters.*—As regards point (3), I would most strongly urge concentration of recess quarters for parties working in adjacent areas, even if the parties are independent of each other and not under one Superintendent. Such a concentration brings the various members together, encourages energy and rivalry amongst them, and must tend to efficiency. I am, as will have been seen already, anxious to have all the offices of a circle under one roof and one officer, because it must be economical; one small staff can then look after the whole of the possessions of the parties while the latter are in the field and any drawing work that has not been finished during recess can be continued in the same office under the permanent staff of that office, instead of each party having to make its own special arrangements to the detriment of its field work. The compilation of the smaller scale maps, preparation of charts and of the professional records, can then be properly arranged for without the breaks that occur always where such duties are left entirely to field parties, whose main object is field surveying, and the present confusion and arrears of work should not in the future occur.

The present system of housing the parties in such bungalows as may be available, most of which are unsuitable as drawing offices, will be avoided, and everything will be on a more systematic footing.

8. *Recruitment of the Imperial Branch.*—With regard to the recruitment and terms of services of officers of the Imperial Branch, I agree to the suggestions that the appointments in the first instance should be made for a period of five years only, by the end of which time, the Surveyor-General would have been able to form an opinion as to whether an officer was suitable for permanent service in the department or not. Officers themselves would also during this period be able to decide whether they would accept permanent service, if offered to them, or not. The appointments of Surveyor-General, Deputy Surveyor-General, Superintendent, Trigonometrical Surveys, and of Superintendents of Circles, would be sufficient, in my opinion, to induce officers to accept permanent service in the department which, I consider, is, in India, essential to the well-being of the department. To offer to such a large number of officers as will have to be employed, and who will have made India their home and the Survey Department their profession, but five posts of any direct responsibilities as the Committee suggest, namely, Surveyor-General, Deputy Surveyor-General, Superintendent, Trigonometrical Surveys, Superintendent, Frontier Surveys, and *one* Travelling Inspector, would not, in my opinion, attract the best class of officers to the department, and to both the two latter appointments I have already objected as unsuitable. The other staff appointments now styled Assistant Surveyor-Generals are most unpopular, and always must be, as long as the headquarters remain in Calcutta. They are not looked upon as a reward for past services, but as a necessary evil consequent on seniority.

9. *Recruitment of surveyors.*—Hitherto recruitment and training of surveyors has almost always been carried out by the officers in charge of parties themselves, but some years ago a school was started at Dehra to train the necessary surveyors, and officers were directed to state the numbers they wanted each year. The pay offered did not attract a good lot of men and the supply from the neighbourhood of Dehra was soon exhausted. The regulations did not admit of the travelling expenses to the school being paid by officers recruiting in distant parts, and consequently this attempt was abandoned. Its object was to relieve the field parties of the burden and expense of training their own men and of assimilating pay. Now that we are embarking on such an extended programme, the number of surveyors to be trained will be very great and the supply must be constant. For efficient working and for uniformity of results, the training should be systematic and continuous, and this can better be carried out by making one officer responsible for it in each group, than by making each officer in charge of a party recruit and train his own men. The class of survey to be carried out in the future is higher than any that has been done in the past, and the success of the work will depend very largely on the preliminary training of the surveyors, a duty, which I know from experience, is very troublesome and detrimental to the general work of a field party. I should ask for no extra staff for this duty, the circle officer would employ such members of the topographical parties under him as he considered advisable from time to time. He would also be able under this system to strengthen any particular party at any time without necessarily weakening another and to equalise the working power of his parties.

The 28th April 1905. F. B. LONGE, *Lieut.-Colonel, R. E.*

CHAPTER VIII.

Methods and style of publication of topographical maps.

Disadvantages of photo-zincography.

103. Turning now to the third head of our instructions, we have already noticed the incompleteness of a large number of the standard sheets, and the fragmentary nature of the patchwork surveys on which they are based. The next great defect in most of the maps is owing to the method of reproduction, namely, photo-zincography. Under this admittedly inferior method, the whole execution of the maps is rough and coarse, and sometimes, in close districts, especially where there are many heavy contours, important details, such as roads and tracts, are nearly illegible. As an example the 2″ sheet of Simla, in which it is extremely difficult to distinguish the cart-road to Kalka, may be referred to, though the scale is double that of the ordinary topographical map. For military purposes this is an important defect, and it applies also to the coarse lines indicating railways, the small etchings indicating cuttings and embankments, and in fact to nearly all the details which are important from a military point of view.

Superiority of engraving.

104. The only method by which these defects can be thoroughly remedied is by the adoption of engraving, and it has been strongly pressed on the Committee by Sir John Farquharson, that their report should contain a recommendation that this process should be resorted to, not only for the $\frac{1}{4}$″ maps for which it is at present used, but for the 1″ standard sheets.

It is right to say that, but for Sir John Farquharson's raising the subject, we should not have considered this great extension of the engravers' art to Indian maps as practicable; but he has convinced us that the matter is one deserving the most serious consideration, and we wish to call attention to his decided opinion on the subject, though we are not prepared to recommend that so great and costly a work as the engraving of the standard sheets of India should be undertaken.

Cost of engraving the standard sheets.

105. We have received estimates of the probable cost of engraving the 1″ maps in England from Colonel Grant, from the Ordnance Survey and from a private firm, which differ very largely. We need not criticise these differences, which appear to depend on the class of engraving required, especially of hill features, and the extent to which the sheets taken as specimens may be regarded as representative of the work to be done throughout the country. It is sufficient to say that the estimates vary from £460,000 to £1,300,000 for the whole of the work. Assuming that all attempts at vertical hill hachuring are given up, and that only horizontal contouring is, as in the American maps, used for the delineation of hill features, we should hesitate to place the estimate below £500,000 for the whole country, and this amount would involve for 25 years an annual expenditure of £20,000, or three lakhs of rupees.

Staff of engravers required.

106. Sir John Farquharson in his final proposals* has suggested that Burma might be excepted from the area for which engraved maps are required, and that for the rest of India the work might be executed partly in England

* *Vide* page 57, Section II in Part II of the Report.

and partly in India, where a staff of 89 engravers would be required. This estimate is however based on the rates of work of English engravers, and cannot, we fear, be accepted as applicable to the stamp of engraver who can be obtained in this country. Owing to the miscellaneous nature of the work on which most of the engravers are employed at Calcutta, we do not attach too much importance to estimates of outturn based on past experience there. But we are informed that at present only seven of the $\frac{1}{4}$″ degree sheets can be engraved in one year by the staff, which will therefore require to be considerably augmented for work on the $\frac{1}{4}$″ sheets *alone*, since the average annual number to be prepared will be about 17. As the new standard sheets will be of the same size as the degree sheets, and 280 of them will on the average be published annually, it is obvious that even after making very great allowance for the easier nature of the work on the 1″ map, no great assistance in the work can be expected in this country, unless the staff is increased to an extent that we are unable to recommend.

Heliozincography, not engraving, recommended.

107. While fully admitting, therefore, the incomparable superiority of copper-plate engraving to any other form of reproduction, we cannot recommend the Government of India to undertake the expense required to apply it universally to the standard 1″ sheets. The recently issued Burma sheets are accepted by the military authorities as sufficiently good in style for their requirements; and are, we think, adequate for all present purposes. Further improvement in execution is possible, as it appears clearly from Colonel Grant's report, and from specimens of maps which he has shown us, that heliozincography is capable of producing very much better results than are at present obtained in this country. We recommend, therefore, that the efforts of the Department be directed to improving its existing methods and to the substitution of heliozincography for photozincography, rather than to the adoption of copper-engraving on an extensive scale. The work on a great number of the sheets of India is so open and the demand for the sheets so small that we do not think the expense of engraving, however superior the results might be, would be justified.

We should be glad, however, to see exceptions made in cases where these conditions do not apply,—such as in the case of the map of Simla already referred to,—and we think that the Surveyor-General might be authorised to incur some small expenditure, say Rs. 15,000 a year, in having standard sheets, for which there is likely to be a demand, engraved. The Government of India would thus in a few years have better materials than at present for a conclusion as to whether the additional expenditure was justified.

This decision not to recommend the engraving of the 1″ standard sheets does not carry the concurrence of Sir John Farquharson, who has given the reasons for his dissent in the note appended to this chapter.

Want of uniformity in the maps.

108. Probably the next most serious defect in the 1-inch maps, which should be noticed is the entire absence of uniformity in their style of preparation, in the details shewn upon them, and in the varying absence or presence of symbols. When symbols are used they are never uniform. In this respect every successive Surveyor-General has been a law unto himself.

Necessity for uniformity in the use of symbols.

109. We are of opinion that a remedy should be applied to this defect before any of the revised 1-inch maps of India are published. We have prepared a characteristic sheet shewing those details which can in our opinion be shewn by contractions, by various kinds of type, and by conventional signs, on the maps. Those symbols which are more important, more especially those of importance to soldiers and travellers, should be inserted for reference on the bottom margin, as is done on most European maps; the rest should be shewn on a "characteristic sheet" to be printed as a separate paper, as is now done by the Survey of India. But the number of symbols shewn on the map itself should be uniform, and should not vary (as is now the practice) according to those which actually appear on the body of the map. As to boundaries, we are of opinion that the symbol should be the same throughout. It is not in our opinion material in a topographical map, although it is of importance in a cadastral map, whether a boundary following a small stream which is shewn by a single line on the map, should be drawn on one side of the stream or the other; but it is of importance that a boundary should be readily followed throughout its course from end to end of the map, and the present complicated practice of changing a boundary symbol consisting of a number of dashes and dots to a symbol of dots only, when it meets a natural feature such as a small stream, makes it impossible to follow the boundary except by the expenditure of much time and trouble. We have also found cases, one on a 2-inch map of so recent a date as 1900, where dots of exactly the same character are used to shew features so different as "contours" and the "limits of cultivation," and these small dots actually cross each other frequently on the map. We think, on the other hand, that

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Dissent by Lieutenant-Colonel Longe regarding the proposals about symbols.

Boundary Symbols.—In paragraph 109, the Committee lays down certain boundary symbols to be used on the maps in future. Owing to want of time, this point has, I think, been insufficiently considered. In India, especially on the frontier, we have boundaries which have been defined by treaty, but not demarcated, boundaries which have been demarcated but not surveyed, and boundaries which though recognised by custom are still undefined. For all these some special symbols must be used.

On a minor point, namely, that of defining a boundary along a stream, canal or road, I would urge that the present custom of showing it by dots, as now done in the Survey of India maps, be continued. In England there being topographical maps on several scales, it is immaterial whether a boundary is shown on one side or the other of a stream even though the centre of the stream is the actual boundary, as the public have another map to refer to; but in India the 1-inch map will be the standard, and there will be nothing to refer to on a larger scale except such cadastral maps as may exist; and it is, therefore, important to show on that map, the *correct* position of a boundary, if it is shown at all, and this can best be done by placing dots alternately on each bank of small streams. The Committee state that this may lead to confusion, and quote the case of a topographical map which they examined on which certain contours and the limits of cultivation were also shown by dots. Such a case should not occur in the future, for orders have been issued that the limits of cultivation should not be shown along natural features, and the contours in future will invariably be in brown, whereas the boundary dots will be black, and it has not anywhere been suggested to show contours on the topographical maps by means of dots. The use of dots to define boundaries along streams would only be employed where the width did not admit of the ordinary boundary symbols being carried down the centre of the stream. Under the circumstances, I would suggest that the whole question be left to be settled by the Surveyor-General in consultation with the Government of India.

The 28th April 1905. F. B. LONGE, *Lieut.-Colonel, R.E.*

all symbols should be thoroughly distinctive. Most of the above remarks apply also to the $\frac{1}{4}$-inch map.

From these recommendations Colonel Longe dissents for the reasons given in his note on the preceding page.

Necessity for permanency in the form of the maps.

110. We think that the top margin of the map should be reserved for the purely descriptive title of the map, and its number, which should be always on the right hand top corner. On the bottom margin should be shewn the symbols, a small index shewing the position of the map, the scale, the name of the Surveyor-General who publishes the map, but not the names of any subordinates, with the dates of survey or revision and of publication, and any short explanatory foot-notes which may be necessary. On all the margins the number of the adjoining sheets should be given. Had time permitted, we should have desired to prepare a specimen map shewing the marginal entries above described; but this is the less necessary in that our proposals on this subject cannot be considered final. We have however shown in our "characteristic sheet," how the unnecessarily elaborate marginal lines now in use might be simplified.

The form of the topographical maps of any country, once decided upon, should be permanent; we are not aware of any exception to this rule in the case of the maps of any country. We recommend, therefore, that the form of the future 1-inch maps of the Indian Survey should be fully considered and decided upon by the Government of India. We further most strongly recommend that after the form of the maps has been thus settled, no interference with that form should be afterwards allowed. As above said, all the topographical maps of every country are and should be on one uniform pattern.

Size of the map.

111. As to the size of the revised 1-inch maps of India, we are of opinion that they should be half the present size, the present map to be vertically divided into two. This will give maps approximately (within the margins) of 16 inches by 17. There are two advantages in this course. The maps will themselves be less unwieldy; and the reduced size will give much greater facilities for good registration, should the maps be colour-printed. In view of the fact that we propose that all hill features should be printed in brown from a separate plate, this last point is important.

Scales of survey and publication.

112. We have considered very carefully the question of the scales of survey and publication. It is a sound principle and one, we believe, of almost universal adoption in other countries, that the scale of survey should be at least double the scale of publication; in India also very general effect has been given to the principle. Thus all topographical maps prepared from cadastral maps are reduced from the 16″ or some larger scale, those from revenue or forest surveys from the 4″, while a considerable amount of topographical surveying has been done on the 2″ scale. In Native States generally, and also in difficult country elsewhere, the scale of both survey and publication has been the 1″, but many of the Native States surveys appear to have been made with the primary object of affording material for the $\frac{1}{4}$″ Atlas sheets; so that the general principle was not infringed in their case. The Committee have considered with care whether, with a view to save

expense, especially in publication, and to facilitate the preparation of maps by engraving instead of by inferior processes, it would not be sufficient to survey on the 1″ scale and publish on the ½″. They are unable, however, to recommend this course for the following reasons :—

(1) The accepted scale of publication is at present the 1″.

(2) For military purposes the 1″ scale is generally necessary, and the military authorities are of opinion that this is the smallest scale of use for tactical purposes.

(3) Even the 1″ scale is not large enough for all purposes. On the Frontier there is so much intricate physical detail that publication of the maps of certain areas on the 2″ scale has been asked for ; and engineers, with few exceptions, represent that the 1″ map is too small. In some cases 4″ maps have been asked for for irrigation purposes, but this request has not been pressed, and the greater part of the evidence we have received shows that for almost all special purposes a survey on the 2″ scale will be sufficient.

We recommend therefore that the ordinary scale of survey be the 2″ and the ordinary scale of publication the 1″, with the following exceptions :—

(i) Where the country is difficult, unhealthy and undeveloped, and the expense of a 2″ survey would be great, we would allow the survey to be on the 1″ scale.

(ii) Similarly, where there are few physical features to be delineated, as in the desert parts of Rajputana and Bahawalpur, a 2″ survey is unnecessary.

(iii) Where a tract comes under revision or resurvey, of which the existing maps have been published on the 1″ scale, though possibly the survey was carried out on the 2″ scale, the method of revision or resurvey must be left to the Surveyor-General, who would either use manuscript copies of the 2″ work or special prints of the resultant 1″ maps, as he considered best and most economical.

(iv) Where the survey is made on the 2″ scale, we would allow publication on that scale, (as well as on the 1″,) in any case where maps on the larger scale are required for the purposes of any department. The larger scale maps will apparently be required by irrigation and railway engineers, and are in some cases specially asked for by the military authorities.

(v) We are divided in opinion as to whether publication on the ½″ scale would not be sufficient in certain localities where there is little information to be shown in the maps, and where such information cannot be obtained without great expense. Such tracts are the desert parts of Rajputana, the outer ranges of the Himalayas, the Orissa and Chittagong hill tracts and the like. In the opinion of the President and Sir John Farquharson the ½″ scale is sufficient for giving all the information required in such parts, while Colonels Longe and Kelly are of opinion that uniformity should be preserved by the issue of 1″ sheets throughout. As the survey will be made on the 1″ scale, the question is not of great importance, so far as expense is concerned, unless it is decided to engrave the maps.

Levels.

113. As to levels, the evidence which has been given before us has been unanimous on two points: firstly, the military evidence is to the effect that on many or most of the 1-inch maps an insufficient number of altitudes has been shewn along the top of ridges or passes and along the bottom of valleys; and, secondly, the evidence of engineers is to the effect that many more of those levels which are required by them for preparing schemes for roads, railways, canals, etc., should be shewn on the 1-inch maps.

The remedy for the first defect is comparatively easy; it consists merely in an additional supply of clinometric heights by the field surveyors, and these have indeed been largely supplied already on the most recent 1-inch maps prepared by the Survey of India, such as the maps of Burma. It only remains for the Surveyor-General to see that in future such heights as are necessary for military purposes should be inserted on the maps. Clinometric heights, which are always connected with the calculated heights of the trigonometrical stations, are sufficiently accurate for those purposes.

It is otherwise with the levels which are required by engineers Some of those who gave evidence, it is true, professed to be satisfied with approximate levels, but we do not think that that opinion would be endorsed by the profession generally; and we recommend that a large extension of instrumental levelling be carried out over India during the revision of the 1-inch maps. These levels need not be of the extreme precision required for the main lines of levels which have already been extensively carried across India, but they would be sufficiently accurate for all practical purposes. The Surveyor-General estimates that one leveller with each field party could run 80 miles of levelling per month, and that this would supply from 50 to 60 linear miles of levels for each full standard sheet. We strongly recommend that he be authorised to carry out this work during the revision.

Immediate necessity of equating main circuit levels.

114. But there is a preliminary work which we think should be taken in hand at once. The Superintendent of the Trigonometrical Branch informed us that the work of distributing the errors in the main circuits which have already been levelled, is greatly in arrear. There is a great temptation to postpone this work, because it shews no results in the form of progress for annual reports. But that postponement is in its results most wasteful both of labour and money. The unequated levels on the main lines are inserted on the maps; when the levels are equated, every one of those levels will have to be re-calculated and a new level will have to be substituted. But this is not all. Every new line of secondary levelling has to start from the levels on the main circuits, and consequently any alteration in the latter has to be carried out for every level in the secondary circuits. If, for instance, we assume that our recommendation is adopted, that the field parties are to carry out such lines of secondary levelling, each party will run some 500 miles of levelling in the season; for 15 parties that will amount to about 7,000 miles annually of levelling; if the distribution of error is not carried out before the levels are inserted on the maps, then, when the errors are actually distributed, some 7,000 levels will have to be re-calculated and new levels will have to be substituted, and this labour will go on accumulating at the same rate of 7,000 additional levels every year. The labour involved is exactly the same whether the error should be 4 feet or $\frac{1}{4}$th of a foot. It will thus be seen how wasteful it is to postpone the

inevitable work of adjustment of error, and also how it not only affects the correction of the errors themselves, but also may largely render necessary the labour and inconvenience of carrying out corrections on the plans themselves. We therefore strongly recommend that the Surveyor-General of India should call upon the Superintendent of the Trigonometrical Branch for an estimate as early as possible of the cost and time likely to be required for completing the adjustment of error on the main lines of levelling carried across India, and that this work, if the necessary funds are granted, should be completed as soon as possible. As we are recommending that field parties should simultaneously, except in some of the north-western areas, begin the work of revision all over India, this question affects the whole country. No new extensive system of levelling should be carried out until the basis from which it is to start is placed on a satisfactory footing.

Preservation of stations.

115. There is another important matter in connection with triangulation and levelling to which attention must be drawn, and that is the preservation of the permanent survey marks on the ground. Orders are in force for the careful preservation of the Great Trigonometrical Survey stations, but we believe that in some parts of India these orders have not been observed, or it may be that the stations had disappeared before they were issued. In the plains of Bengal we understand there are hardly any Survey stations to be found. The importance of maintaining the stations of the Trigonometrical Survey of India need not be insisted on. But if a system of periodical revision of the topographical maps is now embarked upon, there will be a marked advantage to be gained from the preservation of as many triangulation points in hilly districts, and traverse points in the plains as possible. We have recommended that the conduct of cadastral surveys be left to Local Governments, but it is one of the first essentials of the system that they should erect and maintain every permanent mark of the triangulation or traverse survey. In cadastral districts in every four or five miles square at least one survey point should be fixed permanently, specially marked, and carefully maintained in connection with the main triangulation system of India.

Contours.

116. We have little change to propose as to contours. It is intended that they should, as in the case of the existing maps of Burma, be shewn in brown on the revised maps. We are of opinion that the present system of surveying and drawing them is sufficiently accurate for all practical purposes, and that it would be impossible, in view of the large area to be dealt with, to undertake any general system of surveying instrumental contours for the 1-inch maps. Where such contours are required in special areas for engineering purposes, it will be for the engineers to survey them for themselves, as indeed, we are informed, has already been done in various parts of India for irrigation purposes.

An inspection of some of the maps of European countries and of the United States convinces us that for maps on the 1-inch scale there is, so far as copper engraved maps are concerned, no difficulty in shewing contours at 100 feet intervals up to the greatest heights, and until the ground becomes actually precipitous, when the symbol for cliffs is used; as to whether on photo-zinco-

graphed or helio-zincographed maps it is possible on very steep slopes to satisfactorily shew them we reserve our opinion, merely remarking that on such maps as those of Simla and Darjeeling the contours overwhelm and obscure every other detail, and make the map useless for every practical purpose. On lower ground and slightly undulating slopes we recommend that, if possible, the contours should for the 1-inch map be at 50 feet intervals. There would be no practical difficulty in carrying out this recommendation on an engraved map, because the contours could be distinguished by numbering; but on a photo-zincographed map such numbering on steep ground would be practically impossible. We therefore leave both the numbering of selected contours at, say, every 500 feet, and the representation of 50 feet contours, as open questions.

For the $\frac{1}{4}$-inch map, should it turn out to be impossible to get engravers of the necessary artistic skill and in sufficient numbers to engrave the hill features by vertical hachures,—and this seems a possible, if not a probable, contingency,—the hill features will, in the case of this map also, have to be shewn by horizontal contours, and on steep ground the contours will have to be at not less intervals than about 250 feet. Whether contours or vertical hachuring is used, we recommend that for this map also the hill features should be printed in brown by preparing a separate plate.

Printing in colour.

117. We recommend that an edition of the 1-inch map should be printed in colour, more especially for military purposes, and that the colours should be black for the detail, brown for the hills, blue for the water, and burnt sienna (or lake) for the roads, those being the colours almost universally used for colour printed maps.

Village boundaries.

118. It is evident from the replies received to our series of questions that for administrative purposes a map showing village boundaries is required. Many of the officers consulted state in fact that they prefer a skeleton or index map giving the boundaries of the villages to one showing full topographical details but omitting the boundaries. Others again, and the majority of such officers are among those more accustomed perhaps to using topographical maps, consider that in a map with full topographical details village boundaries are unnecessary and only tend to obscurity. In our opinion the inclusion of such details as village boundaries in a topographical map is not only unnecessary but is indeed objectionable. Where villages are small, a 1″ map showing boundaries presents a mass of lines which represent nothing which can be found on the ground, whereas if only large villages are to be marked out, the administrative object in view is defeated. The revised 1″ topographical map should not, we think, show village boundaries.

But at the same time we consider that in order to meet administrative requirements the Survey of India should be prepared to issue another edition of the 1″ map showing village boundaries, provided that the Local Government concerned supplies the necessary material for their insertion. The cost of producing large scale maps from cadastral surveys down to the 1-inch should fall on the Local Governments, who should be at liberty to decide whether the village boundaries are to be simply surprinted on the topographical map, or only on the detail plate omitting the hill features, and so forth. It is possible that certain Provinces, *e.g.*, Madras and Mysore, which

have already their own arrangements for producing 1" maps showing these boundaries will not require any second edition of the topographical map. Where, however, such a map is required, and the materials for its compilation are supplied, its preparation should be regarded as a legitimate function of the Survey of India.

Numbering of standard sheets.

119. A proposal has been made to us by the military authorities that the standard sheets should be numbered in one series for all India, but we do not recommend its adoption. The numbering would reach an excessive figure, and we prefer to retain the present system of numbering by Provinces.

The $\frac{1}{4}$-inch or 4-mile maps of the Indian Atlas.

Commencement of the Indian Atlas in England.

120. The great work of the Indian Atlas was commenced in 1826. The labours of the topographical surveyors of the Madras Military Institute, based on Colonel Lambton's triangulation, had attracted attention as soon as the results arrived in England, and the necessity for the publication of accurate and detailed maps of India was at once acknowledged. Aaron Arrowsmith, the famous cartographer, constructed a projection for an atlas of India on the scale of four miles to an inch, and published in 1822 an atlas of South India from Cape Comorin to the Kistna in 18 sheets. The projection is a modification of the conical development; it represents the parallels of latitude by concentric arcs, and the meridians by arcs concave to the central meridian, not by straight lines as in the true conical development. On Arrowsmith's death the work of compiling and engraving the sheets of the atlas of India was entrusted by the East India Directors to their geographer John Walker, a member of a family of map engravers. Arrowsmith's projection and scale were adopted, and the first sheet of the atlas was published in 1827. The atlas was designed to occupy 177 sheets, 40 inches by 27. The size of the sheets led to delay in the compilation of the materials and the engraving of the plates It was therefore decided in 1864 to publish the atlas in quarter sheets. Up to 1868 Mr. John Walker, whose health then completely broke down, had completed the engraving of 84 of the sheets. There has always been the highest testimony to the accuracy and excellent style in which the sheets were produced.

The engraving of the Atlas transferred to India.

121. In 1869 the work of engraving the atlas was transferred to India, a carefully selected staff of English engravers having been brought out by Colonel Thuillier. During the remainder of his incumbency of the post of Surveyor-General great efforts were, as already noted, made to push on the completion of this most valuable work, and by 1877 materials for a first edition of the atlas were practically complete. The revision and republication of the sheets has been continuously persevered in since that date, as new material became available.

Errors in the scale and projection of the Atlas.

122. The meridian adopted* for the projection was that of the Madras Observatory, as then ascertained, namely, 80° 18′ 30″ E. The latest value, ascertained in 1894-96 by means of the electric telegraph, is 80° 14′ 51″, a difference of 3′ 39″. Another point which must be noticed about these atlas sheets is that the scale used by Mr. Walker was not exactly 1 inch to 4 miles, which

* The longitude hitherto adopted for the standard sheets is 80° 17′ 21″.

equals $\frac{1}{253,440}$, but a scale of $\frac{1}{255,561}$. In consequence of this the dimensions of the full copper plate, which should have been 38·31 by 24·65 inches within the border lines, were only 38·00 by 24·45 inches. This error is negligible against errors introduced by shrinkage of the paper on which the maps are printed.

The Atlas now obsolete.

123. The style and the quality of the engraving of a large number of these atlas sheets is excellent, but the older sheets are in this respect inferior. As has been said above, the earliest sheets date from 1827, and at that time the copper-plate engraving of maps had not reached the standard which it has since attained.

All the evidence which we have received tends to shew that a great deal of the detail shewn on this map of India is now obsolete, and would have to be erased from the copper-plates, while a great deal of new detail would have to be inserted on them. In the mountainous districts, like the Himalayas, and even in hilly districts, the removal of obsolete detail is likely to injure the engraving of the hill features, which has in most cases been well done. But by far the greatest defect of many of the maps is the immense number of names which have been inserted on the older sheets, and which are either now entirely unknown, or are represented by a spelling which is now superseded. This applies to many sheets both in Bengal and Madras. Nearly all the names on these sheets would have to be removed and modern names engraved. The labour and cost of the consequent erasures from the copper-plates and the insertion of the new names would probably be prohibitive, in addition to the erasure of the old detail and replacing it by the new. We have therefore been reluctantly compelled to abandon the whole of these atlas sheets. It should be added that the projection on which these $\frac{1}{4}$-inch maps have been prepared, is not suitable for the extension of the map to the extreme east and west of India in Burma and in Baluchistan.

Degree sheets.

124. It is proposed to replace the sheets of the Indian Atlas by what the Survey of India calls "degree sheets," the projection of which is the same as that of the 1-inch standard sheets. Each sheet published in standard form is bounded by 15 minutes of latitude and 30 minutes of longitude. Thus the area lying, for instance, between latitudes 30° and 31° and longitudes 73° and 74° is divided into exactly eight standard sheets. If, as we recommend, the standard sheets are reduced to half their present size, each degree sheet will cover the same area as sixteen standard sheets. There is considerable convenience in this arrangement, and in the fact that the boundary lines of the degree sheets will coincide with those of the outer standard sheets they contain. It is proposed to engrave this new map on copper, and to complete each sheet as soon as the necessary number of standard sheets have been published. The engraving of the detail will probably present little difficulty; but, as has been indicated above, it is uncertain whether a sufficient number can be obtained of the specially skilled and artistic engravers who would be required to engrave the hill features by vertical hachures, or whether it may not be necessary to shew them by horizontal contours. We are therefore obliged to reserve our opinion as to which of these methods should be adopted for completing the map.

A few of these degree sheets have already been prepared by photo-zincography for Burma; but we are not prepared to recommend that their publication by this method should be continued over the rest of India, for which we recommend that engraved maps only should be prepared, without any preliminary edition like that of the Burma maps. From this view Lieutenant-Colonel Longe and Colonel Kelly dissent, as they consider that a preliminary photo-zincographed edition should be prepared, in order to avoid the delay in publication inevitable in engraving.

The $\frac{1}{M}$ map.

125. Some years ago, the Department, in accordance with the recommendations of the Seventh International Geographical Congress of 1899, commenced the preparation of maps on the scale of 1 : 1,000,000. The Congress hoped that all civilised Governments would co-operate in the production of a map of the world on this scale. Only a few sheets have been issued up to date; and none have been completely engraved. When commencing this map the polyconical projection recommended by the Congress was not adopted, but the Surveyor-General informs us that it is desirable to revert to that projection, which is the one employed for the 1″ standard sheets and the $\frac{1}{4}$″ degree sheets. We have had some hesitation in deciding whether to recommend the continuance of this map. We think that on the whole its preparation may be sanctioned for the whole of the interior of India, where it will eventually take the place of the $\frac{1}{16}$″ Provincial maps. Maps on the latter scale have been prepared for most Provinces, and one is in hand for the Punjab which should be finished. But these $\frac{1}{16}$″ maps are now out of date, being based on the obsolete material of the atlas sheets. After finishing the Punjab map, further work on these Provincial maps should be stopped, though there is no objection to their publication in their present state, until they can be replaced by the sheets of the $\frac{1}{M}$ map. There is but little difference between the two scales 1 : 1,000,000 and 1″=16 miles. The $\frac{1}{M}$ map, which will of course be an engraved map, will fulfil all the objects at present served by the $\frac{1}{16}$″ maps.

Each sheet of the $\frac{1}{M}$ map covers sixteen degree sheets. There will thus be provided eventually a series of maps of practically the same size on the 1″ scale (standard), the $\frac{1}{4}$″ scale (degree sheets) and the $\frac{1}{M}$ scale (India and adjacent countries), the area of each being an integral multiple of the preceding map.

The Commander-in-Chief has asked for an engraved map on the $\frac{1}{16}$″ scale for strategic purposes. His wishes will be met by the publication for the present of the existing $\frac{1}{16}$″ maps. The $\frac{1}{M}$ map will gradually become the strategic map of India as materials for its production become available from the revision of the 1″ standard sheets.

General remarks.

126. We would express the hope that the above recommendations will at least obviate for the future some of the most prominent defects of some of the existing topographical maps of India, which come in some instances down to the most recent dates; such, for instance, as the anomaly that the lower slopes of the Himalayas, and the long rolling ridges of Upper Burma, both covered with dense forest, are represented on the 1-inch maps dated 1901 and 1903, of those districts, as being country of the same character as the bare country of the Sussex Downs.

Some general remarks may, in conclusion, be made as to the maps dealt with in this chapter.

The general character and the periods of origin of the two principal topographical maps of India, the $\frac{1}{4}$-inch atlas sheets and the 1-inch standard sheets, appear to us plainly to indicate that the former was always intended to be the principal topographical map of the country, and that the latter has always been treated, at least until comparatively recently, as merely a subsidiary. The former, commenced in 1826, was begun at a time when the scale of $\frac{1}{4}$-inch to a mile was, especially in the case of a large country like India, considered sufficient for all practical purposes: its general style and clearness of detail, excellence of workmanship, and the cost expended in England on its preparation, as well as its general uniformity throughout as to type, symbols, etc., as contrasted with the variety shewn in the case of the 1-inch maps, all point to the same conclusion.

The 1-inch standard sheets on the other hand, dating from so recently as 1866-67, are evidently an after-thought, suggested by the then recent introduction of the process of photo-zincography. By that time also, 40 years later than the commencement of the $\frac{1}{4}$-inch atlas, ideas as to scale had developed. The disadvantages of the process adopted were overlooked, and the quality of the map was sacrificed, to the one point of rapidity of production, although no doubt those who first superintended its preparation lived on in the hope, which has certainly not been realised, that they could ultimately by those methods get results equal to those of copper-plate engraving. The alterations of detail, symbols, etc., shown on the map, which were sanctioned by successive Surveyors-General, point to the same conclusion. They would not have dealt with the map in so varying a fashion if it had been the recognised principal topographical map of India, and not merely a subsidiary map.

Sir John Farquharson's reasons of dissent as to the Engraving of the 1-inch map.

I have, ever since a close inspection of a large number of the existing standard 1-inch maps of India, held the strongest possible opinion that the revised maps on that scale should be produced by engraving on copper; and I must therefore differ in that respect from the other Members of the Committee who decline to recommend that that course should be adopted.

The subject is mentioned in Colonel Grant's Report dated 21st February 1905, paras. 20 to 23; it was also discussed in Calcutta on the 25th February 1905,—see Colonel Grant's evidence of that date, paras. 29 to 50; and it has been further discussed in my own Statement at Calcutta of 23rd February, paras. 52 to 57, and in that made at Simla on 10th and 19th instant, paras. 61 to 74 and 86 to 91, so that I shall now confine myself mainly to summarising my reasons for dissenting from the recommendation of the Committee.

1. The other Members of the Committee agree that engraved maps are much the best maps.

2. All the best European and American topographical maps are engraved maps.

3. It is admitted that the existing 1-inch maps of India are so bad as to clearness of definition that they ought to be improved, and I understand that the Committee now propose that engraved maps of special districts should be prepared. As to this proposal (1) I am not aware of any country which publishes its principal topographical map by two methods, a superior and an inferior method; and (2) the Surveyor-General will find it difficult to justify any action he may take in giving one particular district a map greatly superior to the maps of other districts. On what principle is he to select?

4. The present maps are hopelessly bad military maps. In mountainous country it is impossible on photozincographed maps to draw the contours clearly on the steepest slopes, or to number the contours, or to devise symbols which can be used to indicate the classification

of roads by the width and thickness of the lines, or to devise any except the coarsest symbols for railways and other features. It is impossible to imagine any soldier admitting that the existing Indian Survey maps of such well-known places as Darjeeling and Simla are fit to be placed in the hands of any officer for military purposes, or that any officer would find them of the least use for moving his troops over the country. And yet it is argued that because the surrounding country is "open," its maps are not worth engraving. It is impossible to tell in what districts of India military operations may not be at some time necessary whether the nature of the country is "open" or "close." India is surely of all countries that in which its soldiers should be provided with the best kind of military map for the whole country.

5. There is no guarantee, or even much definite promise, that maps produced by the present photographic processes can be improved in India. Colonel Grant in Calcutta,—see his Report of 21st February 1905 and his evidence of 24th—25th February,—avoided giving anything like a definite opinion as to this point; and it is only on 23rd March, after his return to England, that he commits himself to the statement that "I see no reason why the work in India, with improved training of workmen and methods of reproduction, should not approximate in quality" to English work. Even that does not amount to much of a guarantee, and Colonel Grant's bias, (I do not say it is not an honest bias,, in favour of his own speciality of the Photographic or "Process" methods for producing maps, had been already sufficiently indicated by the variety of his estimates of the cost of engraving—see my statement of 10th April 1905 at Simla.

6. The existing 1-inch map has always vitiated the taste and education of the Indian official and other classes in the matter of the quality of maps, because they have never known any better ones. There was the case, for example, of an engineer giving evidence before the Committee as to the high qualities of the present 1-inch maps of India who, on being shewn an English 1-inch map, made it quite clear that he had never even seen a topographical map of his own country.

7. The President and one of the Members of the Committee have, I believe, held all through that the expense of engraving the one-inch maps would be too great to be borne by a country like India. I do not believe that India is a poor country. It is a contradiction in terms to say that a country, which has a budget and an expenditure of about 80 millions sterling a year, is a poor country. Even in the case of the very poorest classes of any country, their comfort depends upon their wants; and I believe the very poorest classes in India lead far more comfortable lives than the poorest classes in the East End of London.

8. The Committee proposes that India should expend annually £150,000 or more in revising the existing one-inch maps, but declines to recommend that a further expenditure of from one-tenth to one-seventh, namely, a maximum of from about £15,000 to £20,000 a year, should be incurred to enable her to obtain the full value of the principal expenditure. That is surely a wasteful economy.

9. It is alleged, I understand, by another Member that, as the country is so open and as there will be so few purchasers of the maps, it will "not be worth while" to go to the expense of engraving them. The following is the opinion of Dr. M. A. Stein, the traveller as to the quality of the existing maps of a neighbourhood which is certainly as "open" as any in India, and which is not likely to provide many purchasers of the maps: "On the "one hand, the photozincographic process is too coarse to permit of the insertion of the finer "details shown by the original drawing, even where the necessary space is available. On the "other, it apparently cannot do justice to such accurate hill-shading as would give a correct "representation of slopes, relative heights, &c. An illustration of these remarks is supplied, "*e.g.*, by the very inadequate way in which the steep slopes to the south of the Shahkot pass "and at the northern foot of the Landake spur in Swat appear in the copy of Trans-Frontier "Sheet No. 35 now before me. Having had an opportunity of seeing the original plane-"table sheets of the survey of this portion of Swat, as prepared with masterly skill and care "by Captain C. L. Robertson, R.E., during 1897-98, I can fully realise the loss to accurate "cartography for which the imperfect method of reproduction is here responsible."

Dr. Stein apparently thinks that, when a survey has been well made, India should even although the country is open and purchasers would be scarce, expend the additional money required for her to obtain the full value of that survey.

It will surely be lamentable if the proceedings of this laborious Committee should end in the permanent adoption for India of a kind of topographical map inferior to that of any other country.

10. It only remains that I should briefly state what course I would suggest as to carrying out the engraving of the 1-inch maps of India, and what would, in the earlier years, be the probable cost.

In my statement* of the 19th April 1905 at Simla I proposed that 89 copperplate engravers should be meantime employed on the work.

Of these I would propose that 2 European engravers, to be brought from England as Superintendents, and 28 natives should be employed in India, the latter to be recruited specially for the work, and trained either at Calcutta or elsewhere, the latter for preference, say at Dehra. They would make little progress for two or three years, even at line-engraving.

It would be inconvenient to employ more natives, because more of them would not be permanently wanted for engraving work, and discharges are inexpedient.

The Ordnance Survey should be asked to provide 10 engravers, or more if they could, the work to be done in England.

Messrs. Malby and Sons might be asked to employ the balance of 49 engravers, their work also to be done in England, or more, if they could for the first three or four years, until the native engravers should be trained.

The output of sheets from the field parties would be for the first two or three years limited. The cost of engraving would not, I believe, exceed the following amount annually, at least for the first year or two :—

	£
The Indian party, including 2 Europeans, and contingencies for office rent, etc. ...	1,468
The Ordnance Survey party, including 25 per cent. contingencies	1,755
Messrs. Malby and Sons' party, ditto ditto	7,644
TOTAL ...	10,867

So that £11,000 or £12,000 a year would probably meet the whole expenditure. Burma, as explained in my statement of 19th April, is meantime left out of account in the above estimate.

The 22nd April 1905. J. FARQUHARSON.

* Page 57, Part II of the Report.

CHAPTER IX.

Organisation of the Reproducing Offices.

Offices examined.

127. A careful examination of the following offices was made by Colonel Grant, who was specially deputed to advise the Committee on the subject of reproduction, *viz.* :—The Central Offices at Calcutta, the Madras Survey Office, the Poona Photo-Lithographic Office, the Printing Establishment at the Rurki College, and the Survey of India Office at Dehra Dun. Colonel Grant's report is submitted herewith.

Object of examination.

128. The main purpose held in view, in considering the organisation and capabilities of the various drawing and publishing offices, has been to devise measures to ensure the publication of the maps as soon as possible after the surveys on which they are based have been completed. In the past serious delays have occurred in the publication of maps, to which we have referred elsewhere.

Extra-departmental work.

129. It had been understood that the chief, or at any rate a great and preponderating, cause of such delays was the burden thrown on the reproducing offices by the mass of extra-departmental work sent in by the various Departments of the Government of India. On our visit to the Zinc and Lithographic-printing Department we were shown a number of plans and diagrams, for instance, which were being printed for the Public Works Department in the Railway Branch. These included plans of carriages and their component parts, and illustrations for a railway report, all of which had no connection whatever with the actual work of the Survey of India, and there were numerous other cases of similar work in the correspondence of a single day. Among the annexures to our report will be found three statements* showing the outturn of the Photographic and Lithographic Office for the year 1902-03 for work done for the Survey of India and for other departments; and also the outturn in each case for the last 17 years. The last of these statements shows how greatly extra-departmental work has increased in the past few years. We were at first disposed to think that all such work should at once be removed from the head-quarters office.

But Colonel Grant's report shows that the personnel and equipment of the Central Office are sufficient for the execution of all the work required at present. The present demand on the Photographic Department is about 2,000 negatives a year, and we are informed that it can easily turn out twice that number. Similarly the Zinc and Lithographic printing offices can with the existing number of machines and presses attain an annual output of from at least 1½ million to 2 millions "pulls" or impressions, while the present demand is about 1,300,000 pulls; and of these 360,000 pulls represent regular topographical map work, 177,000 pulls extra-departmental work based on maps that can be more economically produced at Calcutta than elsewhere, and 763,000 pulls extra-departmental work which could be prepared and printed elsewhere. It is, therefore, obvious that the pressure on the reproducing offices is not at present a matter of urgent moment.

From Colonel Grant's report and the evidence brought before us in the head-quarters offices, it is, however, apparent that there is considerable

* *Vide* Mr. Pope's evidence in Section III, Part II of the Report.

pressure, which should be removed, on the drawing sections of the offices. The requisitioning departments often do not know what will be the easiest and cheapest method of reproducing their maps and plans, and do not send them to the Survey Office drawn in proper form. Unnecessary work is often asked for, or a demand is made for reproduction in an unsuitable or expensive manner, by lithography, for instance, instead of by photozincography. It has apparently been the custom to attempt to comply as far as possible with such demands in the shape in which they are made. All this throws a large amount of avoidable work on the drawing establishment, whose difficulties are enhanced by the fact that the extra-departmental work is generally described as urgent, and can often only be undertaken to the detriment of the real work of the Survey. This state of affairs requires to be remedied.

Survey work the first duty of the Department.

130. We wish in the first place to emphasise the fact that the primary duty of the Survey is to see that its own work is done, and that no extra-departmental work is allowed to interfere with that. If work is sent in which cannot be executed within a reasonable time, without detriment to Survey work proper, the Surveyor-General should return it at once to the requisitioning office. If he can do so without much trouble, he might suggest to the Department concerned another reproduction office to which the work might be sent.

Drawing of extra-departmental work not a Survey duty.

131. In the next place we agree with Colonel Grant that all Departments should be required to send in all work drawn in a style suited for reproduction by photography, or such other method as may best meet the requirements of the case. It should be a *sine quâ non*, before any extra-departmental work is undertaken by the Survey, that no drawing work is thrown on its establishment. It is on all accounts desirable in the interests of economy that the expensive plant, skilled labour and superior supervision required for reproduction by photography, which are already provided in the Survey Offices, should be utilised to their full capacity, but draftsmen can be practically found or trained anywhere, and each Department can provide itself with a sufficient drawing staff at no great expense.

Sufficiency of existing reproducing offices.

132. Provided that these conditions are fulfilled, we consider that there is no immediate necessity for diverting any large quantity of the extra-departmental work to other offices. But in view of the recent large growth of this class of work, arrangements might be made to commence the diversion, which will eventually be necessary, by gradually transferring the heavy work required by the Public Works Department to Rurki.

In a few years' time, when the new topographical programme is in full working order, and the maps drawn by the fifteen Field Parties come in for reproduction, a reduction in the amount of extra-departmental work undertaken at Calcutta may be necessary. We draw attention to Colonel Grant's conclusion that there is ample plant at Poona and Rurki for the execution of all such work that is likely to be required. The Madras Survey Office already does all the work of that Presidency, but there is little room for expansion in its present buildings, and with its existing plant it cannot undertake more work.

133. We have elsewhere recommended that the Local Governments should be entirely responsible for revenue or cadastral surveys. It follows that they should also undertake the preparation and production of their own cadastral maps. In almost all the Provinces this system already practically obtains; the only cadastral maps at present being regularly reproduced at the Central Office are those of Burma. In Assam and Burma the Vandyke process is already used, and there is no reason why this simple method, which is thoroughly sufficient for the production of cadastral plans, should not be introduced in those Provinces that have at present no reproducing plant or establishment. The Bengal Drawing Office is organised on a good basis, and carries out all this class of work under the Superintendent, Provincial Surveys. In Rangoon there is a small establishment attached to the Government Press which reproduces certain administrative maps for the Burma Government. It is very advisable that the system should be extended, and that the Local Governments should become self-supporting in this respect.

Reproduction of cadastral maps.

134. We support Colonel Grant's recommendation that the Letter Press Printing section should be reduced by transferring the printing of forms to the Central Government Press. This would have the advantages of decreasing the pressure on the limited accommodation available, and of lessening the amount of supervision at present diverted from the work of map printing proper.

Letter Press Printing Section.

135. The removal of the Photogravure section to the Central Press suggested by Colonel Grant is a measure that we do not at present support. We consider that the staff and plant employed in this section, on work of which the Survey of India is justly proud, should be kept in reserve to meet the possible requirements for the reproduction of hill plates by photo-etching, should it eventually be decided to introduce that system.

Photogravure Section.

136. In chapter VIII we have given our reasons for proposing that the task of continuing to correct the existing $\frac{1}{4}$" Atlas sheets and $\frac{1}{1\frac{1}{6}}$" Provincial maps should be stopped, and that the Engraving department's energies should be concentrated on engraving the new Degree sheets and the $\frac{1}{M}$ map of India. When these new engraved plates come into use, the present practice of printing direct from the engraved plate should be given up. We consider that Government should at once take steps to provide an electro-typing plant for the preparation of matrices and duplicates to print from. The cost, as estimated by Colonel Grant, is only £2,500 (Rs. 37,500) a trifling sum compared with the importance of preserving undamaged and intact plates prepared by the costly process of engraving.

Necessity for an electro-typing plant.

137. We draw attention to Colonel Grant's remarks regarding the necessity for improved arrangements for storing the original manuscript documents—maps, plans and records of observation and calculations. It is advisable that separate fire-proof accommodation should be provided for storing these valuable documents.

Storing of original documents.

138. In the Photographic and Lithographic offices Colonel Grant observed a want of cleanliness and order, and a failure to use labour properly, and ascribed the somewhat inferior reproduction work carried out at Calcutta to the

Supervision in the Photographic and Lithographic Offices.

use of an unsuitable process of heliozincography with inferior material. Our visits to the offices confirm the impression that the management has not attained the degree of firmness and efficiency that is desirable for the systematic production of the best results.

In regard to the supervision we have, in our proposals for the organisation of the Survey of India, recommended that an assistant should be appointed to the officer in charge of the Photographic and Lithographic Office. We attach considerable importance to this proposal. It is in the first place necessary that there should be some one in training to succeed eventually the officer at present in charge of this very specialised work. In the next place there will probably be some increase in the work of the office when the new topographical maps come in for reproduction, and good management will be essential to the success of the programme. But at the same time we doubt whether there will be full work for two officers in this branch, though there will be more than one can overtake. We would therefore attach the Mathematical Instrument Office and Manufactory to their duties. This will harmonise with our plan of making the Deputy Surveyor-General and his Assistant responsible for the entire working under the Surveyor-General of the head-quarters office, a duty which they could not undertake satisfactorily in addition to the routine involved in the management of the Mathematical Instrument Office.

Subordinate staff in the Photographic and Lithographic Offices.

139. As to the subordinate staff we entirely agree with Colonel Grant in thinking that an effort should be made to work with fewer but better men. As in the case of the draftsmen and engravers, the Surveyor General should have greater freedom than he has in the matter of payment by results. An attempt should be made to introduce piece-work in the publishing offices, and the hours of labour, which are at present from 10 A. M. to 4 P. M. should be increased as far as mere printing work is concerned. There is no reason why the printers in the Photographic and Lithogaphic Office should not work under similar rules and conditions as the printers in a Government printing press. When bringing in longer hours of labour and piece-work, the officer in charge should have also power to pay for extra work done in overtime. In fact greater elasticity is required to keep work up to date and to meet sudden emergencies without entire dislocation of current work.

These remarks as to piece-work and overtime do not apply to the foremen. As Colonel Grant suggests the number of these men should be gradually reduced, steps being taken to improve the position and pay of those retained and of a very few superior men who should at once be recruited from England or the Continent. The poorly paid native workmen no doubt require more supervision than the more intelligent and better educated men employed on similar work at home. But we are inclined to think that the number of foremen on small salaries is excessive, and that the quality and quantity of the outturn would be more satisfactory under a smaller number of hard-working superintendents on substantial salaries.

Minor improvements in methods and processes.

140. There are several points of detail in Colonel Grant's report, in which he has suggested improvements in methods and processes of photography and heliozincography, the storing of negatives, zinc-plates and stones, and the provision of sundry fitments in the offices. These need not be recapitulated

here, as Colonel Grant's report is available for reference by the Surveyor-General and his assistants. One matter, however, to which we would direct the attention of Government is the necessity for utilizing the best obtainable quality of drawing and printing paper. It is poor economy to detract from the finish of the maps on which the work of the Survey is depicted by using inferior or unsuitable paper. The existing arrangements under which paper is obtained through the Indian Stores Department do not appear to be satisfactory. The Surveyor-General should be given more freedom in this matter and should be encouraged to use the very best quality of paper, irrespective of trifling variations in cost. When obtained, arrangements should be made, as far as practicable, for seasoning the paper before use.

Publication of maps from obsolete material to be stopped.

141. A small section of the Drawing Office, consisting of a retired Provincial officer and 10 draftsmen, has of recent years been employed in drawing from old material standard sheets of Bengal and Assam, which have never yet been published. Nearly all the material is quite obsolete, and our examination of the maps showed the results to be most unsatisfactory. Now that systematic revision is likely to be undertaken, we consider that all work of this nature should at once be put a stop to. The draftsmen will be required to assist in the work of the general revision, in the course of which tracts, for which maps in standard form have not been published, will be provided with up-to-date maps in their proper turn. The intermediate issue of maps based on out-of-date material is unnecessary and undesirable in view of the demands which will be made on the strength of the Drawing establishment.

Arrangements for the issue of maps.

142. The issue of maps to the public and to the officers of Government, who require to use them, is dealt with in a separate branch of the Surveyor-General's office, *viz.*:—the Map Record and Issue Office, but the subject may conveniently be mentioned here. From the evidence we have received, it appears that little or no difficulty is experienced in obtaining maps, provided they are not out of print, but there is often considerable difficulty in discovering what maps exist. The only remedy for this is the provision of up-to-date catalogues and index maps. Steps have lately been taken to publish revised catalogues, such as those of the general maps of India and of Bengal, but some of the existing provincial catalogues are nearly 20 years old, and are practically useless. The publication of new maps is notified in the various official Gazettes, but this is not sufficient to bring their issue to the notice either of the public or even of officials. Revised editions of all the catalogues should be provided as soon as possible, and at certain stated intervals addenda should be published. These catalogues should be widely distributed.

Officers of Government and others should be encouraged to apply for maps connected with their work or their charges. We do not recommend any extensive free issue of maps, which would only tend to lessen their value in the eyes of the recipients, and we think that ordinarily the Local Government or the Department, for the officers of which the maps are required, should be debited with their cost.

The main principle to be followed is the liberal issue of index maps and catalogues, and the supply of copies of all standard and degree sheets published to the Local Governments concerned and to the Quarter Master General, for distribution to subordinate officers, or for orders as to the number of copies required.

CHAPTER X.

Estimate of the expenditure required for the revision.

Preliminary.

143. The orders constituting the Committee directed that the report should include an estimate of the additional expenditure required to give effect to our proposals. Such an estimate can be given only in general terms, as we have refrained from dealing with any details that seem to us more suitable for settlement by the Government of India on the recommendation of the Surveyor-General. The main item of expenditure is the cost of the survey parties, which, if our proposals are sanctioned, will be increased both in number and in strength, and we have estimated the expenditure on this account at Rs. 1,50,000 a year for each of the 15 parties employed, or Rs. 22,50,000 in all. The cost of reproducing the maps in four colours by heliozincography, based on estimates furnished by Colonel Grant, but modified owing to our proposal that the size of the existing standard sheets should be halved, is placed at Rs. 4,30,500 for the whole of the standard sheets, the annual expenditure* thus amounting to the comparatively insignificant sum of Rs. 17,220. Further expenditure will be necessary in the engraving office to allow of the engraving of the Degree sheets and eventually of sheets on the $\frac{1}{1,000,000}$ scale, and the increases proposed in the engraving staff and in the trigonometrical branch have also to be taken account of. We deal with these below in attempting to estimate the increase in the Survey budget that will be necessary.

Present Survey grant.

144. Owing to the very confusing and complicated manner in which that budget is prepared, it is impossible to deal with this question without going into some detail. An analysis of the budget for a number of years back will be found in our Secretary's note forwarded along with the report, from which the following figures are taken.

The average allotments made by the Government of India for survey work in all its different branches during the last five years are as follows :—

	Gross estimates, average for 1900-01 to 1904-05.
	Rs.
Controlling and administrative staff	1,74,896
Head-Quarters Office	5,95,670
Survey Parties, Scientific	2,55,790
" " Topographical	9,14,546
" " Traverse	1,58,808
" " Special Surveys (towns, etc.)	48,066
" " Miscellaneous and general	79,220
" " Revenue	8,35,496
" " Forest	1,56,234
Total ...	32,18,726

* Of the 7,000 sheets 280 will be ready for reproduction in each of the 25 years of the programme, and each sheet will cost Rs. 61-8 to reproduce.

Deductions amounting to nearly half this sum are, however, made by transfer of expenditure from the Survey of India budget, to other heads in the accounts, or by recovery from Provincial Governments, other departments or local bodies for whom the work is executed. These are :—

Deductions from Survey of India accounts.

		Rs.
Recovered for revenue parties in	Burma	2,34,302
	Bengal	5,71,964
	United Provinces	4,880
	Punjab	24,350
Total Revenue		8,35,496
For forest parties in	Bombay	74,144
	Madras	82,090
Total Forest		1,56,234
$\frac{3}{10}$ths of controlling staff		52,470
$\frac{3}{10}$ths of correspondence and drawing office		55,788
Cost of cadastral maps		48,734
Extra-departmental mapping		1,490
Extra-departmental work		4,553
Instruments and maps for other departments		2,09,240
GRAND TOTAL		13,64,010

	Average for 1900-01 to 1904-05. Rs.
Revenue, Cadastral and Forest work, charged to Local Governments (detail in margin).	13,64,010
Special surveys	48,310
Recovery from Marine Department for tidal work.	1,200
Instruments supplied to revenue parties.	37,406
Frontier work for the Foreign Department.	6,000
Probable savings (deducted by Finance Department).	23,000
Total ...	14,79,926

The net average amount charged during the last five years in the Imperial budget for the Survey of India has therefore been Rs. 17,38,800.

Our proposals contemplate the diversion of the present forest survey parties to ordinary topographical work. Since the creation of the post of Superintendent, Forest Surveys, an annual expenditure of about 1½ lakhs has been allotted for forest surveys and charged in the Imperial budget against topographical surveys, but in addition to this a further average annual sum of Rs. 1,56,230 has been charged to the Governments of Madras and Bombay under the orders quoted in paragraph 67 above. This sum, if our recommendation that forest areas should be surveyed in the ordinary course of the topographical programme be accepted, will be available for topographical work, though the charge will be transferred from the provincial to the imperial head of accounts. To further simplify the budget we recommend* that the sums now charged to "Revenue" for a share of the controlling staff and the correspondence and drawing office, should be finally debited under the head "Survey of India." The total average net grant for surveys exclusive of cadastral surveys is therefore Rs. 20,03,290 as detailed in the margin.

	Rs.
Present net *India* Estimate ...	17,38,800
Additional forest survey charges	1,56,230
3-10ths of head-quarters ...	52,470
3-10ths of correspondence and drawing.	55,790
	20,03,290

145. The average annual cost of topographical, traverse and forest parties included in this amount is Rs. 12,29,588. The total annual cost of the topographical parties required to carry out the revision of the maps of India under our proposals is Rs. 22,50,000 and the increase to be provided for on this account is therefore Rs. 10,20,412. The colour printing of the new heliozincographed standard sheets will cost an additional Rs. 17,200

Additional expenditure required for topographical programme.

		Rs.
Topographical Parties		7,65,643
Forest do.	Imperial	1,84,903
	Provincial	1,56,234
Traverse do. ...		1,53,808
		12,29,588

* *Vide* paragraph 154.

per annum, making a total increase in expenditure of Rs. 10,37,600. To this has to be added the increased annual charge for officers not included in the estimate of cost of survey parties and for the engraving of the $\frac{1}{4}''$ Degree sheets.

Cost of additional officers outside the topographical parties.

146. The additional officers proposed by us, apart from those employed in the parties who are provided for in the estimate of cost of the parties, are a Superintendent of Frontier Surveys, an Inspecting Officer, two additional assistants in the Trigonometrical Branch, and two assistants at Head-quarters. We have refrained from making any recommendation as to the exact rate of salary to be given to them, but assuming that the Superintendent, Frontier Surveys, is given the same pay as the Superintendent, Trigonometrical Surveys, that the Inspecting Officer receives the same pay as the Assistant Surveyor-General in charge of the Surveyor-General's office, who is replaced by a junior officer, and that the four additional assistants receive the pay of the highest grade of Assistant Superintendents, including allowances, *viz.*, Rs. 800 each, we have the following additional expenditure against which may be set off the pay of the Superintendent, Forest Surveys:—

	Rs. per mensem.	Rs. per annum.
Superintendent, Frontier Surveys ...	1,800	21,600
Inspecting Officer, substituted for Assistant Surveyor-General		No charge.
Four Assistants ... ... (each)	800	38,400
Deduct—Superintendent, Forest Surveys ...	1,400	16,800
Net additional expenditure		43,200
Add for travelling allowance, local allowances, exchange compensation, &c.		26,800
Total		70,000

Increased expenditure in reproducing offices.

147. Colonel Grant's report shews that the Photographic and Lithographic office, which at present costs about Rs. 1,37,000, can cope with all the reproduction work it is likely to receive for some years to come, and can meet an increase in its work by diverting to other Government establishments part of the extra-departmental work it now executes. It is impossible to state what the effect of our recommendations as to the eventual introduction of piece-work will be, but to allow for improvements and for increased supervision in this office, we assume that the expenditure may rise as high as Rs. 1,50,000 a year.

The Engraving office, costing Rs. 67,500, will require strengthening to enable it to engrave the Degree sheets, but the increase will be in the actual engravers not in the more expensive foremen. We think that an additional grant of Rs. 50,000 should sufficiently provide for the extra staff required.

Non-recurring charges.

148. So far we have dealt with annually recurring charges. Provision should also be made by the Government for certain small items of immediate expenditure, such as the purchase of electro-typing plant and new lenses, the replacing of worn out zinc-plates and so forth, but such expenditure must be treated separately, as must the cost of the removal of the engraving office to

Dehra Dun, or elsewhere, should that eventually be found necessary.

149. The results of our estimates can be stated very simply—

Final result of the proposals.

	Rs.
We take the present cost of the Survey of India to be (*vide* paragraph 144)	20,03,300
The additional cost by our scheme will be—	
for topographical revision	10,20,400
for producing heliozincographed maps in colour ...	17,300
for additions to the staff of officers	70,000
for the reproducing office establishments	63,000
The total allotment for the Survey should therefore be ...	31,74,000

This sum of 31¾ lakhs per annum is not appreciably in excess of the limit of £200,000 sterling, to which, as we have several times pointed out, the Survey budget was limited in 1875 at a period of great financial pressure. When it is considered that that amount was fixed when the frontiers of the country were much more limited than at present, and when there were no expensive surveys on the present scale in Burma and Baluchistan, we think that the proposed outlay cannot be regarded as excessive; and while we feel that the data we have to rely on are in many respects insufficient, we have made our estimates on so liberal a scale that we feel some confidence, that if the Survey Department is allowed to follow out its programme without interruption, and with no additional work thrown on it, our estimates will not be exceeded.

Expenditure on surveys in Native States.

150. In concluding this part of our report we would draw attention to the fact that a large part of the proposed expenditure is on account of surveys in Native States. Their area is approximately 594,400 square miles out of the total area of 1,830,000 square miles, and nearly 270,000 square miles of this area requires a new survey. Taking the general rate of Rs. 31¼ per square mile for the production of revised maps of the Native States, the total cost will be Rs. 1,85,75,000, or Rs. 7,43,000 per annum for the 25 years of the proposed revision, while according to the lower estimate made by cost rates and given in chapter VI of the report, it amounts to Rs. 1,46,70,000 or Rs. 5,86,800 per annum. It is a matter for consideration how far Native States should be called on to contribute to this expenditure. Our enquiries, which could not however bind the States in any way, indicate that the more advanced States will not object to meeting at least a part of the expenditure, and some of them have in the past, as in the case of Mysore, contributed the whole cost. In other cases objection has been taken to bearing any part of the expense, but it would seem to be reasonable that some contribution should be made to a great imperial work, such as is in contemplation.

CHAPTER XI.

Miscellaneous.

Difficulty in ascertaining cost of survey work.

151. We have been much impressed in the course of our enquiries by the difficulty of obtaining accurate and definite information on many points on which we desired it in connection with the Survey. This has been specially the case in dealing with cost-rates of survey, and we have been obliged to make our estimates with considerable diffidence, because of the difficulty of ascertaining the actual cost-rates of work done in the past. Such rates are given in the statement* attached to Lieutenant-Colonel Longe's memorandum on reorganisation, but the variety of the work is such, that it is difficult to arrive at any decision as to the rates actually applicable to surveys on a particular scale. For much of the difficulty we have experienced, the miscellaneous character of the work done in the past is no doubt responsible: and we anticipate that if a definite programme is approved by Government, much of the confusion that at present exists will disappear, and arrangements will be made to systematise the operations throughout, and to present the results in a form more intelligible to the controlling authorities. These arrangements involve many points of detail with which the Surveyor-General must be left to deal as they arise; but there is one matter of primary importance that we wish specially to refer to.

Intricacy of the Survey of India budget.

152. The annual estimates of the Department, as at present prepared for the Government, form an extremely complicated document. They deal with a mass of figures in which expenditure on many classes of survey is included. The details are then manipulated by a complicated process of deductions and adjustments, some portions of the expenditure are transferred to the Imperial account under other heads of the annual estimates; other portions are charged in the accounts of Provincial Governments. In some cases anticipated receipts are deducted before the final charge is entered in the estimates.

Necessity for better financial control.

153. We are not sufficiently acquainted with the procedure followed in drawing up the estimates of the Government of India, to feel justified in making definite recommendations on so technical a matter as the manner in which the budget of the Department can best be presented, so as to meet the purposes of the Financial Department. But we are strongly of opinion that better arrangements for financial control are necessary than at present exist, and that the first step required in this direction is the presentation of the estimates in a more intelligible form. That the Surveyor-General himself finds it difficult to maintain the necessary control would appear from the fact that, according to the best examination we can make of estimates and actuals, the expenditure during the five years 1898-99 to 1902-03 was on an average below the budget allotment of the year by over a lakh of rupees. It is not satisfactory that lapses of grants to this extent should be possible.

Simplification of the budget.

154. The form of the budget can, we think, be improved in two directions :—

(1) by simplifying, and as far as possible, doing away with the adjustments and deductions to which reference has been made;

* *Vide* page 122.

(2) by showing clearly and under separate heads the estimates for each different section of the work of the Department. At present, for example, in order to ascertain the estimates for trigonometrical and scientific surveys, it is necessary to look in one part of the budget for the pay of the Superintendent, in another for the charges of his office, and in a third for the cost of the parties employed on trigonometrical and scientific work.

The deductions and adjustments made in the estimates may have some connection with the orders regarding the charges to be taken against the grant (20 lakhs) to which the Department was limited in Lord Northbrook's time, but that limit, as we have shown, is now obsolete, and we can discover no reason for the continuance of the existing complications.

We fail, for example, to see why $\frac{3}{10}$ths of the charges of the controlling staff and of the correspondence and drawing officesshould be deducted from the Survey budget and transferred to the head " Land Revenue—Survey "—also an Imperial head of account. If the amount is an Imperial charge at all, the most convenient place to charge it off finally appears to be the budget of the Survey Department. There are many minor adjustments and details in the estimates, the correct arrangement of which would require to be settled by a trained officer of the Accounts Department, more especially as regards the manner in which the charges of the Mathematical Instrument Office are dealt with. We think it would be very advisable to show the accounts of that office entirely outside the Survey budget. It is not maintained for the Survey Department alone, and there appears to be no reason why it should not deal with the Survey in the same way as it does with other Departments, charging the Department the cost of all instruments supplied, or repairs effected, and making an allowance on instruments returned to store.

Suggestions for the arrangement of the budget.

155. To give effect to our suggestions the Survey Estimates, as contained in " Detailed Account No. 26-A., Survey of India " in Volume I of the Civil Estimates, would be arranged under some such heads as the following :—

Head-quarters of Department.

Controlling and Administrative Staff ... ...

(Omit Superintendents of Trigonometrical Surveys, and of Frontier Surveys). ...

Head-quarters Offices.

Correspondence and Drawing... ... ...

Photographic and Lithographic ... ...

Engraving ... ...

Total Head-quarters Offices ... ...

Trigonometrical Surveys.

Administrative Staff	...	...	...	...	...
Trigonometrical Office, Dehra Dun		...	...	...	...
Survey Parties No. (*a*)		...	...	...	...
No. (*b*)		...	...	...	...
etc., etc.		...	...	...	...
Total Trigonometrical Surveys				...	...

Topographical Surveys (other than Frontier).

Administrative Staff	...	...	...	...	...
Survey Parties No. (*c*)	...	...	...	...	...
No. (*d*)	...	...	...	...	...
No. (*e*)	...	...	...	...	...
etc., etc.	...	...	...	...	...
Total Topographical Surveys					...

Frontier Surveys.

Administrative Staff	...	...	...	...	...
Frontier Drawing Office	...	...	...	...	...
Survey Parties No. (*f*)	...	...	...	...	...
No. (*g*)	...	...	...	...	...
No. (*h*)	...	...	...	...	...
etc., etc.	...	...	...	...	...
Total Frontier Surveys				...	...

(Forest Surveys to be similarly dealt with, if charged to *India*. If existing arrangements continue, it would be necessary to deduct $\frac{7}{10}$ths of the charge, and show it in the Forest Estimates.)

Miscellaneous	...	...	...	...	...
Total Survey of India	...	...	...	...	...

No provision is made in these heads for cadastral surveys, as all such charges are finally and rightly shown under a different head in the estimates. If it is necessary to add them in the Survey of India estimates merely to deduct them again, we would suggest that they might be shown in italics at the end of the Survey estimates proper.

We think that a re-arrangement of the estimates on some such lines as are proposed above would render them much more intelligible, to the great benefit of all concerned, and we hope that it may be possible for the authorities dealing with the accounts to give effect to our proposals.

Standards of work.

156. We have been asked to report whether any standards of work have been fixed and whether it is possible to fix them, varying as they must do in different kinds of country, and whether there is any systematic method of comparing the outturn and quality of work and the cost of different parties. On the first point we have received replies from all officers in charge of parties, from which it would appear that the adoption of such a standard is generally considered impracticable in topographical work, owing to the varying degrees of difficulty of the work. A standard fixed in area appears to be generally regarded as likely to mislead; some officers have told us that they prefer to judge the outturn of their surveyors' work by the number of plane-table fixings rather than by area; others combine these two standards. In cadastral parties there are definite standards of work, and the surveyors are paid strictly according to their outturn. It appears to be the case also that though no regular system is followed in topographical parties, still the officer in charge forms a mental standard of the outturn which his surveyors should work up to in different classes of ground, and on this, amongst other matters, he bases his recommendations as to their pay.

We think that an endeavour should be made to introduce a more systematic method of appraising the work of each surveyor. Appended to Sir John Farquharson's statement in Part II (Section II) of the Report will be found specimens of the progress returns submitted to the Ordnance Survey in England, from one of which it will be seen that the cost of surveying each acre is returned, as well as the cost "reduced to medium." Though this return refers to cadastral work, we think that the same principle might be extended to the work of topographical parties. A square mile of work completed by one surveyor may be equivalent to two square miles done by another, owing to the greater difficulty of the country; but we cannot think it impossible to allow for such differences, and we consider that in each party an endeavour should be made to estimate the average cost or the average time required to survey a square mile of medium country, and to appraise the work of each surveyor accordingly. The standards would vary from party to party, and would themselves afford a means of comparing the cost of work in different parties, as the Surveyor-General, from his general knowledge of the country in which each party was working, would be able to judge whether any difference in the standards was sufficiently accounted for by differences in the conditions of work. We fully agree with the remarks made by Sir John Farquharson on this subject.

Maps to be produced by the Survey of India.

157. Another point to which we attach importance is the laying down definitely of the maps for the production of which the Survey Department is to be responsible. It is a matter we think for the decision of Government whether any particular class of map is required, and it should not be left to the Department itself, and still less to other branches of the administration to decide on the preparation of some particular class of map on the ground that it will meet some public convenience. We have no doubt that all the maps produced are of great use, especially in a country where there is no private enterprise in map-making, but unless some check is applied, the energy of the Department is liable to be diverted from its most urgent work—work which will in future give it full employment.

Owing to the number of general maps which the Survey has in stock, and which are engraved or on stone, we find it difficult to make definite recommendations. When a map has already been prepared either on copper or on stone, we do not suggest its discontinuance, but we think that no further work should be undertaken in keeping such maps up to date except under the special orders of Government.

We assume also that the Government or the military authorities will give special orders as to any trans-frontier or confidential maps that they may require.

The maps that should, we think, be regarded as the primary duty of the Department to publish and to issue fresh editions of, as fresh surveys are made, are the following :—

Standard sheets—

(1) On the 2″ scale, if surveys are made on that scale and publication on that scale is required in the public service.

(2) On the 1″ scale in ordinary course.

(3) On the 1″ scale with village boundaries added, if the necessary material on that scale is supplied by the Local Government concerned.

Reductions from the standard sheets —

(4) On the $\frac{1}{4}$″ scale—Degree sheets for the whole of India (engraved).

(5) On the $\frac{1}{8}$″ scale—Skeleton district maps (engraved).

(6) On the $\frac{1}{1,000,000}$ scale—Map of India (engraved).

General maps of India—

Maps on the following scales should suffice for all ordinary purposes :—

(7) 1″=32 miles

(8) 1″=64 miles

(9) 1″=80 miles (general railway map).

(10) 1″=96 miles

(11) 1″=192 miles.

(12) 1″=256 miles

We have omitted district maps from the above list. Such maps are, as a rule, either on the $\frac{1}{4}$″ or the $\frac{1}{2}$″ scale, and there is considerable difference of opinion as to which is the more useful. For $\frac{1}{4}$″ maps the Degree sheets suffice, and as most officers, who have expressed an opinion on the subject, desire to have maps that show the country outside the border of the district concerned, we do not think it necessary for the Department to undertake the compilation of a special map, showing the country inside the district border only.

As regards $\frac{1}{2}$″ maps, these are prepared already locally in many Provinces, and we think that Local Governments should continue to make their own arrangements for the issue of such maps. Their preparation for the whole of India would be a considerable addition to the work of the Department, and it often happens that Local Governments desire information of some administrative use to be shown on the maps, or changes inserted, which are not in the Survey maps. We think that work of this description can best be decentralised.

158. We think (Sir John Farquharson dissenting) that it would be advisable in order to bring the Survey of India into closer touch with the departments of the public service most interested in its work, and to strengthen it in resisting pressure from special departments or from local authorities to undertake work outside its programme, that the annual programme should be discussed with a Committee or Board, as is done in France, and as is already done in this country in the case of other Scientific Departments, the reports and programmes of which are discussed by the Board of Scientific Advice. We think that this procedure would be much superior to that now in force, under which the Surveyor-General merely submits his annual programme to one Department of the Government of India, by which the opinions of other Departments are collected, and orders giving effect to them are issued. It would allow the Surveyor-General the opportunity of explaining with more fulness, than is possible in written reports and proposals, the extent to which the survey was proceeding in accordance with the general programme that may be decided on by the Government of India on consideration of our report; it would allow of his showing whether the cost was in excess of the general estimates we have made; and it would afford an occasion for discussing any changes which altered conditions may necessitate in a programme extending over a period of 25 years. He would at the same time be able to make any representation that he considered necessary as to whether local surveys, not under his control, were being conducted in the best manner for utilization in topographical work. In France we are informed that the Committee, which consists of 20 members representing the various State Departments concerned, serves to connect the different departments which have geographical and topographical sections, and to centralise the work so as to prevent reduplication. It reviews all under-

Proposed Committee to discuss the annual programme.

Reasons for dissent as to the Committee's proposal for a Council to be assembled, as is done in France, to discuss the annual programme of the Indian Survey.

The following are my reasons for dissenting from the above proposal:—

1. There is no analogy between the conditions in France, and those which hold good in India. It is well known that various Departments in France are empowered to prepare their own maps and that there does not exist there a Department which prepares maps for the whole country. Thus the War Office (L'Etat-Major) prepares its own maps (the "staff map"), the Minister of Interior prepares his own map (Carte Vicinale), and the Department des Ponts et Chaussees prepares its own maps, and so on with other departments. The result is that the French Council is a necessity, to prevent over-lapping. No such necessity exists in India, where the only map-maker is the Surveyor-General. The Committee therefore proposes to borrow from France an institution for India, the conditions in which country are exactly the reverse of the conditions in France.

2. I think the proposed Council would be mischievous. Either it is to have power or not to have power. If the latter, it would be a useless form; but it is clear that it must have power, and that power could only be used to interfere with the Surveyor-General in the execution of his work. In this the Committee is surely inconsistent. Its recommendations have been drawn up throughout so as to prevent interference with the Surveyor-General by Local Governments, and it now ends by proposing that every facility should be given for interference with him to representatives from no less than six departments, of which none except his own departmental chief, and possibly the Finance Department, should have any power of interference whatever. It is surely most manifest that the only chance of the work of revision being carried out energetically, and without interruption and diversion to other objects, is that no one except the Government of India should have power to give orders to the Surveyor-General: it is now proposed that five other officials, besides his own depart-

takings which necessitate the execution of surveys and maps at Government expense, decides on their value and urgency, and studies the best methods of reproduction and of keeping maps up to date. Though there are comparatively few surveys in India at present independent of the Survey of India, we think that a Board on the French lines would none the less prove of great advantage, not only to the Survey Department but also to the Government of India, and we strongly recommend its adoption. It should, we would suggest, be composed of the Surveyor-General and of representatives of the Revenue, Commerce, Foreign, Military, Public Works and Finance Departments of the Government of India, and of Army Head-quarters. Unless there were any special business to be brought forward, the Committee or Board need not meet more than once a year, to hear from the Surveyor-General an account of the progress made in carrying out the programme for the past twelve months, and to consider the programme for the ensuing year.

Removal of the head-quarters offices from Calcutta.

159. Amongst the questions referred to us is the advisability of moving the Survey Head-quarters offices from Calcutta to Dehra Dun. From the enquiries we have made we are satisfied that the transfer of the offices is feasible, but we are not prepared to recommend that any such measure should be taken at present. The site on which the offices now stand in Calcutta, which was purchased in 1873 for a little over a lakh of rupees, is now valued at four lakhs (Rs. 3,99,582). The Municipal valuation of the buildings is almost exactly 7½ lakhs of rupees, and is accepted as fair by the Superintending Engineer, though it is impossible to say what the buildings would fetch if sold. We gather from a letter that we have received from the Government of Bengal, that it would probably be unnecessary to sell them, as further accommodation

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mental chief of the Revenue and Agricultural Department should have every inducement to upset all his arrangements, if the interests of their own departments would be thereby advanced.

3. The President mentions the necessity of discussing a "programme" every year. The "programme" of the Survey of India will have to be fixed for 25 years. Presumably, before revision is begun, the Surveyor-General will have to furnish to the Revenue and Agricultural Department, for the Government of India, and for the Finance Department, estimates of the annual cost of the work, of the annual strength to be employed, and of the annual rates of progress to be anticipated, all put into the shape of a "forecast" for each year during which the work will be proceeding, say from 1906 to 1931; at least I have never known a work of this kind being undertaken without such estimates and forecast being first furnished to the Government. Further, he will presumably have to furnish annually to the Revenue and Agricultural Department and to the Finance Department returns showing the expenditure on revision during the past year, the progress in square miles during the year, the amount of work remaining to be done, and the amount of money still remaining available. Why under such conditions, and under so close a check on his progress and expenditure, he should be required to furnish "programmes" and to consult four other departments on those subjects every year, it is surely difficult to see, and no less difficult to see why that representative of the Indian Government to whom alone he is accountable, namely, the head of the Revenue and Agricultural Department, should be liable to have his authority interfered with by the four or five other members of this proposed council. Any changes that might become necessary during the progress of the revision should be solely the concern of the Government of India.

The 22nd April 1905. J. FARQUHARSON.

is required for Government offices in Calcutta, and we may therefore adopt the valuation given to us as fairly representing the value of the buildings to Government, though probably much in excess of their value for purposes of sale. The cost of erecting similar buildings at Dehra Dun has been roughly estimated for us by the Government of the United Provinces, to whom a plan of the offices was furnished, at $6\frac{3}{4}$ lakhs of rupees, including the purchase of a site. We think that a larger outlay would probably be found to be necessary, but the difference between $11\frac{1}{2}$ lakhs and $6\frac{3}{4}$ lakhs leaves a considerable margin for under-estimating, as well as for the actual expenses of transfer, and for the building of additional house accommodation, if necessary. At Dehra Dun there are only two sites in the limits of the present civil station, where the buildings could be located, and we are informed that there is a considerable demand for land for building purposes, and that these sites may not long be available. We should recommend, however, if it is decided to move the offices, that the question of locating them to the north of Dehra Dun along the road to Rajpur should be considered. There is ample ground available here, at a somewhat higher level than Dehra Dun itself; and an excellent site for large offices with houses for the officers and quarters for the employés could easily be selected. One of the difficulties of the move to Dehra Dun is the limited water-supply, but we are informed by the Superintendent of the Dun that a large supply is now being arranged for, and that there is no reason why further extensions should not be made in future, if required. Whether the move is made to Dehra or to the site beyond, it will be necessary to provide houses for the officers of the Imperial Service attached to head-quarters, as house accommodation of the class required is at present limited in Dehra.

We fully recognise the advantages of locating the Survey head-quarters in a better climate and in a cheaper neighbourhood than Calcutta, but there seem to us to be grave objections to abandoning the buildings, specially built and well adapted for the Survey Department, at a time when a considerable extension of the survey programme is in contemplation. To transfer the office must mean some years of disorganisation, while the new buildings are being erected and a new staff of workmen is being collected and trained at Dehra. The arrangements for the publication of the maps would probably be thrown for some considerable time out of gear; and we advise that the question of making any transfer be dropped altogether, until at least all other arrangements for carrying out the new programme, if it is agreed to, have been got into thorough working order. The Surveyor General and his officers will have sufficient work on their hands in organising the Department for its extended programme, without the additional labour and confusion which the movement of the offices would involve. Should the increase of work make it necessary to provide more room in Calcutta, we think that the best plan would be to transfer the Engraving and Drawing offices, the removal of which would not disorganise the remainder of the establishment.

JOHN O. MILLER.

JOHN FARQUHARSON, *Col., R.E. (retired).*

F. B. LONGE, *Lieut.-Col., R.E.*

F. H. KELLY, *Col., A.A.G., IV Division.*

SIMLA;
The 25th April 1905.

Summary of recommendations.

The following summary of the main recommendations of the Committee is added by order of the President:—

(1) The preparation of a modern 1-inch map of India should at once be undertaken. Paras. 79-83.

(2) This work should be regarded as the most important now before the Department. Para. 91.

(3) The direction of operations should be strictly Imperial, and local authorities should not be allowed to intervene. Para. 90.

(4) The Surveyor-General himself should directly control the operations with the staff proposed in the report. Para. 91.

(5) The operations should be conducted on the lines laid down in Sir John Farquharson's scheme printed as Appendix B to the report. Para. 93.

(6) The whole of India should be divided into tracts, each of which should be allotted to a Survey party, for which a definite programme should be laid down, that should not be departed from without grave reason, and then only under the orders of the Government of India. The number of topographical parties should be fifteen. Paras. 93 and 84.

(7) The departmental programme should extend to the whole of India and 25 years should be allowed for its completion. Paras. 85-86.

(8) Special arrangements should be made for the completion of the work required near the North-West Frontier within a period of 4 to 6 years. Para. 86.

(9) In the course of the 25 years' programme all topographical maps should be brought up to date. There should be no further correction (except for the addition of new railways and canals) until the next systematic revision of the maps of India is undertaken. Para. 87.

(10) Cadastral and other large scale surveys should be left entirely under the control of Provincial Governments and Local Authorities, and should be conducted at their expense, but should be based on a scientific skeleton or traverse. Paras. 62-66 and 71.

(11) Special forest surveys should cease as a general rule, and, where required on scales larger than the regular topographical ones, their cost should be debited to the Forest Department. Para. 70.

(12) For mapping purposes the most important classes of work in the Trigonometrical Branch are triangulation and levelling, and to these the mere purely scientific work of this Branch should give way, if there is any difficulty about sufficiently increasing the staff. Para. 95.

(13) The question of handing over tidal work to the local authorities concerned should be considered. Para. 95.

Para. 157. (14) The Government of India should prescribe the general and special maps which it is to be the duty of the Survey of India to produce.

Para. 110. (15) The form of the topographical maps should be permanent.

Para. 111. (16) The standard sheets of the 1-inch map should be reduced to half their present size.

Para. 112. (17) The scale of survey should, as a general rule, be at least double the scale of publication, and the latter should ordinarily be not less than 1-inch=1 mile.

Paras. 109 and 133. (18) The symbols used on the maps should be uniform throughout, and the modern spelling of names should be adopted.

Paras. 113 and 114. (19) The number of trigonometrical and clinometrical heights and levels, shown on the maps should be largely increased; but first all the main lines of levels should be equated.

Para. 116. (20) The vertical interval between contours is a matter requiring attention.

Para 117. (21) The 1-inch map should be printed in four colours, black for the detail, brown for the hills, blue for water, and burnt sienna (or lake) for the roads.

Para. 83. (22) The topographical maps issued by the Survey of India should contain only information verified by its staff.

Para. 118. (23) Village boundaries should not be shown on the ordinary topographical map.

Para. 157. (24) An edition of the 1-inch map may be prepared showing village boundaries under certain conditions.

Para. 107. (25) For the production of the 1-inch map an improved process of heliozincography should be employed, a few selected standard sheets being engraved on copper.

Paras. 123 and 124. (26) The Atlas of India sheets should now be superseded by "Degree" sheets on the $\frac{1}{4}°$ scale, which should be engraved on copper.

Para. 125. (27) In place of the $\frac{1}{16}°$ Provincial maps a general map of India on the scale of 1 : 1,000,000 should be prepared and engraved.

Para. 91. (28) To leave the Surveyor-General free for the supervision and control of the operations, the Deputy Surveyor-General should deal in the first instance with the business of all kinds of the Survey Office, and should dispose of all matters of routine. He should be allowed an Assistant, and the post of Assistant Surveyor-General in charge of the office will then be unnecessary.

Para 92. (29) To assist him in inspecting the field parties the Surveyor-General should be allowed an inspecting officer.

Para. 91. (30) Surveys towards or beyond the frontier should be treated specially, and be placed directly under a Superintendent of Frontier Surveys occupying a position similar to that of the Superintendent of Trigonometrical Surveys.

(31) Owing to the abolition of special forest surveys, the post of Superintendent of Forest Surveys should lapse. Para. 146.

(32) The Trigonometrical Branch should be strengthened by two officers to assist in triangulation and levelling. Para. 95.

(33) The strength of the field parties should be increased by 50 per cent. Para. 93.

(34) There should be two officers, one in charge, the other his assistant, with each ordinary topographical party. Para. 96.

(35) With the frontier parties there should be three officers, one in charge, and two assistants to allow for special calls. Para. 97.

(36) To meet these proposals the staff of the Imperial Service for topographical and trigonometrical work should be increased from 40 to 70 officers. Para. 98.

(37) First appointments of officers of the Army to the Imperial Service should be for a term of five years only and a language test should be imposed. Para. 100.

(38) The Provincial Service should be divided into two Services, a Provincial or Indian Service, and a Junior Service; the pay of the former to range from Rs. 250 to Rs. 800, and that of the latter from Rs. 80 to Rs. 400; and some modifications in the system of recruiting should be introduced. Para. 101.

(39) Natives of India should continue to be employed in the Provincial and Junior Services in the proportions stated. Para. 102.

(40) Officers in charge of parties should have a free hand to enlist surveyors, and parties should recess in the neighbourhood of their charges. Paras. 44 and 93.

(41) Imperial and Provincial officers employed on cadastral or similar work should be treated as temporarily outside the regular cadre, and the Surveyor-General should be authorised to employ other officers in place of those so deputed. Para. 63.

(42) The supervision in the Photographic and Lithographic Office should be strengthened by the appointment of an additional officer as assistant to the officer in charge. The superintendence of the Mathematical Instrument Office should be placed under these two officers. Para 138.

(43) The first duty of the reproducing offices should be the production of the maps of the Survey of India. Para. 130.

(44) No drawing of extra-departmental work should be permitted to be thrown on the Survey of India office. Para. 131.

(45) Local Governments should reproduce their own cadastral maps. Para. 133.

(46) As the reproduction of the revised topographical maps throws more work on the headquarters office, arrangements should be made to gradually transfer extra-departmental work to other Government mapping offices. Para 132.

Paras. 134-140. (47) Certain improvements should be introduced in the methods, working, establishment and plant of the reproduction offices.

Para. 141. (48) Seeing that the general revision of the topographical map of India is being commenced, the publication of maps compiled from obsolete material should cease.

Para. 142. (49) To facilitate the supply of maps to the public and to officials, up-to-date catalogues and index maps should be freely issued.

Paras. 151-155. (50) The form of the Survey budget should be simplified, and better financial control instituted within the Department.

Para. 156. (51) An attempt should be made to devise more definite standards of work in order to check outturn and cost.

Para. 158. (52) The annual programme should be discussed with the Surveyor-General by a Board or Committee representing the different departments of the Government of India.

Para. 159. (53) The proposed removal of the headquarters from Calcutta should be postponed for the present.

Para. 115. (54) Greater attention should be paid to the preservation of all permanently marked survey points.

C. A. BARRON,

Secretary.

Appendix A.

LIEUTENANT-COLONEL LONGE'S REORGANISATION SCHEME WITH AN EXPLANATION OF THE DUTIES OF THE HIGHER STAFF OFFICERS.

Present organisation.

The Survey of India is composed at present of—

1. The Imperial Service.
2. The Provincial Service.
3. The Subordinate Service.
4. The Menials.

Appointments.

2. *The Imperial Service.*—The Imperial officers are recruited from the Royal Engineers, the Indian Army and in special cases by direct appointment by the Secretary of State. But at the present time there are in this branch two officers who were transferred from the Bombay Survey Department on its reduction, one officer transferred from the Forest Department, and one officer transferred from the Madras Survey Department for special employment as assistant to the officer in charge of the Photographic and Lithographic Office, and he has for some years been in charge of that office.

Royal Engineer officers are eligible for appointment after their arrival in India, provided they have less than five years' service in the Corps, and are not senior to any Royal Engineer officer already appointed.

Indian Army officers are eligible after final admission to the Indian Army. and are appointed on probation for one year, at the end of which time they must pass a departmental examination before they are finally admitted to the Department.

There are no rules regarding the appointment of other officers.

Royal Engineer officers can revert to military duty at any time.

Indian Army officers cannot revert to military duty after 10 years in the Department.

3. *The Provincial Service.*—The Provincial service is recruited by examination in India. The examination is conducted by the Survey of India. Candidates receive permission to sit for the examinations (which are held simultaneously at centres convenient to the candidates) from the Surveyor-General. There are definite educational qualifications laid down, and no application for a nomination is entertained unless these are fulfilled. All candidates must be statutory natives of India, but the appointments are also open to pure natives in the proportion of one native to every three Europeans or Eurasians. The examination is not strictly competitive, but the appointments are almost invariably given to those who qualify, in order of seniority, *i.e.*, in accordance with the marks obtained: the Surveyor-General, however, has the right to select from those qualified, such as he considers for other than actual book knowledge, are likely to prove the more valuable officers.

All provincial officers are appointed on probation in the first instance, and none are permanently appointed until they have been one year in a field party or similar position, and have been well reported on by their immediate superiors.

4. *The Subordinate Service.*—The Subordinate service is purely native, and is not a fixed establishment as the Imperial and Provincial services are. It consists of men who have been as a rule recruited, under the orders of the Surveyor-General, by officers in charge of parties and trained by them as sub-surveyors, computers, etc. There is no fixed rate of pay for such men, but it is recognised that Rs. 100 per mensem is the maximum; they are all brought on as temporary hands in the first instance, but after some years, if they prove themselves worthy, they are made permanent.

5. *Menials.*—The same rules apply to the menial servants in a modified way. Such men may be made permanent, but most of them only serve for six months per annum. This is a great economy to Government, and the latter recognises it, and allows the whole of their service, if unbroken, whether on duty or on departmental or recess leave, as it is called, to count towards pension, and they can be at any time made permanent by the Surveyor-General.

6. *Present establishment of the Imperial Service.*—The Imperial Service consists of—

	1	Surveyor-General.		
	1	Deputy Surveyor General.		
	3	Superintendents,	1st grade.	
	7	„	2nd „	
	9	Deputy „	1st „	
(A)	9	„ „	2nd „	} but of these appointments 3 cannot be filled, being transferred to the Provincial Service and called Pilot appointments.
	8	Asst. „	1st „	
*	7	„ „	2nd „	

* Eventually there will be 8 in the 2nd grade, but pending the absorption of the Pilot appointments at (A) above, only 7 posts can be filled.

By the Civil Service Regulations 20 per cent. of these officers may be on furlough at one time, and by the Military Regulations, Royal Engineer officers are liable to be ordered to Chatham and military duties extending over one complete year, once in their service as Captains or Majors. They are also entitled to three months' special leave in each rank to study for their promotion examinations.

At the present moment, *i.e.*, at the close of the field season, there will be—

	1	Superintendent,	1st grade,	on leave.
	2	Superintendents,	2nd „ „	„
	1	Deputy Supdt.,	1st „ „	„
	1	„ „	1st „	at Chatham.
	1	„ „	2nd „ „	„
	3	Assistant Supdts.,	1st „	on leave.
Total	9			

And in point of numbers we may take it that 8 to 10 officers of the Imperial Service will always be absent out of the total number at present of 42 officers, and under the reorganisation, which is not yet complete of 40 Imperial officers, as the orders are to reduce the strength by—

1	Superintendent,	2nd grade.	
2	Deputy Superintendents,	1st grade.	
2	„ „	2nd „	
3	Assistant „	1st „	
2	„ „	2nd „	
10			

7. There will be therefore in the Department available for duty on the 1st June but 33 officers, who will be distributed as follows:—

	1	Surveyor-General.		
	1	Deputy Surveyor-General.		
	1	Superintendent,	Trigonometrical Surveys.	
	1	„	Forest Surveys.	
	1	„	Provincial Surveys, Bengal.	
	1	„	„ „ United Provinces.	
	3	Assistant Surveyor-Generals.		
	1	Officer in charge, Computing and Reproducing office, Debra.		
Total	10			

Topographical	1	officer in charge	No.	1	Party.	
„	1	„ „	„	2	„	
„	2	„ with	„	2	„	under instruction.
„	1	„ in charge	„	3	„	
Cadastral	1	„ „	„	4	„	
„	1	„ „	„	5	„	
„	0	„ „	„	6	„	
„	1	„ „	„	7	„	
	0	„ „	„	8	„	Superintendent, Provincial Surveys, United Provinces.

Forest	...	0	Officer in charge	No.	9	Party. Superintendent, Forest Surveys.	
Topographical	...	1	„	„	10	„	
„	...	1	„	„	11	„	
„	...	1	„	„	12	„	
„	...	1	„	„	14	„	
„	...	1	„	„	15	„	
Forest	...	1	„	„	17	„	
Topographical	...	1	„	„	18	„	
Forest	...	1	„	„	19	„	
„	...	1	„	„	20	„	
Trigonometrical	...	0	„	„	22	„	(Work stopped in consequence.)
„	...	1	„	„	23	„	
„	...	1	„	„	24	„	
„	...	1	„	„	25	„	
„	...	1	„	„	26	„	
	Total	21					

Grand total 31 officers.

And there will be two officers on special duty,—the Surveyor-General and Captain M. O'C. Tandy. If the Surveyor-General reverts, there will be a lot of changes for the period of two months before Colonel Hobday's retirement. For Nos. 6, 8 and 9 Parties there is no immediate necessity for Imperial officers. No. 6 is in charge of a very experienced Provincial officer, and 8 and 9 are under the direct orders of the Superintendent, Provincial Surveys, United Provinces, and the Superintendent, Forest Surveys, and if Captain Tandy returns to duty from his Aden work, I can re-start No. 22 Party, but I have not a single officer to spare, nor a second officer in or available for any one of the parties now existing.

8. The parties are numbered from 1 to 26, but Nos. 13, 16 and 21 do not exist.

Of the existing 23 parties, 9 are engaged on topographical surveys, 5 are engaged on cadastral surveys, 4 are engaged on forest surveys, and 5 are engaged on trigonometrical and scientific surveys.

9. Excluding the officers required for the administrative appointments and technical offices and absentees therefore, were all the officers now available sufficiently acquainted with the work, I could on my own reversion have one Imperial officer with each existing party, but not one spare officer left.

It is palpable on the face of it that unless there is a large increase in the number of officers, I cannot increase the number or strength of parties, and that I am not in a position to meet any calls for special work of any sort, military or political, without seriously interfering with current work, nor could I replace officers falling sick or other vacancies.

10. *Duties of officers.*—The duties of the various officers are as follows:—

1. The Surveyor-General deals with everything connected with the Department generally, and has a certain number of topographical parties under his immediate superintendence, and all trans-frontier work.

2. The Deputy Surveyor-General deals directly with all cadastral or revenue questions, and superintends a certain number of topographical parties.

3. The Superintendent, Trigonometrical Surveys, deals directly with all the trigonometrical or scientific parties and with one topographical party; as this officer is liable to be appointed Deputy Surveyor-General or Surveyor-General, it has been considered in his interest to put at least one topographical party under him.

4. The Superintendent, Forest Surveys, superintends all the forest survey parties.

5. The Superintendents, Provincial Surveys, two in number, superintend and administer, under the Local Governments, and the professional control of the Deputy Surveyor-General, the cadastral surveys of their provinces.

6. The Assistant Surveyor-Generals are three in number and are in charge of—

(1) The Surveyor-General's office (correspondence and accounts) and of the Mathematical Instrument Department.

(2) The Drawing and Engraving and Map Record and Issue offices.

(3) The Photographic and Lithographic offices.

7. The Officer in charge of the computing office resides at Dehra, and is under the Superintendent, Trigonometrical Surveys; he deals with all the questions of higher mathematics, and is the Surveyor-General's adviser through the Superintendent, Trigonometrical Surveys, on such points; he also superintends the map reproducing office at Dehra.

8. The other officers are what are called the executive officers, their duties being confined to their individual field parties.

All questions affecting the Department generally, its rules and regulations, customs, promotions, etc., of Imperial and Provincial officers, are decided by the Surveyor General, but minor questions and routine matters are dealt with by administrative officers direct.

11. *Need for superintendence.*—It has been found in practice that even with the existing number of parties, the duties of the Surveyor-General and Deputy Surveyor-General are so varied that they cannot afford time to properly inspect and direct the work of the field parties, and the paucity of officers renders this a most highly important duty owing to the constant shuffling of the officers in charge and consequent non-continuity of system. I anticipate that this difficulty will be still more accentuated if any attempt is made to increase the number of parties under the existing system of organisation.

Were it not impossible for the Surveyor-General and Deputy Surveyor-General to superintend more parties directly themselves, there would be no necessity for the Superintendent, Forest Surveys, and possibly the Superintendents, Provincial Surveys, would be unnecessary; but it is essential that surveys of each class should be conducted on uniform systems, and for this reason it is necessary for some senior officer to directly superintend the working of groups of parties working on such systems.

As the main question before the Committee is how to provide a satisfactory topographical map on a scale suitable for military, civil and public purposes, I will give a short description of the present system, by which such maps as the 1-inch = 1 mile standard maps and the 1 inch = 4 miles degree sheets are prepared.

12. *Organisation of a field party.*—When the survey of any large area has been decided on by the Government of India, the Surveyor-General proceeds to organise a party; he appoints one or two Imperial officers to it, from 5 to 7 Provincial officers, and a number of surveyors and sub-surveyors. If the country has not previously been triangulated or traversed, as the case may be, one or more Provincial officers either alone or under an Imperial officer, who would take his share of the work, are deputed by the Surveyor-General, a field season ahead, to prepare sufficient data for the surveyors to start work on the next cold weather.

The officers, Imperial and Provincial, have, as a rule, to be taken from other parties, thus weakening them temporarily, and the surveyors and sub-surveyors are similarly obtained. Thus, for the first season or so, the new party is composed of men from other parties. The officer in charge is informed whence he should draw his khalasis and other menials, and directed to enlist and instruct such surveyors and draftsmen, etc., as he may require to complete his party as rapidly as possible. He is also told where he should recess, and orders are given him to look for and rent a suitable house for the recess office. I attach a copy of the circular order* regarding the duties of an officer on being ordered to start a survey of any large area. An estimate of the cost of his party is either prepared for him or by him, and submitted to the Surveyor-General direct or through his administrative officer. The instruments necessary are supplied by the Mathematical Instrument Department, Calcutta, on indent through the administrative officer, and the stationery is similarly supplied from the Stationery Office, Calcutta.

* Not reprinted.

Each member of the party, including the sub-surveyors on the permanent list, has to provide his own personal tents, but all tents required for the menial establishment

and office purposes are purchased on the authority of the Surveyor-General from one or other of the big tentmaking firms, generally from either the Elgin or Muir Mills, Cawnpore.

Everything being ready, the party takes the field under its executive officer, and work is started. It is the duty of the officer in charge to endeavour to work as economically as he can, consistent with the necessary accuracy, and to enlist and train the additional surveyors required. This is a duty that many officers object to very strongly, as it necessarily retards progress for a time, and throws a lot of extra work on the assistants and others, and raises very much the cost rates of the party in the years the men are under training and before they become efficient. When the programme for the year's survey is nearly completed, or the climate necessitates the closing of field work, the officer in charge reports to his administrative officer, and applies for permission to return to recess quarters. In addition to this report, monthly reports showing progress and the employment of each member of the party, are submitted by the officer in charge of the party to the administrative officer. The maps of the party are fair drawn by the field surveyors, or special draftsmen, if absolutely necessary, during the recess season, all the computations are worked out, charts of triangulation and traversing and the reductions for the $\frac{1}{4}$ inch maps are prepared, and when complete for a degree sheet, such a map is drawn in the office. The fair maps when ready, generally at the close of the recess season, are submitted through the administrative officer to the head-quarters drawing office (Calcutta or Dehra, as the case may be,) for general scrutiny, and by that office forwarded to the photo-zincographic office for reproduction. Proofs are submitted to the officer in charge through the administrative officer (generally), and one of these proofs is coloured up in the party office to show the various classes of roads, cultivation, water, boundaries, etc. ; another is used to show the relative importance of the villages, towns, etc., to guide the head-quarters office in selecting the names that should be shown on the small scale maps, and a third is prepared showing any corrections that are necessary before the map is published. These proofs are then returned to the head-quarters office and the administrative officer decides whether the corrections should be carried out in that office or whether the fair manuscript map should be returned to the party office for correction. Everything having been finally settled, the map is published. All the computations of the triangulation and traversing, etc., are carried out by the party officers, and reports are prepared on hard-and-fast lines and submitted for record to the head-quarters office, where they are carefully stored and kept available for future reference.

The pay of the party is drawn by the officer in charge from the most convenient treasury, authority to do so being granted by the Comptroller of India Treasuries on the application of the officer in charge forwarded through the administrative officer. The officer in charge also submits to the administrative officer an estimate of the money he will require each month to meet the travelling and contingent expenses of the party. Authority is then granted to him to draw up to the amount passed by the administrative officer from such treasury or treasuries as he may have named, and he submits monthly full accounts of all money he has drawn under this authority to his administrative officer. These accounts are carefully checked in the head-quarters office, and forwarded with full criticisms to the Comptroller of India Treasuries, who again scrutinises them, and returns them to the head-quarters office with such orders as he sees fit to pass on them ; the objection statement, as it is called, which contains all the orders of the administrative officer and the Comptroller, is then forwarded to the officer in charge of the party for explanation and compliance, and any corrections ordered have to be shewn in the accounts.

This work takes up a good deal of the time of the officer in charge of the party, but cannot be avoided. Though the budget of the Survey of India is very complicated, the system of accounts, as now carried out, is, I think, very simple, and I hope may not be changed, except as regards the staff employed in carrying it out, about which I shall have something to say in my reorganisation scheme. The survey year begins on the 1st October, and ends on the 30th September for field parties, but the accounts are made up for each year ending 31st March. So that the field work of one year and the recess work of the previous one come into one year's accounts instead of the field work of

any one year and the recess work connected therewith, but on the whole this does not seem to be of great importance, and is unavoidable, unless the general report is delayed in publication, as the field work must precede the recess work.

13. Mainly on account of the enormous extent of country over which the work must be scattered, the paucity of communications which renders travelling except on the main lines, such as railways, extremely slow, and of the experience of the past as regards the unequal quality of the various surveys executed, arising from the impossibility of sufficient supervision on the part of only 3 officers, namely, the Surveyor-General, the Deputy Surveyor-General, and the Superintendent, Trigonometrical Surveys, I most strongly recommend the sub-division of India and its dependencies, excluding Baluchistan and the tribal area of the North-West Frontier Province, into four groups for survey purposes, Baluchistan, etc., being treated separately on account of the special nature of the work.

14. The groups I suggest are as follows :—

No. 1 group.—North-West Frontier Province, Punjab, Kashmir, and the United Provinces, with a total area of 340,500 square miles approximately.

No. 2 group.—Bombay, Sind, Rajputana and Central India, with a total area of 406,000 square miles approximately.

No. 3 group.—Madras, Berar, Hyderabad, Coorg, Central Provinces and Mysore, with a total area of 399,000 square miles approximately.

No. 4 group.—Bengal, Burma, Assam, the Andamans and Nicobars, with a total area of 528,000 square miles approximately.

15. For the survey work to be carried out in each of these groups, I would require fifteen (15) parties of the approximate strength given below, and 2 small parties for supplementary work in the United Provinces and Bengal, and these parties would be distributed as follows :—

In No. 1 Circle 3 large parties and 1 small party.
„ No. 2 „ 4 „ „
„ No. 3 „ 4 „ „
„ No. 4 „ 4 „ „ and 1 small party.

In addition to these, in my scheme I have provided for 2 special parties for Baluchistan and the North-West Frontier generally.

16. The large parties should be composed of—

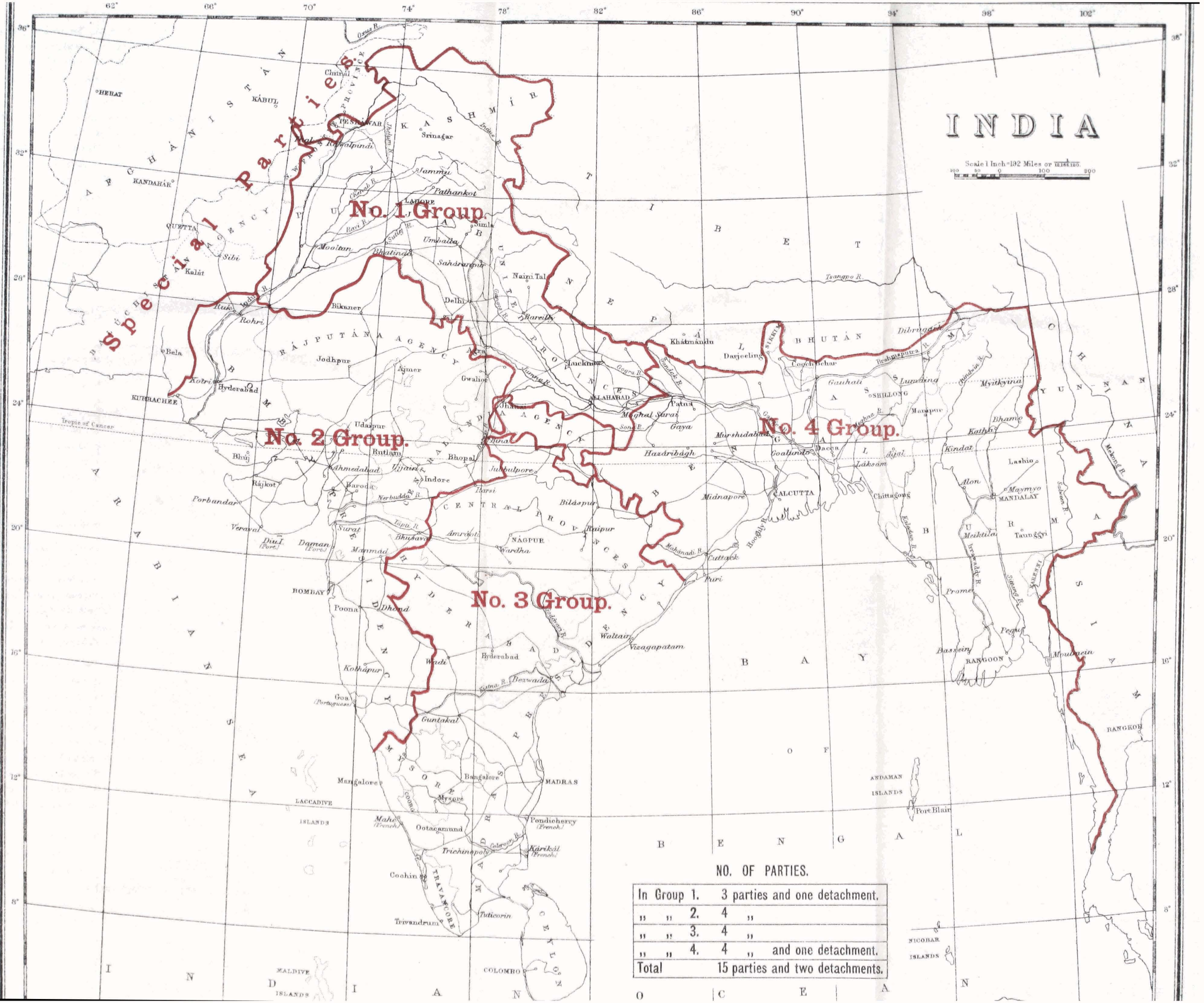
2 Imperial Officers.
5 to 7 Provincial Officers.
32 Surveyors and Sub-surveyors.
2 Writers.
1 Hospital Assistant,
and about 400 menials.

The small parties would consist of 1 Imperial, 2 to 4 Provincial, and a few subordinate officers.

The annual cost of each large party would be from Rs. 1,25,000 to Rs. 1,80,000 according to the locality, and the areas surveyed yearly would vary from 3,000 to possibly 5,000 square miles according to the scale and class of survey and the nature of the country. For special areas in which supplementary survey only is necessary, the areas would be much greater, but for these I employ small special parties.

These figures do not include the expenses that must necessarily be incurred in training the necessary staff, and are based on calculations regarding areas and cost rates given elsewhere. The areas surveyed by each party in the first few years will probably fall short of the estimate which is for parties composed of thoroughly trained men.

17. To superintend these parties and such as may be required on the Frontier, I ask in addition to myself as directly responsible for the Frontier parties, for 4 Superintendents of Topographical Surveys, one for each circle who will be under my direct orders as Surveyor-



NO. OF PARTIES.

In Group	1.	3 parties and one detachment.	
„ „	2.	4	„
„ „	3.	4	„
„ „	4.	4	„ and one detachment.
Total		15 parties and two detachments.	

General, and whose duties are enumerated further on. By this means I hope to ensure uniformity in quality and style of surveying and mapping and to ensure economy. I as Surveyor-General would also be able to see yearly the work of each party while in progress during recess and of a proportion of them in the field, a duty which I consider highly important.

18. In the statement in paragraph 32 I give the organisation of the Imperial Branch, which I consider is best suited for the execution of the work of the department in future, and in it I have provided not only for topographical, but also for trigonometrical and cadastral work. At the suggestion of Sir John Farquharson I have dropped many of the existing titles and substituted simpler ones. Thus for "Assistant Surveyor-Generals" I have substituted "Officers in charge;" the present Superintendents, Deputy Superintendents and Assistant Superintendents I have called Executive and Assistant Executive Officers, while I have suggested that the Provincial service officers should be called Civil Assistants.

19. *Provincial Service.*—I think we should adopt the name Civil Assistant for Provincial service officers and regrade them. I would grade all the present selected appointments, *i.e.*, all above Rs. 500 as 1st grade; 2nd grade those from Rs. 300 to Rs. 500 inclusive, and 3rd grade those below Rs. 300. I would make no further appointments to the existing Provincial Service, but allow it to die out, and in its place I would start a new graded Provincial Service open alike to natives and Europeans and Eurasians, their pay being regulated by annual or biennial increments, subject to approved service, and promotion from one grade to another requiring a qualifying examination in professional subjects, except for the top grade which should be filled entirely by selection from the two grades below.

This has been since changed, and I have agreed to the scheme given in the Committee's report.
23-4-05. F. B. L.

The educational qualifications for the new Provincial Service might remain the same as at present, but I would make the qualifying entrance examination somewhat simpler and improve the subsequent training, selecting the men most suitable for each class of work and giving them special training for the branch to which they would be eventually posted; at the same time I would endeavour to keep down this service to the lowest safe limit which I think would eventually be about 4 per party for topographical work, and I would reduce the number as far as possible in the trigonometrical branch, and substitute more highly paid native agency in that branch.

For cadastral surveys I agree with Major Crichton that the very best possible class of Europeans should be chosen. The work itself is simple, but requires organising powers even in the assistants, and there are great responsibilities and temptations attached to the work, and it is absolutely essential that the officers in charge of the camps should be above suspicion, for it is very difficult for the officer in charge to exercise any vast amount of control over the details of the survey, records and expenditure thereon. I have already submitted a note on Provincial officers generally, but this final note somewhat modifies the previous one.

20. *Subordinate establishment.*—As regards the subordinate establishment, I would raise the standard by offering better initial pay and by more careful selection of candidates. I would endeavour to get a large number of men from the ranks of the native army. The loss of the services of the numbers I should require each year would not be felt in any way. Most of the men I should get would be probably such as were not in every way the most suitable for the army, for example, men who were not likely to become marksmen or had not shown themselves likely to make good non-commissioned officers, but I should also get many very good men who did not wish to prolong their service, and for whom Commanding Officers wished to find billets. Special rules would have to be made with regard to the employment of such men, as I would have to take them on trial for some years before they were definitely transferred to the Survey of India. These men would attract others of similar class, who for some reason or other had not joined the native army. I have no fear of not getting a good lot of native surveyors, if I start on these lines.

21. *Recruitment and pay of Imperial officers.*—As regards recruitment for and organisation of the Imperial Branch at the present time, the prospects of these officers are very poor. There must be a great stagnation of promotion under existing rules, and to increase the department from the bottom of the list only, as at present, would only increase the difficulties. I think if

this big scheme is to be carried through, we must change the system, and I would abolish consolidated pay except for the Surveyor-General, Deputy Surveyor-General, the Superintendents, and for such civil officers as may from time to time be appointed. As such civil officers are only appointed for special purposes, they should be under special rules, and such awkward cases as now exist should not occur again. For instance, Mr. Pope, who is purely a technical officer in charge of one section of the head-quarters office, requiring no survey knowledge whatever, is a Superintendent, 2nd grade, and has officiated and will officiate as Superintendent, 1st grade, though his duties could be equally well filled by a far junior officer. Mr. Eccles, the officer next but one above him, was brought out for purely mathematical purposes and should, in my opinion, have been specially provided for outside the general list, but he is qualified for further promotion, and has a right to look forward to succeeding to the post of Superintendent, Trigonometrical Surveys, when it becomes temporarily or permanently vacant.

I consider that we should in reorganising, as I said before, generally abolish consolidated pay, and give to each assistant the pay of his rank and some survey or departmental allowance, and to each officer in charge of a party the pay of his rank + survey allowance + charge allowance. The Superintendents, who would be specially selected officers, should get consolidated pay. The Superintendent, Trigonometrical Surveys, should draw higher pay than any other Superintendent. The officers in charge of the head-quarters offices should get pay of rank + survey allowance + charge allowance, and if stationed in Calcutta, a special local allowance. The allowance to the officer in charge of the Tidal Party should cease ; there is no necessity for it whatever.

To meet the present emergency I would recommend the appointment of a few Captains, Royal Engineers, who have had experience in either the public works or military works, as well as a number of Subaltern officers, Royal Engineers, and Indian Army. I would attach the Captains as well as the Subalterns to Dehra for a short course of instruction before drafting them into circles, and would attach each Captain to a survey party for one field season before giving him charge of a party; his actual knowledge of surveying will, however, be small, and it is essential for this reason that he should be under the eye of a Circle Superintendent, to whom he could readily go for advice and help at any moment, and from whom he could derive the mass of his instruction. Subaltern officers I would train, as at present, at Dehra and in the field in the Berar party. After a time they would take the places of the temporarily appointed Captains ; for such appointments I would only make at the commencement of the reorganisation and for a five-year period only. I would also appoint no Subalterns for a longer period than five years in the first instance, but allow the Surveyor-General to apply for the retention of their services for a further period if considered advisable, and I would not necessarily discharge all the Captains specially brought in at the end of their five years, but their retention should be exceptional.

22. *Removal of the Survey offices from Calcutta.*—As regards the present head-quarters office, there is a strong feeling in certain quarters that Calcutta is not a suitable place, and there can be no doubt that the climate is most unsuitable for prolonged residence and work of the nature of drawing and engraving, but we have in our reproducing offices and in the Mathematical Instrument Department, a very large amount of machinery and almost all the workmen are Calcutta born and bred, and I do not think it is practicable to move either of these offices, nor would it be economical to move one without the other, as though the superintendence of the work of the Photographic and Lithographic office is sufficient to occupy the full time of an energetic Superintendent, that of the Mathematical Instrument Department is not, though it must have an officer at its head. I would be very glad to see the first named offices removed from Calcutta, namely, the Drawing and Engraving, and with them as a consequence the Map Record and Issue office, as well as the Surveyor-General's and Deputy Surveyor-General's offices, all of which are under one roof. If, as I have suggested, we break up India into four circles, and I consider this is practically essential, the change would admit of the decentralisation of the Map Record and Issue offices, and indeed I think for effective working would necessitate this.

The abolition of the post of Deputy Surveyor-General in its present form, and the substitution of the Superintendents of Circles for his and the Surveyor-General's minor administrative work, will necessitate the amalgamation of his office with that of the Surveyor-General, and I am inclined to advocate the removal of the Surveyor-General's office, *i.e.*, the accounts and correspondence offices and the drawing, engraving and map record and issue offices from Calcutta to a site near Rajpur, which could be easily and cheaply obtained, and would be handy in many ways. I would in that case have one officer in charge of the Photographic and Lithographic and Mathematical Instrument offices with an assistant, who should be an Imperial officer, only in Calcutta.

23. *Map Record offices.*—The map record office for Bengal and Assam could be placed in charge of the Superintendent, Cadastral Surveys, whose head office should be, I think, in Calcutta.

The other map record and issue offices I would locate with the circle drawing offices at a site near Dehra and Rajpur for No. 1 circle, in Poona for No. 2 circle, in Bangalore for No. 3 circle, and in Maymyo, Meiktila or Mandalay for No. 4 circle. I have put the map record and issue office for Bengal and Assam in Calcutta for the sake of convenience and because such an office could readily be looked after by the Superintendent, Cadastral Surveys (Bengal), and it would be inconvenient to have to send all the way to Burma for maps of Bengal or Assam.

With a permanent office in Burma, I have no doubt whatever we shall be able to recruit excellent Burman draftsmen and gradually Burman surveyors for the topographical parties, and I have no fear of the clerical establishment of the Surveyor-General's office nor the draftsmen of the Calcutta drawing office raising any serious objection to a move to the United Provinces, but I could easily replace such as did object.

To move the mechanical offices would not be so easy, and would cause serious disorganisation for probably several years.

24. *Necessity for decentralisation.*—I have said elsewhere that I consider four Superintendents for the proper execution of the topographical programme necessary, and the establishment of a drawing and map record office in each circle as most advisable. It has been found in practice that it is impossible for the Surveyor-General, Deputy Surveyor-General and Superintendent, Trigonometrical Surveys, to exercise the degree of supervision over the field parties even at the present time that I consider is essential for satisfactory and uniform work. I believe Sir John Farquharson does not agree with me that this inspection is essential, necessary or even advisable ; but every officer of experience in the Department considers that it is most essential and necessary, and I have no doubt whatever in my own mind that this is so, and it will be still more essential if, as I think we must, we bring in senior officers for charge of parties without previous training in the Department. At the same time with such an enormous increase in the number of parties and area yearly surveyed, it will be still more impossible for the Surveyor-General to inspect individual parties, and therefore some guiding hand must be available locally to advise and direct as well as criticise the work of individual parties At each station—Dehra, Poona, Bangalore and Maymyo or Mandalay or Meiktila—I would have a central office capable of holding the circle drawing and map record and issue offices and the recess strength of the circle field parties. At each of these offices also there should be a small expense section fitted with spare instruments, drawing materials and stationery.

25. The duties of the Superintendent would be—

1. The arrangements with Local Governments for the main details connected with the work of each of his field parties.
2. The recruiting, training and distribution of the necessary field staff amongst the parties under him.
3. Inspection of the parties in the field.
4. General superintendence of the fair mapping of his parties during recess.
5. Immediate superintendence of the small scale mapping derived from the standard sheets of his parties.

6. Care and maintenance of all records and the distribution of all maps, etc., for his circle.

7. The supply of the necessary instruments, stationery, etc., to his parties.

8. The maintenance and repairs of all Great Trigonometrical stations and level bench marks within his circle.

9. The record of changes in topographical and artificial features and of boundaries within his circle.

10. That the work of his circle is carried out with due regard to economy and efficiency.

11. The preliminary scrutiny of the accounts of his parties and the preparation of the budget estimate for his circle.

12. The preparation of the general report for the circle.

13. The preparation of the qualification reports of his officers, Imperial and Provincial, and recommendations as to changes to be made in the personnel of his parties owing to retirements or officers proceeding on leave, and recommendations for promotions of subordinates.

I would also put upon the Superintendent, No. 1 circle, the enlistment and training of such surveyors as are required for the trans-frontier parties.

I would also, at least once a year, assemble all the Superintendents for a conference on survey matters generally, the record of these conferences being published departmentally.

I consider it most desirable that officers in charge of parties should not be responsible for the personnel of their parties; if each individual party officer is to recruit for himself, there will at once be rivalry and competition in circles, and each officer will endeavour to get the better of his neighbour. I should encourage officers to obtain suitable candidates, but their entertainment and subsequent employment should rest with the Circle officer, subject of course to the final sanction of the Surveyor-General.

26. By my division of India into four circles, I have so arranged that each Presidency and Local Government will have one officer only beyond the Surveyor-General with whom correspondence will be required; by the sub-divisions as laid down by Sir John Farquharson, and indeed by almost any arrangement of parties working direct under the orders of the Surveyor-General, references to Local Governments would have to be made by several officers in charge of parties and confusion would arise. For instance, in scheme No. 1 (though I would very much prefer a block system if it were possible without confusion,) the Bombay officials would have to be constantly referred to in minor difficulties by the officers in charge of Nos. 3, 8, 9, 12 and 14 parties. The Madras officials would have to deal with 13, 14 and 15. Mysore would deal with 12 and 14; Hyderabad with 12 and 13; the Central Provinces with 9, 10 and 13; Bengal with 5, 6, 10, 11 and 13; Rajputana and Central India Agencies with 2, 3, 4, 8, 9 and 10; the United Provinces with 2, 4, 5 and 9; the Punjab with 2, 3 and 4. While the officer in charge of each party, except Nos. 0, 1, 7 and 15, would have to deal with at least two sets of high local officials, and I consider these facts are very great drawbacks, and would lead to confusion and friction. The same applies more or less to the alternative scheme.

Sir John Farquharson's scheme No. 1, dated 23rd February 1905, now superseded by his scheme of 18th April.

By my arrangement the Surveyor-General's hands will be quite fully occupied; he will have the immediate superintendence of all the actual trans-frontier work, and through his six Superintendents of all the other work of the Department, besides the whole of the general administration of the Department.

I consider that my arrangement will tend both to efficiency and economy, and that it or some similar scheme is essential.

27. I quote an extract from a report by Captain Ryder, Royal Engineers, which is perhaps worth recording—

"I consider it of the greatest importance that officers in charge of parties should be under substantial supervision and not the present day shadowy system. I have been most of my time in parties directly under the Surveyor-General. I have never had my work inspected in the field, nor has it ever come to my knowledge that any party directly under the Surveyor-General has ever been inspected in the field. At the usual inspection the officer in charge of a party can show the inspecting officer any particular work or keep it out of his sight just as he likes. If the inspecting officer notices anything incorrectly surveyed, it is only seen at the end of recess when the fair map is practically finished, and when it is not worth while keeping the map back for a year for the alteration to be made. * * * *

"There being so little check and the officers in charge of parties having such an absolutely free hand, I think that if the Surveyor-General does by close inspection find out errors, there is a slight feeling of resentment and a feeling that the Surveyor-General is interfering too much with executive details, and yet to have the Department properly administered and the maps all drawn and the country surveyed on a uniform system, close supervision is necessary.

"The present system of inspection by flying visits once a year during recess is really no inspection at all. I think, as matters now stand, an officer in charge can be as slack as he likes and bring in any erratic and peculiar ideas he may have which will not be noticed till too late. A system by which the officer in charge of a circle would have a permanent office in which all the parties in his charge would recess would be excellent."

This is the only written opinion I have, but it coincides with that of other senior officers with whom I have discussed the future, and is fully borne out by my experience as an assistant, as executive officer, as Assistant Surveyor-General, Deputy Surveyor-General and as Surveyor-General for a period of over 24 years.

28. I do not consider that the appointment of Superintendents of Circles would destroy progress and initiative in officers in charge of parties, but it would have a controlling influence, and while rejecting some would extend other useful changes into the work of adjoining parties, and all such matters would be fully discussed and legislated for at the annual meeting of the Surveyor-General and his Superintendents.

29. The duties of the Deputy Surveyor-General would be—

1. To hold charge of the head-quarters correspondence office.
2. To audit the accounts of the topographical branch.
3. To prepare for the Surveyor-General the general accounts and budget estimates of the whole Department.
4. General supervision of the head-quarters offices during the absence of the Surveyor-General.

30. The duties of the Superintendent, Trigonometrical Surveys, would be—

1. To Superintend the working of the trigonometrical and scientific branch.
2. To audit the accounts of that branch.
3. To prepare the budget estimates for that branch.
4. To generally superintend the drawing and reproducing offices at Dehra.
5. To superintend the instruction of Imperial and Provincial officers in theoretical surveying, and specially the training of assistants for his own branch.
6. The inspection of his field parties.

31. The duties of the Superintendent, Cadastral Surveys, would be—

1. To superintend the working of the cadastral parties in Bengal and Burma.
2. To superintend the Bengal drawing office and to act as general adviser to the Surveyor-General and such Local Governments as may require information with regard to fiscal surveys.
3. To train the Imperial and Provincial officers required for such surveys, and to recruit and train the necessary subordinate staff.

32. *List of Imperial Officers of the Survey of India under my scheme.*

Head-quarters staff ...	1	Surveyor-General.
	1	Deputy Surveyor-General.
	1	Personal Assistant to the Deputy Surveyor-General.
	1	Officer in charge head-quarters Drawing, Engraving and Map Record and Issue Offices.
	1	Officer in charge Photographic and Lithographic and Mathematical Instrument Offices, Calcutta.
	1	Assistant to the officer in charge Photographic and Lithographic and Mathematical Instrument Offices, Calcutta.
	1	Officer in charge North-West Frontier and trans-frontier map compilation and records.
	7	
Trigonometrical and Scientific Staff.	1	Superintendent, Trigonometrical Surveys.
	1	Assistant to Superintendent, Trigonometrical Surveys.
	1	Officer in charge Computing Office and Photo-Zincographic Office, Dehra.
	3	
Field Staff	4	Superintendents, Topographical Surveys.
	1	Superintendent, Cadastral Surveys.
	5	
Total Staff	15	officers.
Executive Officers ...	15	Officers in charge 15 Topographical parties in India.
	2	Officers in charge 2 Frontier parties.
	6	Officers in charge 6 Scientific (Trigonometrical) parties.
	4	Officers in charge 4 Cadastral parties.
Total ...	27	Executive Officers.
Assistant Executive Officers	15	for 15 Topographical parties.
	2	for 2 Supplementary Survey Detachments.
	4	for 2 Frontier parties.
	2	for 2 (Trigonometrical) Scientific parties, G. T. triangulation and levelling and magnetic parties.
	1	spare officer for Cadastral Surveys.
Total ...	24	Assistant Executive Officers.
Grand Total ...	66	officers of the Imperial Branch.

33. *Provincial and Subordinate Services*—

By the July "Green" List the Provincial Service consists of—

Present Strength.

2	Extra	Deputy	Superintendents,	1st grade.
3	,,	,,	,,	2nd ,,
5	(2 supernumerary)	Assistant	Superintendents,	1st grade.
6	,,	,,	,,	2nd ,,
9	,,	,,	,,	3rd ,,
15	,,	,,	,,	4th ,,
17	,,	,,	,,	5th ,,
23	,,	,,	,,	6th ,,
23	Sub	,,	,,	1st ,,
27	,,	,,	,,	2nd ,,
29	,,	,,	,,	3rd ,,

Total 159 of which 4 appointments are vacant, namely, those of the Extra Deputy Superintendents, 1st grade, and 2 in the 4th grade of Extra Assistant Superintendents, the pilot appointments in the Imperial Service not having yet gone sufficiently high to enable the Provincial appointments to be filled, and there are two vacancies at the bottom of the list due to death and retirement.

Their distribution is as follows:—

(1)	Topographical and Frontier Surveys...	61
	Scientific or Trigonometrical Surveys	12
(2)	Cadastral Surveys	29
(3)	On deputation or working under Local Government but not seconded	9
	With Head-quarters or other drawing offices, etc.	17
	With Trigonometrical Branch office	3
(4)	Special duty	1
	Leave	1
	Under instruction	20
(5)	Vacancies	6
		159

Note.—(1) This includes all the men employed in Forest Survey parties. (2) Bengal and Burma. (3) Assam and United Provinces. (4) Seistan Mission. (5) Four of these cannot be filled under present rules.

34. *Reorganisation Strength.*—With regard to Provincial officers in the future, I estimate that we shall require, all told—

For Topographical and Frontier Surveys	110
For Trigonometrical or Scientific Field parties	12
Cadastral Surveys	45
On special duty with Local Governments (say)	10
With Head-quarters drawing office (say)	5
With Circle drawing offices	8
With Trigonometrical Branch office	4
Under instruction to fill vacancies and for casualties and leave	25
For special duties	5
For the Forest Survey drawing office	2
Total ...	226

There will be no use hurriedly recruiting the extra officers required; they should be recruited proportionately to the number of surveyors I can annually recruit and train.

35. The total number of surveyors required for the Topographical parties will be approximately 630, namely—

32 for each Topographical party	=480
30 for supplementary work	= 30
40 for Frontier work	= 40
80 under training	= 80
Total ...	630

I have assumed in these calculations throughout that Forest Surveys as a branch will cease to exist, and that the work will generally be on the ordinary scale of topographical survey, only special areas being surveyed out of turn or on special scales to meet the urgent requirements of the Forest Department.

36. *Clerical Establishment.*—With regard to the drawing and the clerical establishments of the head-quarters offices at Calcutta and Dehra, changes are most necessary, even if no change is made in the superintendence and *locale* of these offices. Some years ago in consequence of the clerks in some of the smaller offices not having equally good prospects as those of the Surveyor-General's office, General Strahan put forward a scheme amalgamating on one list the clerical establishments of the Surveyor-General's, Deputy Surveyor-General's, Drawing, Photographic and Lithographic, Mathematical Instrument and Dehra offices, with the result that we have now many clerks drawing far more pay than they will ever be worth, and others for whom there is little prospect of the promotion they deserve, and the system works extremely badly. The establishment is too small to apply the rules of the Secretariat offices to it, and the powers of the Surveyor-General are too restricted; he cannot even employ (as far as I know) temporary clerks in case of emergency, and the system of recruiting from unpaid apprentices, and allowing such men to rise through the various grades, possibly to the top of the tree, was inadvised, and as a consequence we now find our offices full of clerks of the most limited attainments, most of them being but copyists. The system has of late years proved so disastrous that a certain number of superior clerks have been brought in from outside and put into some of the responsible positions, and every promotion, temporary or permanent, now requires reference to one or other of the officers in charge of the sub-offices, though all promotions must be made by the Surveyor-General, and the officers in charge of the sub-offices, drawing, photographic and lithographic., etc., have not sufficient power over their clerical establishment. If we change the present organisation of the Imperial staff, we should also change that of the clerical, and make each office as regards its clerical establishment independent of the other, and the same system should apply to the drawing offices at Calcutta, Dehra and the North-West Frontier drawing office; and in addition to the

fixed appointments in each office, the Surveyor-General should have power to sanction the temporary employment of extra clerks and draftsmen at any time, subject to the limits of his sanctioned budget grants, without reference to the Government of India.

37. *Recess Offices.*—Up to the present time there have been no regular offices or recess quarters for the field parties, and each party has had to find and rent from year to year such private dwelling-house accommodation for its office as it could in the station at which it was ordered to recess. I have never seen yet a thoroughly suitable office of this description, and none of them have, as far as I know, ever had suitable storage accommodation and furniture. Every party has, in its personnel and its accommodation, lived from hand to mouth, the personnel being dependent on the sudden calls of Government for special or new surveys, which necessitate the formation of new parties or detachments at the expense of the existing ones, and the accommodation being dependent on the will of the landlord.

38. Of late years instead of increasing the Imperial Service to meet the extra work that has been required of the Department, it has been decreased. The prospects and pay of the Provincial Service have been improved at the expense of the Imperial, but this has in no way strengthened the Department,—far from it. The Provincial Service officers who have benefited or will benefit by the change are mostly too old and too exhausted, to be in any way suitable for topographical field work, and would never have been, in my opinion, satisfactory officers in charge of parties.

39. *Supply of tents, etc.*—As regards tents, I would recommend that all tents for the use of the Department be in future supplied at Government expense, and issued to parties by the Circle offices in accordance with the requirements of the party. The Circle officer, when inspecting, will have to see that these are in proper order and that no unnecessary tents are employed. The Civil Service Regulations regarding carriage of tents and camp equipment should be modified.

40. *Suggestions for immediate action.*—If the Committee agree to my scheme generally, I would ask that the Surveyor-General may be authorised to nominate one Imperial officer of standing to visit the various Circle centres and in conjunction with the local authorities draw up a scheme for the accommodation of the various parties and offices in each Circle; he would have to select sites and get out plans and estimates of buildings, etc.

I would also ask that the Surveyor-General be authorised to appoint one Imperial and from four to eight Provincial officers to recruit and start training the sub-surveyors that will be required within the next year or two, one or two officers for each Circle in accordance with the number of recruits obtained.

The military authorities should also be approached with a view to arranging for the supply of a certain number of sepoys or non-commissioned officers from the regiments in each circle for employment in the Survey Department. As much of the work is being done for military purposes, they should be only too willing to afford the Surveyor-General all possible assistance in this direction.

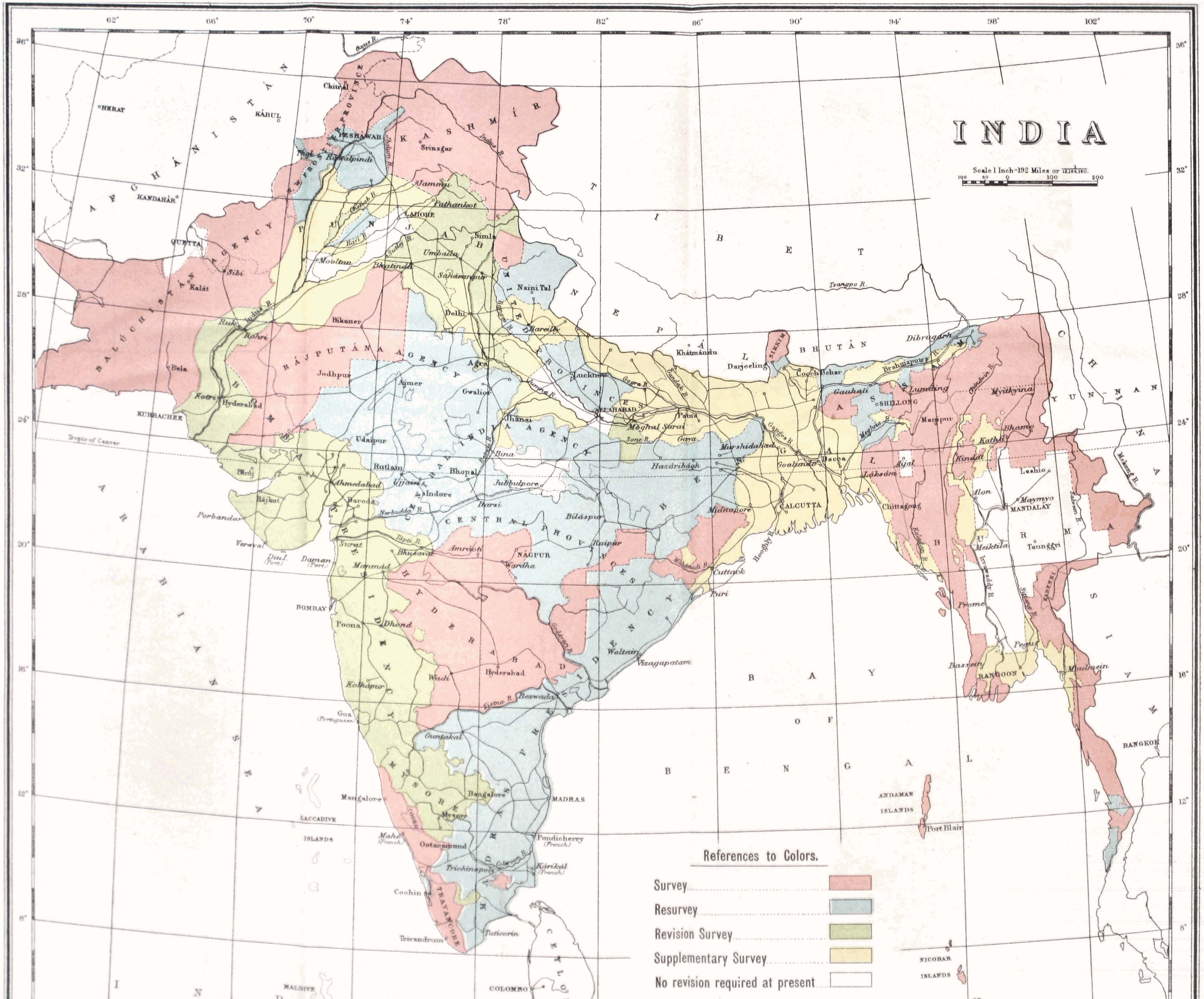
41. *Provincial Service.*—It has always seemed to me most necessary to encourage thrift in the Provincial Service, and more than one officer, one quite a junior one in that service, has approached me on the subject, and I would strongly recommend that a fixed proportion of the pay of every officer be deducted monthly and invested in some Government security for him from the very commencement of his service.

It should be illegal to borrow money on the savings thus accruing. The present system of Life Insurance is, in my opinion, in many cases but a trap for getting men into debt; they insure their lives for the purpose of borrowing money and in consequence become more and more involved in debt.

I would also recommend that every European or Eurasian officer of the Provincial Service be compulsorily made to join the so-called Volunteer Corps. If we have Circles, such as I have advocated, each Circle head-quarters should be able to turn out from 25 to 30 volunteers, and promotion in the department should to some extent depend on efficiency as a volunteer.

DEHRA DUN;
The 24th March 1905.

F. B. LONGE, *Lieut.-Colonel, R.E.*



INDIA
Scale 1 Inch=192 Miles or 1:12,165,120.
References to Colors.
Survey
Resurvey
Revision Survey
Supplementary Survey
No revision required at present
AFGHÁNISTÁN
BALÚCHISTÁN AGENCY
N.W. FRONTIER PROVINCE
KASHMÍR
PUNJAB
RÁJPUTÁNA AGENCY
BOMBAY
UNITED PROVINCES
CENTRAL INDIA AGENCY
CENTRAL PROVINCES
BENGAL
ASSAM
HYDERABAD
MYSORE
MADRAS PRESIDENCY
BOMBAY PRESIDENCY
TRAVANCORE
BURMA
TIBET
NEPÁL
BHUTÁN
SIKKIM
CHINA
YUNNAN
SIAM
CEYLON
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
LACCADIVE ISLANDS
MALDIVE ISLANDS
ANDAMAN ISLANDS
NICOBAR ISLANDS
Tropic of Cancer
HERAT
KÁBUL
KANDAHÁR
QUETTA
Chitral
PESHAWAR
Rawalpindi
Srinagar
Jammu
Pathankot
LAHORE
Simla
Umballa
Mooltan
Bhatinda
Saharanpur
Naini Tal
Delhi
Bareilly
Agra
Lucknow
ALLAHABAD
Jodhpur
Ajmer
Gwalior
Jhansi
Bikaner
Sibi
Kalát
Rohri
Bela
Hyderabad
KURRACHEE
Udaipur
Rutlam
Bhopal
Indore
Ujjain
Ahmedabad
Baroda
Rájkot
Porbandar
Surat
Bhusawal
Jubbulpore
Itarsi
Bina
Bilaspur
Raipur
NAGPUR
Wardha
Amraoti
Manmad
BOMBAY
Poona
Dhond
Kolhápur
Goa (Portuguese)
Wadi
Hyderabad
Bezwada
Waltair
Vizagapatam
Cuttack
Puri
Midnapore
CALCUTTA
Hazáribágh
Murshidabad
Goalundo
Dacca
Patna
Gaya
Moghal Sarai
Khátmándu
Darjeeling
Cooch Behar
Gauhati
SHILLONG
Lumding
Dibrugarh
Manipur
Chittagong
Bhamo
Myitkyina
Katha
Kindat
Lashio
Maymyo
MANDALAY
Meiktila
Taunggyi
Prome
Pegu
RANGOON
Bassein
Moulmein
BANGKOK
Guntakal
Bangalore
Mysore
MADRAS
Mangalore
Ootacamund
Pondicherry (French)
Kárikál (French)
Trichinopoly
Cochin
Trivandrum
Tuticorin
COLOMBO
Port Blair
Mahe (French)
Diu (Port.)
Daman (Port.)

GROUP I.—*Areas.*

Province or State.	Survey.	Resurvey.	Revision survey.	Supplementary survey.	No survey required at present.	Total.	REMARKS.
	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.	
Punjab and North-West Frontier Province.	6,000	26,600	24,600	58,600	31,600	147,400	
United Provinces ...	4,200	33,100	19,800	48,300	6,800	112,200	
Kashmir	80,900	...	...	...	...	80,900	
Total ...	91,100	59,700	44,400	106,900	38,400	340,500	

Of the total area of 340,500 square miles, the survey of 38,400 square miles has been lately completed, so that 302,100 square miles remain to be dealt with.

In this group I had also placed originally Baluchistan and the tribal areas of the North-West Frontier Province, but these areas are so involved with other than survey considerations, and the work is of so confidential a nature, that I have decided that all such areas should be dealt with by special parties working under the direct orders of the Surveyor-General, who will, I presume, be generally with the head-quarters of the Government of India, in close touch with the Foreign Department and Quarter Master General's Department.

GROUP I.—*Cost of surveys..*

Province.	Survey.	Re-survey.	Revision survey.	Supplementary survey.	Cost for Province of each class.	Scale of survey and cost-rate.
	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.	Rs.	
Punjab and North-West Frontier Province.	6,000	...	...	...	2,40,000	At Rs. 40 per sq. mile. 1″ = 1 mile.
Ditto ...	...	26,600	...	...	11,97,000	At Rs. 45 per sq. mile. 2″ = 1 mile.
Ditto Revision	...	...	24,600	...	2,46,000	At Rs. 10 per sq. mile. Mostly on 2″ scale, part on 1″.
Ditto Mapping	...	...	19,000	...	95,000	At Rs. 5 per sq. mile.
Ditto	...	...	...	44,100	6,61,500	At Rs. 15 per sq. mile. 2″ = 1 mile.
	...	...	...	14,500	1,45,000	At Rs. 10 per sq. mile.
Total ...	...	...	...	...	25,84,500	

GROUP I.—*Cost of surveys*—contd.

Province.	Survey.	Re-survey.	Revision survey.	Supplementary survey.	Cost for Province of each class.	Scale of survey and cost-rate.
	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.	Rs.	
United Provinces	4,200	...	...	...	1,26,000	At Rs. 30 per sq. mile. 1" = 1 mile.
Ditto	...	13,700	...	...	4,11,000	Hills at Rs. 30 per sq. mile. 1" = 1 mile.
	...	19,400	...	...	4,85,000	Plains at Rs. 25 per sq. mile. 2" = 1 mile.
	...	...	19,800	...	2,37,600	At Rs. 12 per sq. mile. 2" = 1 mile.
Ditto	...	...	...	48,300	5,79,600	At Rs. 12 per sq. mile. 2" = 1 mile.
Total ...	...	...	...	...	18,39,200	
Kashmir	80,900	...	...	...	24,27,000	At Rs. 30 per sq. mile. 1" = 1 mile.
Total ...	...	...	...	...	68,50,700	

In the Punjab I consider the areas for re-survey should be carried out on the 2" scale. In the Himalayas the cost was nearly Rs. 70 per square mile, if not quite, but in the areas under re-survey we shall require little triangulation, and I think Rs. 45 per square mile should cover the cost.

The original work in Kangra should be on the 1" scale, and would cost, owing to difficulties of the country and distances, at least Rs. 40 per square mile.

The revision work in the plains should not cost more than Rs. 10 per square mile, I think.

Kashmir.

I do not think we could put down the survey of Kashmir at less than Rs. 30 per square mile. I do not put it at a higher figure as the country is bold, and only here and there will survey in great detail be possible or advantageous, and the scale should be 1"=1 mile.

GROUP II.—*Areas.*

Name of Province.	Survey.	Re-survey.	Revision survey.	Supplementary survey.	No survey required at present.	Total.	REMARKS.
	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.	
Bombay	2,700	...	141,100	...	...	143,800	Practically all on 2″, but revision will be heavy.
Sind	(*a*)18,100	...	(*b*) 34,900	...	...	53,000	(*a*) Maps on $\frac{1}{4}$″ scale available. (*b*) Light revision.
Central India and Rajputana	(*c*) 52,400	156,600	...	...	...	209,000	(*c*) Desert area; great part surveyed on $\frac{1}{2}$″ scale.
Total ...	73,200	156,000	176,000	...	...	405,800	

GROUP II.—*Cost of surveys.*

Province.	Survey.	Re-survey.	Revision survey.	Cost for Province of each class.	Scale of survey and cost-rate.
	Sq. miles.	Sq. miles.	Sq. miles.	Rs.	
Bombay	2,700	...	...	32,400	At Rs. 12 per square mile, 2″ scale.
Bombay	...	...	141,100	16,93,200	At Rs. 12 per square mile.
Sind	18,100	...	...	2,71,500	Rs. 15 per square mile, 2″ scale.
Sind	...	...	34,900	69,800	Rs. 2 per square mile.
Central India and Rajputana.	52,400	...	...	7,86,000	Rs.15 per square mile, 1″ scale.
Central India and Rajputana.	...	156,600	...	46,98,000	Rs. 30 per square mile, 2″ scale.
Total ...	...	...	...	75,50,900	

In Bombay the Belgaum and South Maratha survey cost Rs. 22·5 per square mile for 21,082 square miles on the 2″ scale. Revision should not cost more than Rs. 10 per square mile—

Cutch survey cost Rs. 34-4 per sq. mile, 2″ scale.
Deccan „ „ „ 35-4 „ „ „ „ „
Guzarat „ „ „ 36 „ „ „ „ „

These latter surveys have few or no heights, and will require a good deal of revision, the cost will not be less than Rs. 12 per square mile, though they are probably the most detailed surveys in India.

Group II.—*Cost-rates.*

Bombay, Sind, Central India and Rajputana.—In Bombay the last surveys are practically all on the scale 2″=1 mile, and we, I think, will agree that the revision should be on the same scale.

There is about 3,000 square miles on the ½″ scale only in the extreme north-west bordering on Sind and about 3,000 on the 1″ scale bordering the Central India Agency.

The cost-rates for these surveys are as follows, taking the mean of the rates for as many years as I can get from the records :—

2″ Scale.

Name of Party or District.	Triangulation. Rs	Traversing. per square	Detail survey. mile.	Total.	Estimated cost of revision.
10 and 11 parties. Bombay (Revenue), 1877-1883 ...	...	...	...	Rs. 27·4	Rs. 10 to 12 per square mile.
Belgaum and Gujrat (Topographical), 1883-1892.	7·2	6·3	22·5	36·0	,,
Cutch, 1883-1886	7·8	13·1	13·5	34·4	,,
Deccan, 1883-1886	8·9	6·6	19·9	35·4	,,
South Maratha, 1884-1896 ...	7·0	5·6	16·0	28·6	,,
Mean	7·7	7·9	18·0	33·6	,,

In Central India the cost-rates are not obtainable, but 1″ work for 2 seasons in Malwa cost Rs. 37·6 per square mile.

In Rajputana, in 1883-1886, it cost approximately Rs. 20 per square mile.

1883-1884 is the 1st year in which cost-rates are given in the report.

In Sind from 1895 to 1903 inclusive, the cost-rates for 2″ work works out per square mile at—

Triangulation.	Traversing.	Detail survey.	Total.
Nil probably.	10·8	14·7	25·5

The cost-rate for ½″ work in the desert of Sind works out per square mile at about—

Triangulation.	Traversing.	Detail survey.		Total.	
8	*Nil*	4·3	=	12·3	× 1½ = 18·5 (A)
On the 1″ scale it is about					
8	*Nil*	10·4	=	18·4	

In order to survey the deserts of Sind and Rajputana on the 1″ scale, I consider that a rate of Rs. 15·4 per square mile will be sufficient. This would enable us to have a complete 1″ map of Sind and Rajputana.

In 1882-86 in Rajputana the cost-rates for 1″ work worked out per square mile at about—

Triangulation.	Traversing.	Detail survey.	Total.	
3·8	—	18·8	22·6	
	On the ½″ scale	in desert it is about		
3·8	...	4·5	8·3	× 1½ = 12·4 (B)

Mean of A + B for ½″ in desert.

$$= \frac{18{\cdot}5 + 12{\cdot}4}{2} = \frac{30{\cdot}9}{2} = 15{\cdot}4$$

GROUP III.—*Areas.*

Name of Province or State.	Survey.	Re-survey.	Revision survey.	Supplementary survey.	No survey at present required.	Total.	REMARKS.
Hyderabad ...	82,700	...	...	...	...	82,700	
Berar ...	17,700	...	...	...	...	17,700	
Mysore ...	...	...	29,400	...	...	29,400	
Coorg ...	1,600	...	...	...	...	1,600	
Central Provinces	23,300	80,600	...	...	(*a*) 12,000	115,900	(*a*) Recent survey and in progress.
Madras ...	27,000	108,200	(*b*) 16,500	...	...	151,700	(*b*) Surveyed by Forest Survey Party 15,088 square miles of this area.
Total ...	152,300	188,800	45,900	...	12,000	399,000	.....

Of which areas 12,000 square miles is new work, and will not require revision in the 1st edition of the new series, leaving 387,000 square miles to be dealt with.

In the Central Provinces there has been a good deal of forest survey work which, however, will, I think, have to come under the term revision, though it will be mostly for heights and contouring :—

GROUP III.—*Cost of surveys.*

Province.	Survey.	Re-survey.	Revision survey.	Cost for Province of each class.	Scale of survey and cost-rate.
	Sq. miles	Sq. miles.	Sq. miles.	Rs.	
Hyderabad ...	82,700	...	...	24,81,000	2″=1 m., Rs. 30 per sq. m.
Berar ...	17,700	...	...	5,31,000	2″=1 m., Rs. 30 per sq. m.
Mysore ...	...	...	29,400	3,52,800	1″=1 m., Rs. 12 per sq. m.
Coorg ...	1,600	...	...	48,000	1″=1 m., Rs. 30 per sq. m.
Central Provinces	23,300	...	...	6,99,000	2″=1 m., Rs. 30 per sq. m.
Central Provinces	...	80,600	...	14,50,800	2″=1 m., Rs. 18 per sq. m.
Madras ...	27,000	...	...	10,80,000	2″=1 m., Rs. 40 per sq. m.
Madras ...	...	108,200	...	32,46,000	2″=1 m., Rs. 30 per sq. m.
Madras ...	...	...	16,500	82,500	2″=1 m., Rs. 5 per sq. m.
Total ...	...	...	...	99,71,100	

GROUP IV.—*Areas.*

Name of Province.	Survey.	Re-survey	Revision survey.	Supplementary survey.	No survey required at present.	Total.
Burma	141,500	2,700	None at present.	29,700	83,300	257,200 square miles.
Assam	38,200	21,500	...	9,400	2,200	71,300 ,,
Bengal	26,400	49,700	...	120,300	...	196,400 ,,
Andamans and Nicobars	3,100	...	...	...	...	3,100 ,,
Total ...	209,200	73,900	...	159,400	85,500	528,000 ,,

of which area 2,200 and 83,300 square miles=85,500 square miles, need not be considered at present, as the work is modern. This leaves 442,500 square miles to be dealt with.

GROUP IV.—*Cost of surveys.*

Province.	Survey.	Re-survey.	Revision survey.	Supplementary survey.	Cost for Province of each class.	Scale of survey and cost-rate.
	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.	Rs.	
Bengal	26,400	...	...	...	10,56,000	Rs. 40; 2″ scale.
Bengal	...	49,700	...	...	17,39,500	Rs. 35; 2″ ,, Mostly only on 1″ now.
Bengal	...	...	...	120,300	12,03,000	Rs. 10; 2″ scale.
Burma	141,500	...	...	...	56,60,000	,, 40; 1″ ,,
Burma	...	2,700	...	...	81,000	,, 30; 1″ ,,
Burma	...	...	...	29,700	5,94,000	,, 20; 1″ ,,
Assam	38,200	...	...	...	15,28,000	,, 40; 1″ ,,
Assam	...	21,500	...	...	6,45,000	,, 30; 1″ ,,
Assam	...	...	...	9,400	1,88,000	,, 20; 1″ ,,
Andamans, etc., ...	3,100	...	...	...	1,24,000	,, 40; 1″ ,,
Total ...	...	...	...	...	1,28,18,500	

Abstract statement shewing cost rates of Topographical surveys.

Locale.	COST-RATE PER SQUARE MILE IN RUPEES.											
			SCALES OF SURVEY.									
	Triangulation.	Traversing.	1/4"	1/2"	1"	2"	4"	6"	8"	12"	16"	32"
Sind	11·3	17·0	...	4·3	10·4	14·7	39·6	90·9	...	105·0	...	...
Himalayas ...	17·2	19·0	...	...	21·8	53·9	89 3	...	...	...	...	...
Baluchistan ...	18 2	29·1	...	8·6	10·8	57·2	...	150·5	...	365·4	...	...
Mirzapur	15·2	...	...	...	35·0	79·3	...	...	...	...	...	...
Madras	10·9	...	...	...	16·9	...	...	...	...	...	...	...
Rajputana	3·8	...	...	4·5	18·8	70·1	...	...	...	109 0	...	...
Belgaum and Gujarat ...	7·2	6 3	...	...	...	22·5	103·9	...	100·3	...	...	...
Cutch	7·8	13·1	...	2·9	...	13·5	...	...	...	478·5	...	...
Mysore	7·3	61·4	...	...	18·3	...	...	...	...	461·7	...	...
Malwa	16·5	...	...	...	29·4	...	...	...	...	...	..	...
Southern Maratha ...	7·0	5·6	...	...	...	16·0	...	...	89·6	...	...	...
Deccan	8·9	6·6	...	...	...	19 9	...	...	...	...	...	...
Allahabad	...	28·5	...	...	...	11·5	...	...	...	85·0	...	...
Bombay	...	...	...	...	...	27·4	...	...	...	...	...	...
North-West Provinces ...	...	...	...	...	...	81·1	...	...	...	...	...	...
Mean ...	10·9	20·7	...	5·1	20·2	34·8	77·6	120·7	95·0	267·4	...	...
Upper Burma ...	10 3	...	3·1	...	23·8	...	...	...	...	...	804·2	...
Lower Burma ...	6·6	39·1	...	...	26·4	102·6	98·3	...	...	...	...	...
Burma	...	...	...	...	...	60·9	...	...	...	...	...	...
Mergui	35·0	50·3	...	...	85·8	...	...	...	...	...	...	...
Amherst	...	...	...	...	..	45·3	...	...	...	...	...	...
Kyaukse	...	...	...	...	...	53·1	...	...	...	...	...	...
Upper Chindwin ...	...	...	...	...	56·4	...	...	...	...	...	...	...
Minbu	...	...	...	...	...	26·1	...	...	...	...	...	...
Mean ...	17·3	44·7	3·1	...	48·1	57·6	...	...	...	...	804·2	...
Aden	1·5	...	...	5·2	...	...	...	...	...	...	...	...
Andaman	9·6	35·8	...	9·3	...	...	229·3	...	...	...	...	...
Assam	...	32·9	...	...	...	21·6	...	...	...	...	...	444·3
Lushai	31·6	...	...	...	63 0	...	...	...	...	...	...	...
Brahmaputra Island ...	...	...	...	...	...	13·7	...	...	...	...	...	...
Chittagong ...	...	...	...	...	...	22·7	...	...	...	...	...	...
Jalpaiguri ...	...	49·2	...	...	...	67·9	33·4	...	139·8	...	...	...
Orissa	...	22·6	...	...	10·5	9·1	...	...	...	...	...	...
Indus Riverain ...	...	15·3	...	...	8·5	...	12·4	...	...	...	...	...
Aligarh and Etah ...	18·3		...	...	...	30·7	49·0	...	Includes Triangulation and Traversing.			

For the execution of the work in 20 years, I should, I consider, require in—

	Imperial officers.	Provincial officers.
Circle I or Northern Circle.		
1 party of full strength for Kashmir	2	7
1 party of full strength, the country west of longitude 75	2	7
1 party of modified strength, the country east of longitude 75	2	5
1 special party for the supplementary work in the United Provinces	1	2
Total ...	7	21
I have put a special party for the supplementary work, as I consider this should be carried out at once before the maps get too antiquated. This work would probably not occupy many years, and the men would then be available for other work or for transfer to similar work in other Provinces.		
Circle II or Western Circle.		
I would require 4 parties of modified strength. The work in this Circle is all original survey, re-survey or revision survey. It may be possible to reduce the number of surveyors, but it must be remembered that there will be the mapping of 406,500 square miles roughly to be done in 20 years or 20,325 square miles per annum or at the rate of 5,100 square miles per party on the 2" scale which is very large.	8	24
Total ...	8	24
Circle III or the Southern Circle.		
1 Full party for Hyderabad and Berar	2	7
1 Modified party for Central Provinces and Madras, north of latitude 18° ...	2	5
1 Modified party for Mysore and Madras, north of latitude 12°	2	5
1 Modified party for Mysore and Madras, south of latitude 12°	2	6
	8	23
Circle IV or the Eastern Circle.		
3 Full parties with 1 spare Imperial officer for special work in Burma and Assam ...	7	21
1 Full party for Bengal	2	7
1 special revising detachment for the supplementary work	1	4
Total ...	10	32
Total for Topographical Parties within Indian limits	33	100

F. B. LONGE, *Lieut.-Col., R.E.*

Appendix B.

Sir John Farquharson's scheme for the Revision of the Topographical Maps of India and the organisation required.

1. The basis of the estimates of areas and work for each party is taken partly from the Preliminary Report of the earlier Committee; partly from the "Green Book" shewing the present strength of the topographical parties of the Indian Survey; and partly from the tables* which accompany the report dated Dehra Dun, the 24th March 1905, of the Surveyor-General of India as to the areas and classes of survey (under four heads "Survey," "Re-survey," "Revision," and "Supplementary,") which after an examination of the existing maps, have been considered to be applicable to the future work of revision of all the 1-inch standard sheets of India.

2. The estimate and distribution of parties are not at all founded on "Cost Rates," but on the rates of progress and amount of work done in the past by the various parties who have been already employed on similar work. It is admitted that of some classes of work done there has hardly been sufficient experience. But the same objection applies to "Cost Rates," upon which the Surveyor-General of India bases his estimates and proposals, and in the case of the latter there is the further objection that it is often difficult to say how much they include, *e.g.*, as to cost of superintendence, etc. My own estimates, therefore, must be considered as a check upon those of the Surveyor-General, as they have been prepared from entirely different data.

3. From the Report of the earlier Committee of 1904, and from one or two other sources, but mainly from the former, I have made the following notes of the average rates of progress per season of topographical parties :—

				50 per cent. added.
(1) New survey, 2"	... ...	2,000 square miles	...	*3,000*
Ditto	Assam and Burma ...	1,400 „	...	*2,100*
(2) New survey, 1"	... ...	2,700 „	...	*4,000*
Ditto	Assam and Burma ...	1,700 „	...	*2,600*
(3) Re-survey, 2"	... ...	2,700 „	...	*4,000*
(4) Ditto 1"	... ...	3,500 „	...	*5,000*
Ditto	Assam and Burma ...	2,500 „	...	*3,700*
(5) Supplementary survey	... ...	4,000 „	...	*6,000*
Ditto	Assam and Burma ...	3,200 „	...	*4,800*
(6) Revision...	... ...	4,250 „	...	*6,500*
Ditto	Assam and Burma ...	3,500 „	...	*5,200*
(7) Revision special of recent work like Bengal where the maps are good	... ...	10,000 „	...	*15,000*

The above entries in roman type represent the annual rates of progress of parties with the present average strength; but it is proposed for the organisation, which will have to carry out the revision all over India, to increase that strength by 50 per cent. A corresponding increase of progress and out-put will then naturally be expected, and I have entered in *italics* in the second column above the rates of annual progress which will thus result.

It is upon these that the proposed areas, distribution, etc., shewn on the map opposite the next page and on the tabular statement on page 130 are based.

4. It has been said above that it is proposed to increase by 50 per cent. the strength (for future revision) of each topographical party, and to add to each a subaltern as second Imperial officer. The following will show the strength and cost of the increased party: the strength and cost, as here shewn of an existing party are taken from an examination of the numbers,

* *Vide* pages 115—121 *ante*.

cost, etc., given in the latest "Green Book" of the Survey of India, an average being struck as nearly as I can :

	Imperial officers.	Provincial officers.	Surveyors.	Draftsmen.	Khalasis, etc.	Cost (annual average).
						Rs.
Present strength	1	5	20	14	266	1,00,000
Proposed increase... ...	1	2½	10	7	133	50,000
Future establishment ...	2	7½ say 8	30	21	399	1,50,000

I may add that, especially as to Provincial officers, the average "Present strength" given above seems to exceed proportionally the numbers given as to the strength of a full survey party costing Rs. 90,000 a year in the Report of the preliminary, or earlier, Committee of 1904.

5. It is not proposed in the future organisation to have any parties smaller than full parties. With a fixed area in which officers have to work, the Commanding Officer of each party will have full power to divide or detach smaller sections in any way which he may consider most advantageous for his work. Under the condition of parties of different size, it will evidently be much more difficult to compare and check the periodical outturn of each.

6. As the Committee are aware, my first proposal was to divide the whole of India into rectangular blocks from west to east according to the number of parties available, and to tell off a party to each block to complete the revision of the 1-inch map within the time which may be fixed by the Government of India. This method, however, has been rendered inexpedient by the fact that all the existing maps of India have been examined by the Committee by Provinces, and their existing state and the amount of revision they are likely to require, have all been assessed by Provinces; and the tables prepared by the Surveyor-General to shew what they are likely to require, are also prepared by Provinces or Local Governments. As the whole basis of the estimate of the strength and time required for the revision must depend upon the amount of work which may have to be expended on the existing maps, it follows from the above that my own estimate must be drawn up mainly by Provinces and Local Governments, modified, so far as may be necessary, by the amount of work which each party can do within a specified time. But no change is thereby intended to be made in the principle which the Committee has agreed upon, namely, that Provincial and Local Governments should have no power of interference with the revision of the topographical maps.

7. The table on page 130, which shows the areas allotted to the various parties and the number of years in which the revision is expected to be completed, has been prepared in the following way :—

The classes of the work required are taken from the assessments made for the Province by the Committee, and contained in the tables above mentioned drawn up by the Surveyor-General : to these are applied the annual rates of progress laid down above in *italics* in paragraph 3 : the average rate of progress for the whole Province is then struck : and the total area of the Province divided by this average annual rate in square miles gives the number of years which one party will require to complete the whole of the revision of that Province.

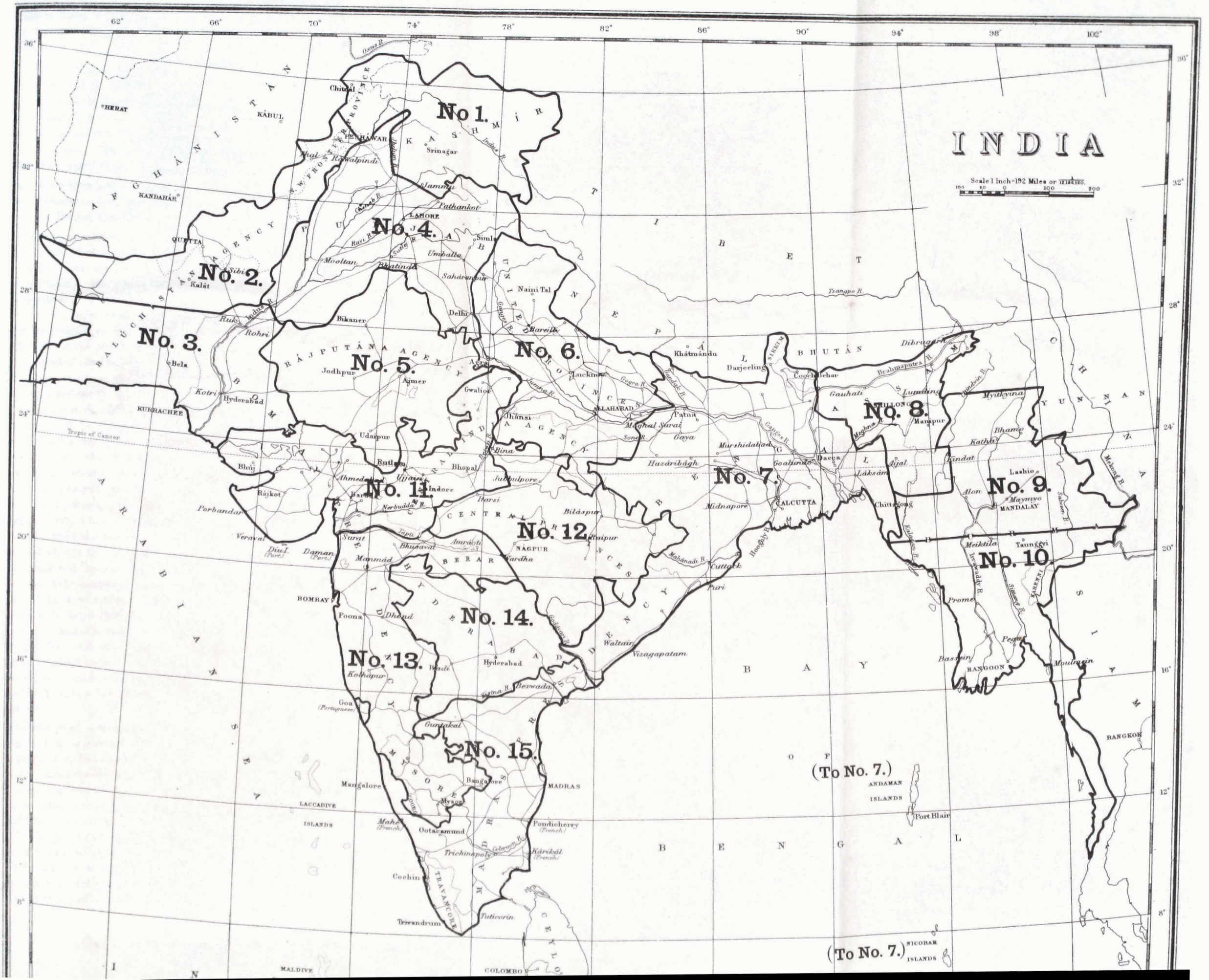
Taking Madras as an example :—the table showing classes of survey required, gives for Madras, see page 120 of the Surveyor-General's Tables :

15,700 square miles "Survey" on the 2″ scale (1);
119,603 „ „ "Resurvey" on the 2″ scale (2);
and 16,372 „ „ "Revision" specially easy of recent good maps (3).

151,675 square miles, total area.

The Surveyor-General's tables now show the areas as modified in Committee. The annual rate of progress is not much affected, being 4,900 square miles for the revised figures.
C. A. BARRON.

SHOWING NUMBER AND LOCATION OF PARTIES TO COMPLETE THE REVISION IN 25 YEARS.



The rates in *italics* in paragraph 3 of this paper give 3,000 square miles a year as the annual rate of progress for (1); 4,000 square miles a year for (2); and 15,000 square miles a year for (3).

The proportions of each class are thus approximately $\frac{1}{10}$, $\frac{8}{10}$, and $\frac{1}{10}$, of the whole area of the Province: and $\frac{1}{10}$ at 3,000, $\frac{8}{10}$ at 4,000, and $\frac{1}{10}$ at 15,000 are found to give a mean annual rate for the whole Province of 5,000 square miles as the annual rate of progress for each party employed in the Province. The whole area of the Province 151,675 square miles divided by 5,000 square miles thus gives 30¼ years as the period which one party would require to revise the Province. Thus if the period of revision is restricted to 25 years, about 25,000 square miles or five years' work must be assigned to another party to revise.

The above considerations will explain why, as a reference to the map will shew, there are so great differences in the areas allotted to the several parties; see for instance the allotment of parties No. 7, Bengal, and No. 8, Assam.

8. The time assumed for the completion of the revision is 25 years. I gave in the statement, which I made at Calcutta in February last, the reason why that period appears to me not to be too long for intermediate and periodic revisions of the maps, namely, the simple reason that in most districts the maps remain good enough for practical purposes for that time after their publication or revision. The present case, however, of a first general revision is different, and it will be for the Government of India to decide what the period is to be. One element is that of cost; if the Government of India decide on 20 years as the period over which the first revision is to extend, a simple calculation shews that, instead of the 15 parties required for a 25-year period, the number will have to be 18½ or an increase of 25 per cent.; if they decide on 15 years, the increase will have to be to 24 parties, or an increase in number and cost of 60 per cent. I do not of course mean that the total cost of the work will be increased by those amounts, but that the annual proportions of expenditure will be thus increased. The areas allotted to each party will have to be largely reduced, while their annual output of work will have to be largely increased. It is also clear that this point affects that of organisation and training. If, as is assumed in this case, the strength has to be increased by 50 per cent., the first two or three years have to be largely devoted to training recruits, and the normal or average output for the whole period will not be reached until the third or fourth year. In order to make up for this deficiency the increase of strength and output has to go on for some years longer; in the case of a period of 15 years probably until the middle of the term, or 7½ years, when, as it is always practically impossible to discharge the increased strength of trained men all at once at the end of the period, discharges will have to begin to bring the force to the required strength when the special work has to be completed. Thus in the case of a short period for carrying out a large special work of this kind a large number of men will hardly have been fully trained when it will be necessary to begin thinking about how they can be gradually discharged; a period of 20 years no doubt makes it easier to solve this problem: but in the case of a 25-year period the service gets for a still longer period the full benefit of the better and more efficient work of the men it has itself trained. On the whole, therefore, I see no reason to change the opinion which I have always expressed that a period of 25 years for the completion of the work now under consideration, is a fair practical compromise between undue delay and undue haste in carrying it out.

9. The next point is as to cost. I have assumed as to this point, and it is natural to do so, that when a sum is given in the "Green Book" as the "Budget" for the year of a topographical party, it includes everything which has to be expended for the maintenance of that party for the year, not merely the men's pay, but the cost of their superintendence, the cost of moving them, the cost of their recess quarters and offices, their camp equipment, office furniture, materials, and everything which is required to enable them to carry out their work in field and office. In that case the method which I have adopted for arriving at future cost is extremely simple. I find the average present budget of a topographical party is Rs. 1,00,000 a year, and I am assuming, as part of my organisation, that it is to be increased to Rs. 1,50,000 a year. Fifteen parties at Rs. 1,50,000 give an annual cost of Rs. 22,50,000, which multiplied by 25 years gives a total cost of Rs. 5,62,50,000. (Expressed in sterling, these amounts come to £150,000 a year, and £3,750,000 for the 25 years.)

Taking, as I think the Committee has throughout done, the area of India as about 1,800,000 square miles, and dividing the total sum of Rs. 5,62,50,000 by that number, we get the cost per square mile to be 31¼ rupees.

10. The Surveyor General of India takes the total cost of the work as estimated by "cost-rates" at Rs. 3,56,95,508, and the total area of India at 1,675,449 square miles; and hence he brings out the cost per square mile at 21·3 rupees per square mile.

This was written before the effect of certain modifications in areas and cost rates in Colonel Longe's estimates had been worked out. The revised figures are :—

Total cost	...	Rs. 3,71,91,200
Area	...	1,673,800 sq. m.
Cost-rate	...	Rs. 22·2 per sq. m.

C. A. B.

There is thus a difference of nearly 50 per cent. between the two estimates, which would have been slightly increased rather than diminished, if we had both taken the same number of square miles as the area of India. (The total cost in sterling as brought out by the Surveyor-General is £2,379,700*.)

* Now practically £2,480,000.
C. A. B.

With reference to annual expenditures, they will manifestly turn upon whether the Surveyor-General's total estimate or my total estimate of cost will turn out to be correct. But as those estimates now stand, the annual expenditure under the estimate of the Surveyor-General will be £118,985† for 20 years, and under my estimate it will be £150,000 for 25 years.

† Now £ 124,000.
C. A. B.

11. This difference of 50 per cent., in the estimated cost of revising a square mile of country, is evidently a vital point.

I must adhere to the correctness of my own estimate unless it can be shewn—

Firstly.—That the rates of annual progress noted in the earlier report of 1904 on the Indian Survey are fallacious. (I may here remark, more especially as no other member of the Committee has acknowledged its assistance, that this little report within its own limited scope has been most useful to me, and that I have derived much assistance from it during the proceedings of the present Committee.) Now, so far as I can gather, the information on this particular point must have been supplied to that former Committee by the Surveyor-General of India, and must consequently carry with it his authority. Not only so, but that information agrees, roughly and inferentially, with statements of progress occasionally entered in the Surveyor-General's annual reports, although it must be admitted that it is extremely difficult to extract *precise* information on this subject from those reports, the progress entered being nearly always of a mixed character.

Secondly.—That the "Budget" amounts entered in the "Green Book" as the expenditure are also entirely fallacious.

12. There is further the element in the question that, as I have already said, "cost rates," unless strictly defined, may often be very misleading; and the further element that admittedly there has been little experience as to the cost of three divisions of the work which has to be done, namely, Re-survey, Revision and Supplementary Survey. Nor can I check the Surveyor-General's rates, because they are merely arbitrary amounts of rupees per square mile. The strength he lays down in paragraphs 32 to 35 of the report, which accompanies his estimate, is also stated arbitrarily, that is, he gives no data of the amount of work for which that strength will be required, and there is no possible means of checking it from that point of view; while many of the parties are described as of "modified," which I suppose means of indefinite, strength, to which no standard of annual cost can be applied until it is known what the actual strength will be. It is true that it may be within the powers of the Committee to remit with their Report the Surveyor-General's estimate to the Government of India *verbatim et literatim* without remark, but I doubt if the Government of India would hold them to be thus relieved of their responsibilities. There are other points connected with the revision which should form the subject of estimates which can only be furnished by the Surveyor-General, if at all; namely, the cost of the preparation in the office of the actual maps which are to be handed to the reviser for his field work; the cost of halving the size of the maps, which the Committee has practically decided on; and the cost of cutting 2 or 3 inches off the size of each map, so as to get rid of the foot-note about the Madras Observatory. None of those items will probably cost very much, but they should not be entirely ignored as to the cost involved.

13. I must now leave this important subject of estimates and of cost for the consideration and decision of the Committee, and proceed to explain the organisation which I would propose for carrying out the revision of the 1-inch standard sheets of India.

In the first place I should not disturb any existing arrangement, except when absolutely necessary, *i.e.*, I should not move a party or an officer or a surveyor or a building so long as they could, where they are at present, be utilized for carrying on the work of revision. There is no doubt one case which might have caused exceptions, namely, military considerations, but under the conditions I am to propose I do not think they will.

14. Following the above principle, there need not be any change as to the present 9 topographical parties, except that they should at once be instructed to recruit up to 50 per cent. additional strength, except in the case of the two frontier parties which seem to be already nearly up to the required strength of surveyors. As one of the latter is likely to be always in the north (No. 11 Party), its recess quarters will have to be changed from Bangalore. This party will have to be nominally allotted to Kashmir, but for several years it will have to remain actually at work on the North-West Frontier. Thus the stations will be for these 9 parties—

No. 1 Party, now in Central Provinces, to remain there (see 12 on map).
„ 2 „ „ „ Berar, to remain there (see 13 on map).
„ 3 „ „ „ Lower Burma, to remain there (see 10 on map).
„ 10 „ „ „ Upper Burma, to remain there (see 9 on map).
„ 11 „ „ „ North-West Frontier, to remain there, but nominally for the present to take 1 on map.
„ 12 „ „ „ Sind, to remain there (see 3 on map).
„ 14 „ „ „ United Provinces, to remain there (see 6 on map).
„ 15 „ „ „ North-West Frontier, to remain there (see 2 on map).
„ 18 „ „ „ Punjab, to remain there (see 4 on map).

Next come the 4 Forest Parties, which it is agreed are to be absorbed for topographical work, and as to three of these the changes need be very slight in the matter of station—

No. 9 scattered over various districts, to take up Rajputana (see 5 on map).
„ 17 now in Bombay, to take up Hyderabad (see 14 on map). Recess to remain Poona.
„ 19 „ „ Madras, to remain there (see 15 on map).
„ 20 „ „ Burma, to take Assam (see 8 on map). (But I believe it is now actually working in a part of Burma, allotted to Assam work).

(All the Burma parties should recess at Maymyo.)

Thus 13 out of the 15 allotments would be provided for from parties now actually existing, all officered and complete, and only requiring to be filled up to necessary strength in the case of most of the topographical parties.

Two remain unprovided for, namely, Central India—No. 11 on map, and Bengal— No. 7 on map. As to these there should, if the surveyors employed on forest work are of the same class as those employed on topographical work, be no difficulty in providing 20 or 30 surveyors for each of these two new parties at once from the four existing forest parties. For the latter are shown as having an average at present of 58 surveyors each.

The two new parties for Central India and Bengal should be numbered 13 and 16, numbers at present wanting on the list. Trained officers would be required to take charge of them. These are available from the two junior officers employed on the cadastral survey of Bengal, young officers being sent to take their place; there should be no scruple, in view of the pressure for topographical work, in adopting this course. This would complete the required number of officers for actual command, *viz.*, 15. But some of these will be occasionally entitled to leave; to meet these casualties there will be others returning to duty, and there seem to be some officers employed on subordinate duties in the Trigonometrical Branch, who are no doubt trained for topographical work, and should be diverted to it if necessary, their places in the Trigonometrical Branch being filled by young officers. Thus a supply of the 15 officers required for command of parties seems assured.

I have hitherto treated as a reserve No. 8 Cadastral Party, with Captain Coldstream, in the United Provinces, because I do not know if its surveyors are fit to take up topographical work. Possibly some of them would, and in any case I believe the party is likely soon to be at the disposal of the Surveyor-General with its officer and seven Provincial officers.

15. The same principles should be followed in the case of Provincial officers. Of these for the 15 Topographical parties from 105 to 120 will be required; they already have 69; Nos. 4, 5, 6 and 7 Cadastral should contribute 14, being half their present strength, leaving a deficiency of only from 22 to 37, say 30. It should be possible to get trained topographers

also in this case from other duties, out of the whole strength of 157 on the Provincial list leaving their places to be filled up by recruits.

Thus as to subordinates the organisation I propose is the simplest possible. Instead of 13 parties, which the Surveyor-General now commands, he would for the revision command 15. Everything else remains as before. So also as to the senior officers; the only change I propose is that the officer now called Deputy Surveyor-General should be turned into Chief Staff Officer; all the other senior officers remain as before. And the only increase in the staff of Imperial officers is the addition of 15 subalterns to form the second officers in all the increased 15 field parties.

16. As to the advantage which is claimed for the system of direct communication between the 15 field parties and the Surveyor-General and his chief of the staff, (instead of through intermediate officers of high rank,) under which they can see every report and every return of work done, check any diversion of strength to other objects, and compare in every respect, and directly instead of indirectly, the work of the whole 15 parties with each other, it is surely too manifest to require being advocated at any length. I say nothing of the cost, unnecessary as I consider it, of a senior staff who themselves do nothing personally to advance the progress of the work, and who would have under them a strength very little exceeding, as to the number of parties, the number at present employed. There would, in addition, be certain demands for offices and clerical staffs.

17. I must next deal with Colonel Kelly's proposals as to the requirements of the Commander-in-Chief for the early re-survey of areas near the North-West Frontier. These are comparatively simple. They seem to me to involve new 1-inch plans for an area little exceeding from 100,000 to 150,000 square miles. To attain this object I would concentrate on that area the whole of the six parties or divisions nearest to it, namely, Nos. 1, 2, 3, 4, 5, and 6 as shown on the map and it ought to be completed in from four to six years. It would be mere peddling at the work to add one or two parties specially to the Survey for this duty. It is true that the revision of the maps in the areas 1, 2, 3, 5 and 6 on the map would be delayed for those four or five years, but on the other hand nearly the whole of the Punjab would be completed straight off, and for the rest of the 25 years the party in the Punjab would be available to accelerate the work of its neighbours. So that at the end of the period things would have reached their level again. But the main reason for my proposal is that I think military considerations, as they prevail on the Home Survey, so much the more should they prevail in India.

18. The moving of the Frontier Drawing Office to Simla, which is also proposed by Colonel Kelly, I should concur in if it were part of a general scheme which it seems to me has much to be said for it, namely, to make a separation between the so-called "rigorous" or "exact," and the so-called "reconnaissance" surveys carried out by the Survey of India. In carrying it out I should have at Simla under the Surveyor-General an officer in the position of the Superintendent of Trigonometrical work, of rank not under Lieutenant-Colonel, to be in permanent command of the five parties nearest the frontier, each of these to have 3 officers so as to supply the demands, which the Surveyor-General complains are constantly being made on him, for officers for special expeditions and surveys, without interfering with the regular work of the Department; to have all his confidential plans stored in his own office, and under his own direct charge; to have a sufficient drawing and printing establishment to produce his own special trans-frontier maps; and to be in touch with the Indian Government, the Commander-in-Chief, and the Foreign Office. But such an officer must clearly be entirely independent of the staff of the Army including the Intelligence Branch. His work would be impossible if he were liable to interference from the local staff at Simla. He should be responsible only to the Government of India and the Surveyor-General. The object in view would be that the Government of India should always have at its immediate disposal not only all maps connected with Frontier and Trans-frontier countries, but an officer possessed of full information as to how and by whom they had been compiled, how far they could be depended on or otherwise, and how best they could be improved, if necessary. It is clear that a duty of that kind could not be effectively discharged by the Surveyor-General himself, consistently with his superintendence of all the interior surveys of India.

SIMLA;
18th April 1905.

J. FARQUHARSON, *Col., R.E. (retired).*

AREA AND DISTRIBUTION OF WORK FOR THE PARTIES.

With reference to the map, the areas and distribution proposed for the different parties are as follows :—

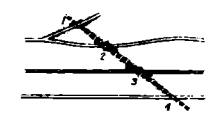
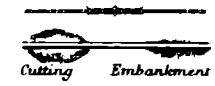
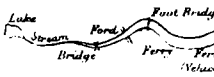
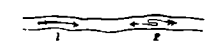
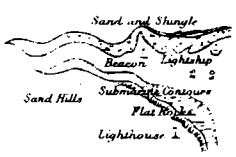
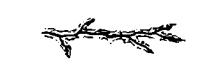
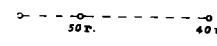
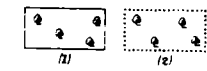
Number of Party.	Number of years estimated for: The whole work.	The part of the work in each Province.	Province or Provinces in which work is allotted to the Party.	Area in square miles allotted in each Province.	Total area in square miles allotted to the Party.	Remarks
1	25½	20½	Kashmir	80,900	...	
		5	North half North-West Frontier Province	19,350	100,250	
2	25½	20½	North Baluchistan	74,000	...	2,740 square miles excluded, just done.
		5	South half North-West Frontier Province	19,350	93,350	
3	20½	15½	South Baluchistan	55,560	...	
		5	Sind	53,000	108,560	
4	21	21	Punjab	102,100	102,100	31,600 square miles excluded, just done.
5	25	25	Rajputana and Ajmere	130,251	130,251	
6	24	20	United Provinces	105,443	...	6,800 square miles excluded, just done.
		4	Central India: Bundelkhand and Bagalkand	20,000	125,443	
7	25	18	Bengal	196,400	...	
		6	Madras N. E. corner: Ganjam and Vizagapatam ...	27,000	...	
		1	Andamans, Nicobars, etc.	3,143	226,543	
8	25	22	Assam	69,100	...	2,200 excluded, just done.
		3	Western Burma—part of...	9,000	78,100	
9	27	27	Burma, North or Upper	82,450	82,450	83,300 excluded, just done.
10	27	27	Burma, South or Lower	82,450	82,450	
11	23	12	Central India	58,772	...	
		11	North Bombay	71,500	130,272	
12	27	27	Central Provinces	103,900	103,900	12,000 excluded, now in progress.
13	23	12	South Bombay	72,300	...	
		6	Berar	17,710	...	
		5	Mysore and Coorg	31,026	121,036	
14	27	27	Hyderabad	82,700	82,700	
15	24	24	Madras	124,695	124,695	
...	...	...	Total ...	...	1,692,100	138,640 excluded.*
...	...	...	Add ...	...	138,640	
...	...	...	Total area ...	...	1,830,740	

* I do not think anything should have been excluded.

J. FARQUHARSON,—15-4-05.

CHARACTERISTIC SHEET OF SYMBOLS
OR
METHOD OF DEPICTING NATURAL AND ARTIFICIAL FEATURES ON MAPS.

Feature.	Symbol or method of depiction. 1 Inch = 1 Mile.	Symbol or method of depiction. 1 Inch = 4 Miles.
Town (actual shape to scale)		
		○
Village	×	×
huts	20 ■	
	Ruins	Ruins
place of Worship	Ch.	
or Pagoda	▲	▲
s' or Dâk Bungalow where a cook and provisions found	D.B.	DB
se (no cook or provisions)	R.H.	RH
t Kyaung	Kg	Kg
ng ground (i.e., one regularly taken up as Govt. and demarcated with pillars)	E.G.	EG
ce	P.O.	PO
h Office	T.O.	TO
l Post and Telegraph Office	P.T.O.	PTO
tation (Thana)	P.S.	PS
(a) Masonry lined. (b) Unlined	Radius 20' (a) ◉ (b) ○	Well
	+ Spr.	+ Spr.
market, centre of supply	Market	
ry or Hospital only necessary in villages—in it may be taken for granted that they exist	(Dispensary) (Hospital)	
h line (need not be shown along railways)	• • • • • • • • • •	• • • • • • • • • •
l G. T. Stations me to be printed level with the base of the triangle.)	Sides of Triangles 60' & 20' G.T.S. △ Akra	Sides of Triangles 60' & 20' G.T.S. △ Akra
ry Stations	Sides of Triangles 60' △ Khari	Sides of Triangles 60' △ Khari
ted points	Sides of Triangles 60' △ Khari	.
metrical Heights	1539	1539
tric Heights	.1923	.1923
ric and Boiling Point Heights	.1360 b	.1360 b
Heights	15 r.	
arks	B. M. 853	B. M. 853
d roads (avenues of trees should be shown)		Same as 1 inch.
oads unmetalled for cart traffic (avenues of trees shown)		,, ,,
track in the plains or camel roads near the Frontier, or trade routes in hilly countries like a, Shan States, &c.		,, ,,
paths, bridle paths		,, ,,
hs (in hills and ravines only)		,, ,,
with distributaries & locks	 Lock	
uct		

Feature.	Symbol or method of depiction. 1 Inch = 1 Mile.	Symbol or method of depiction. 1 Inch = 4 Miles.
Railways—		
Two or more lines		Same as 1 inch.
Single lines		,, ,,
Mineral lines & tramways		,, ,,
Tunnel		,, ,,
1 Roadway over railway		,, ,,
2 ,, under ,,		,, ,,
3 Railway over ,,		,, ,,
4 Level crossing		,, ,,
Viaduct		,, ,,
Cutting and embankment in case of railways, roads, canals, irrigation dams		,, ,,
Cliffs, Precipices, and quarries		,, ,,
Lakes, bridges, fords, ferries, streams, and rivers	 Blue wash for water.	,, ,,
Flow of stream (1)		,, ,,
Tidal stream (2)		
Coast features	 Blue wash for water.	,, ,,
Tanks (with Embankment) (excavated and lined) (1) (2) (3)		,, ,,
Limits of cultivation—		Not to be shown.
(a) Dry	(a) Yellow Ochre.	
(b) Wet	(b) Light blue wash.	
Nullahs or ravines		Same as 1 inch.
Karezes (giving depth of vertical shaft,—in blue if water exists)		Not to be shown.
Marshes, swamps, jhils, bogs	Blue 	Same as 1 inch.
Orchards, baghs, mango groves—		Not to be shown
(1) Walled		
(2) Open		
Woods or jungles	 Forest dense. Forest open. Low shrub jungle.	Same as 1 inch if de at all.
Extensive grass lands		,, ,,
Extensive stony wastes	The words "stony waste" to be printed over the spot on the map.	,, ,,
Mile-stones	. 5	Same as 1 inch, but fourth mile-stone to be shown.
Boundaries—		
Province or State		Same as 1 inch.
District		,, ,,
Subdivision, Tahsil, Pergunnah, Taluka		,, ,,

This is the characteristic sheet of symbols referred to in paragraph 100 of the report. It is understood that for photo. or helio-zincographed maps certain of these symbols must be drawn less finely than here shown.

SUBSIDIARY DIRECTIONS REGARDING SYMBOLS.

Heights. Supplementary heights should be frequently shown along crests of hills and in more or less corresponding places along the valleys, and especially on saddles, and wherever decided changes of slope occur at junctions of roads and streams, and at river crossings, also at intervals along roads, railways, canals, rivers, &c., &c.

Relative heights: In rivers, streams, and nullahs the distance in feet from top of bank to bottom should be shown at every mile or two.

Water. Where the water in streams, nullahs, wells, &c., is undoubtedly perennial it will be shown in blue.

Wells. On the 1″ scale only drinking water wells, and on the ¼″ scale only important ones where the water supply is of great moment, should be shown.

Rainfall. The average amount of the rainfall in inches should be mentioned in a foot-note at the bottom of the map. The distribution during the different seasons should also be roughly indicated.

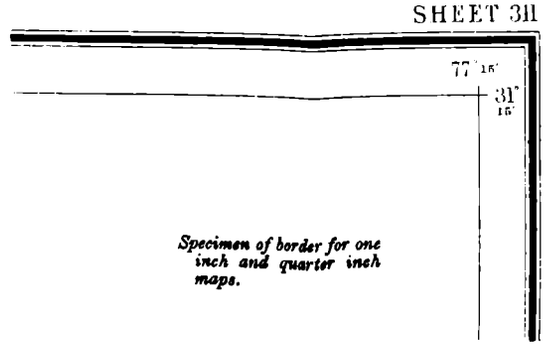
Vernacular names. A foot-note should give the translation of any vernacular names which may be denoted by letters on the map, *e. g.*:—N. (Naddi) = river, Ch. (Choung) = stream.

Communications. Wherever communications cut the margin of a map, the distance to or from, as well as the name of the next important place beyond, should be given in the margin.

Remarkable trees and rocks. When these are shown on the 1″ map, they should be depicted as true to nature as possible.

Railways. When the gauge of a railway differs from the ordinary Indian standard gauge, it should be entered alongside the line.

In the case of a roadway running over, under, alongside, or between the metals on a railway bridge, the word "Road" should be written along the length of the bridge.



Specimen of border for one inch and quarter inch maps.

ɔTIONS REGARDING SYMBOLS.

along crests of hills and in more or less corresponding places along the
d changes of slope occur at junctions of roads and streams, and at river
, rivers, &c., &c.

› distance in feet from top of bank to bottom should be shown at every

undoubtedly perennial it will be shown in blue.

›n the $\frac{1}{4}$" scale only important ones where the water supply is of great

l be mentioned in a foot-note at the bottom of the map. The distribu-
indicated.

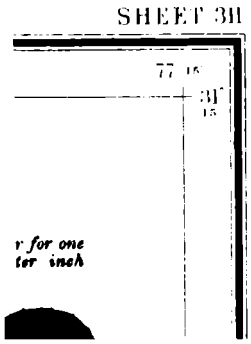
rnacular names which may be denoted by letters on the map, *e. g.*:—

›, the distance to or from, as well as the name of the next important

be depicted as true to nature as possible.

ary Indian standard gauge, it should be entered alongside the line.

gside, or between the metals on a railway bridge, the word "Road"



Report by Colonel S. C. N. Grant, C.M.G., R.E., on the Drawing and Reproduction of Maps and Plans.

I. Summary of deductions and recommendations.

1. The personnel and equipment of the Central Office, Calcutta, are sufficient for executing all the work for the moment required. It would be, however, advantageous to free the drawing department from the actual drawing of all extra-departmental work, which drawing should be done by the requisitioning department.

2. In one or two years' time, when the result of increasing the field parties is felt in the reproduction office, some of the extra-departmental work should be transferred to Poona or Roorkee.

3. The question of taking steps to train apprentices to strengthen the engraving department depends upon the recommendations which may be made by the Committee regarding the method of reproduction to be adopted.

4. The printing of cadastral plans should be undertaken locally by the Provincial Governments.

5. Certain additions recommended to be supplied in the lithographic and photographic departments, would tend to greater order, cleanliness and method. The cost would not exceed in all Rs. 15,000 or Rs. 30,000.

6. In the engraving department the installation of an electro-depositing plant is suggested for consideration.

7. Additional room could be obtained in the Calcutta office by removing the photogravure section to the Central Press; by reducing the strength of the letter-press printing department, and possibly by moving the engravers, but not necessarily the copper printing, to some other building in Calcutta or to some other station.

8. There is no necessity for moving the office from Calcutta, but under certain circumstances it might be advisable to do so.

II. Printing to be provided for.

9. The various maps for the reproduction of which provision has to be made are:—

1. Revenue or cadastral maps.
2. The normal publications of the Imperial Survey of India.
3. Special maps on the same scales as those of the Imperial Survey.
4. Miscellaneous maps, plans and drawings.

Maps, etc., under headings (3) and (4) are prepared for nearly every department of the Government other than that of the Survey.

10. These are large scale maps executed, I believe, with one exception, to be afterwards referred to, by the Provincial Governments. They are a class of map of which the reproduction need not be of any superior finish, and of each sheet comparatively few copies are required. A process,* somewhat recently invented, by which a zinc printing plate can be very simply and economically prepared direct from the original positive drawing, affords easy means for the reproduction of these maps. Very little skilled supervision is required, so that one great objection to decentralisation—increased cost for supervision—is obviated.

Revenue or cadastral maps.

* In the following pages referred to as the Vandyke Process.

The reproduction of these maps might therefore well be undertaken independently by the Provincial Governments and, seeing that such a system would give them complete control, not of the survey only, but of the whole work up to its completion, it would be acceptable to them. To a great extent apparently such a system must obtain already, because the only cadastral maps being printed in the Calcutta Office are those of Bengal and Burma. Those of the former are being printed in what is known as the Bengal Drawing Office, a building separate from the Survey Office, and practically forming an organisation complete in itself. So far as the actual work of reproduction is concerned there would be no difficulty in constituting it a separate entity. Those of the latter, that is Burma, are being printed in the Central Office; this is probably because the work of the survey itself is being executed by a party belonging to the Imperial Survey. It is desirable, in order to make a beginning of clearing from the Central Office all work not purely topographical, that this reproduction be transferred to a local establishment to be started under the Provincial Government in Burma itself.

The normal publications of the Survey of India.

11. These, comprising all the maps of the Imperial Survey, consist of—

The standard sheets on the scale generally of 1 inch to 1 mile, but occasionally of 2 inches to 1 mile.

Forest Survey sheets on the 4″ and sometimes larger scales.

The sheets of the Atlas of India on the $\frac{1}{4}$″ scale.

Divisional and district maps on the $\frac{1}{2}$″, $\frac{1}{4}$″ or $\frac{1}{8}$″ scales.

Provincial maps on the scales of 8 miles, 16 miles, 32 miles and 80 miles to one inch.

General maps of India on the scales of 32 miles, 48 miles, 64 miles, 80 miles, 96 miles, 128 miles, 192 miles and 256 miles to one inch.

The maps of the various Frontier and Trans-frontier series on the $\frac{1}{2}$″, $\frac{1}{4}$″, $\frac{1}{8}$″ and $\frac{1}{16}$″ scales.

Certain miscellaneous maps of the Himalayas and more or less distant tracts of Asia, compiled from the reports of surveyors attached to expeditions, military or political, and from all other available information.

In addition to these maps the Survey of India have recently commenced the preparation of "degree" sheets on the scale of 4 miles to 1 inch, and of a new map of India and adjacent countries on the scale of 1=1,000,000.

The publication of these sheets is the first duty of the Central Office and no other or extra-departmental work should be allowed to interfere with it.

Special maps on the same scale as those of the Imperial Survey.

12. These include all maps of India, Burma and Trans-frontier which are required specially by Departments of the Government for military purposes, illustrating reports and for other purposes for which the normal published sheets are unsuitable. The margins of the map may differ from those of the normal sheets and additional information may be required either by additions to the block plate or by superimposed colour printing, but so long as the scale is the same as any of the maps of the survey these special maps should be able to be prepared more quickly and economically at the Central than at any other office. The preparation of these maps should be considered by the Surveyor-General as next in importance to that of the normal standard sheets.

The preparation of any map which can be made by merely enlarging or reducing any of the existing maps as they stand should be executed also in the Central Office.

13. This category includes a varied assortment of subjects; maps and sketches of ground on scales other than those of the survey, plans and elevations of bridges and buildings, plans of railway crossings, diagrams illustrating statistical returns and so forth. Although a large number of plans of this nature are dealt with in the Madras and Poona offices, a sufficient number remain to be dealt with at Calcutta to cause the work of preparation and printing to exceed that required both for the topographical maps proper, as well as for those maps dealt with in the preceding paragraph. It seems advisable that, for the present, Calcutta should continue to deal with this work up to the limit of its printing powers. Any work exceeding this limit can be dealt with at either Poona or Roorkee. This question will be referred to more in detail later on.

Miscellaneous maps, plans, and drawings.

III. Reproducing offices available.

14. The chief drawing and printing offices available for carrying out this work are:—

1. The Central Survey Office, Madras.
2. The Presidency Printing Office at Poona.
3. The Printing Establishment at Roorkee College.
4. The Survey of India Office at Dehra Dun.
5. The Central Survey Office at Calcutta.

Each of these offices has been visited by me.

The four first named offices were visited by me primarily with the view of seeing to what extent they could be made use of for supplementing at once, or in the future, the drawing and printing capacity of the Central Office at Calcutta. A short report of each is appended, and a few remarks on some of the equipment and methods of reproduction, which are applicable to one or more of these offices, will be found scattered through that portion of this report which deals with the Central Office.

15. This office is supported entirely, I believe, from Presidency funds. It has, exclusive of the Superintendent, a total establishment of 166 at an average wage of Rs. 10·7 per month. Only one draws a salary of Rs. 100 or over. It deals practically with all the work of the Presidency, as none of it comes to the Calcutta Office. It cannot take any more work.

Madras Survey Office, Chepauk.

The buildings are suitably constructed, but unfortunately there is little room for future expansion of the department. The camera house is separate from the rest of the buildings, but this inconvenience is, I believe, being remedied. The equipment consists of one camera and lens, and fifteen hand zinc presses, and the work executed comprises photography, photo-zincography, silver printing, and ferrotype printing, and arrangements are being made to add to these Vandyke printing and helio-zincography. This substitution of helio-zincography for photo-zincography will be an improvement, but the quality of the work would be further improved were the present lens replaced by a lens and prism of latest pattern and superior quality. The camera now in use appears to require repairing or being substituted by a new one. It is noticeable that a very large number of plates for illustrating books and reports are prepared by both silver and ferrotype printing. It seems improbable that, when large numbers of copies are required, such processes can be either economical or satisfactory, and the extension of the work to half tone and zinc block

making might possibly be advantageous. Such blocks could be printed, often with the text appended to them, in the Presidency Letter-press Printing Department, or, if more desirable, a small platen press might be obtained for printing them in the Survey Office.

I interviewed Messrs. Wiele and Klein, photographic engravers, Madras; their work appears to be of satisfactory quality, and their prices, 6 annas to 12 annas per square inch, according to the quality of the original and the finish of the block for half tone, appear very reasonable. This firm has already done work for Government officials, and is available for doing any work of this nature which may be required by the Government, and of which execution cannot be arranged for in the Government office itself.

The zinc plates used in this office were not of a quality well suited for printing purposes.

Bombay Presidency Printing Office at Poona.

16. This office is supported from Presidency funds. It has, exclusive of the Superintendent, an establishment of 110 at an average wage of 22·3 per mensem. One draws a salary of Rs. 300; one a salary over Rs. 200 and less than Rs. 300; and two salaries of or exceeding Rs. 100 but less than Rs. 200.

This is a very efficient office turning out work in large quantity, of various style and of good quality. With a slight increase in personnel and with little, if any, increase in equipment it will be able to relieve, if necessary, the Calcutta office of a very large amount of work. This is discussed more in detail later on.

The buildings are suitably adapted for the purposes for which they are used, but for any large increase in work would require extension. This would offer no difficulty. The equipment consists of five photographic cameras, fourteen hand presses (6 large and 8 small) and, driven by a 12 H. P. steam engine, two lithographic machines, a set of ink rollers and a stone grinding machine. The work executed comprises photography, photo-lithography and photo-zincography, including a large assortment of colour printing, zinc typo blocks, half tone and line. Helio-zincography is being introduced in place of photo-zincography. Vandyke printing would, if introduced, be found, I think, very useful. At present this office draws its work not only from its own Presidency, but from Mysore, Hyderabad, Sind, Central Provinces and other States, and the annual balance of account in its own favour is substantial. Last year it amounted to Rs. 30,911. The output of this establishment is referred to later on, when it is compared with that of the Calcutta office.

Thomason College, Roorkee.

17. The printing establishment is a part of the college, and, like the establishments at Madras and Poona, is kept up at the expense of a Provincial Government; in this case that of the United Provinces. Like every other branch of this college the printing establishment is well-organized and liberally equipped. It is capable of undertaking any work under photography, lithography and zincography, zinc and copper block making, line and half tone, photogravure and letterpress printing. It already does a large amount of work for the Punjab Government and other bodies, but it is capable of taking more work which, up to certain limits, would not necessitate any additional expenditure for increase

either in personnel or equipment. The Principal of the College suggests however that, should the amount of work sent to the college necessitate any new equipment, the initial outlay for the same should be borne by the Government of India and not by the Provincial Government. It is improbable that the Central Government would bear the cost of erecting machinery and immediately relinquish all rights over it; it might claim to have its work produced cheaply or for nothing, but surely any such claim would be inconvenient to the college and to the Provincial Government. It might be advantageous rather for the Provincial Government to erect the machinery necessary at its own cost. The profits obtained from the printing should render the expenditure a not unprofitable investment.

Trigonometrical Survey Office at Dehra Dun.

18. This office has drawing and photo-zincographic sections, numbering altogether 107 permanent employés whose average rate of pay is Rs. 21 per mensem. Of one the salary is between Rs. 200 and Rs. 300; of two the salaries are between Rs. 100 and Rs. 200. The equipment consists at present of three cameras and ten hand-presses, but a power-driven lithographic machine is on order and will be available for use some time this year. The work executed here comprises photography, photo-zincography and helio-zincography, and Vandyke printing.

The office is methodically arranged, and the work turned out is good. The chief work carried out here is that of reproducing the standard inch sheets of the North-Western Frontier and Trans-frontier series, for the Quartermaster General's Department, Forest Surveys of all India excepting Bombay, the topographical survey standard sheets of Sind, and the Punjab. Equipped only with hand-presses for printing, the output of this department is naturally not very great. With the power machine which is now on order the output will be more than doubled and it might then be able to assist, if necessary, the printing of the Central Office by taking up some of the miscellaneous or extra-departmental work which cannot be dealt with at Calcutta.

IV. The Central Office at Calcutta.

19. In reporting upon this office it will be necessary to deal separately with the work special to each department and afterwards to discuss such points as apply to one or more branches generally. My visits to the provincial offices already referred to were hurried ones, made more or less with a special object before mentioned. Time to go closely into detail was not so available as it has been at Calcutta, and consequently many points, noticed at this latter office and discussed here, may apply equally to the other offices.

Engraving Department.

20. The maps which are being dealt with and the plates being engraved are very varied; in addition to work on the four mile atlas sheets engraving is being done on five practically new general maps of India on scales of 64, 80, 96, 128 and 256 miles to an inch respectively; on 16 and 32 mile maps of the Punjab; on a large scale plan of Calcutta, also on six inches and three inches to the mile plans of the same town; as well as on Provincial maps, on the 16 mile scale, of provinces in Bengal, Madras, Bombay and the United Provinces. Apparently there are no arrears of new work—that is to say that all drawing of new survey has been, or is in process of being, engraved on the copper plates. There are, however, a

large number of plates, between one hundred and two hundred, for the correction of which mapping material is in the office. Whether this material is, all or in part, sufficiently reliable to render it desirable to go to the expense of correcting the plates and of incorporating it, is not for me to say; the Committee is probably considering this point and will no doubt refer to it in its report. If it be decided not to make use of it the arrears practically vanish. If, however, it be decided to correct the plates a great deal of work will be involved. The Officer in charge of the section forms the estimate that it would probably take two years to correct all these plates, even supposing that all other work be put aside.

Engraving in India and in England.

21. The native of India makes apparently a very fair copper engraver. It is true his wages are comparatively small, but his rate of progress is so slow that there is probably not very much difference in cost between the work done locally and that executed in England. To strengthen the Calcutta Department by training more natives will take time. The Superintendent gives five to seven years as the length of time requisite for training before a native is capable of working for progress. It is worth considering whether, if the corrections referred to are to be made and two years' arrears to be constituted, these corrections should not be done locally whilst the new work, as material for complete sheets becomes available, might be sent to England. The best method of arriving definitely at the relative cost of engraving done locally and at home would be to send impressions of a number of typical sheets, which have been done here and of which the actual cost of engraving is known, and ask for estimates for the work from several selected firms at home. To enable a comparison to be made the actual cost of local labour should be increased by over fifty per cent. so as to cover the cost of supervision, profits and all the contingent expenses that have to be provided for in any estimate given by a private firm.

Printing from engraved plates.

22. In India it is the practice to print from the originally engraved plates with the result that, even when steel-faced, the work becomes in time obliterated, and the plate itself becomes rolled out so that the work is no longer accurate to scale. At home the original engraved plate is never printed from, except of course for pulling necessary proofs during the process of engraving or etching in the case of hill plates. When the original plate is engraved, a matrix and duplicate plate are at once prepared by electro-deposition, and this duplicate is used for printing all impressions required. By this method the original plate is kept undamaged and intact, and by scraping any detail off the matrix and making a new duplicate, a ready and efficient means is afforded for preparing a new and corrected plate at the time of the periodic revision of the survey on the ground. The question whether it is not advisable to instal the necessary electro-typing plant at Calcutta is worth consideration. The plant which exists at present is comparatively insignificant and, were a general system of making matrices and duplicates decided upon, it would be unequal to the work.

Comparative cost of engraving and helio-zincography.

23. The Committee desired an expression of opinion as to the relative cost of producing either by helio-zincography or some other photo process, or by engraving the entire map of India and Burma on the one inch and half inch to a mile scales respectively. The estimated cost of the surveying and drawing, both of which duties are done by the field parties, will be given by the Surveyor General. But starting from

the completion of the fair drawn manuscript plan, the cost for preparing the map in one colour only may be estimated to be as follows :—

(1) Helio-zincography :—

One inch scale	Rs. 75,000.
Half inch scale	„ 22,500.

(2) Copper-engraving :—

	One inch scale.
Outline	18 lakhs.
Brush drawing for hills	9 lakhs.
Hill engraving	42 lakhs.
TOTAL	69 lakhs.

Both the above estimates are for the cost of personal labour only and exclude any sum for supervision and other contingent charges. For the half inch scale although the area of copper to be gone over is only one-fourth of that for the one inch scale, there are other considerations which enter into the cost and I should put down the cost of each duty as one-half that of the one inch scale, and this will make a total of 35 lakhs.

This estimate is based on the supposition that the drawings completed by the field parties are suitable for photographic reproduction ; that the area of India and Burma amounts to roughly 1,800,000 square miles ; and that there are about 3,500 sheets of standard size to be provided for. However, the area of country dealt with is so great, its topographical features are so varied and there is so little, if any, experience of one inch engraving done in India, upon which to form an estimate, that I should be afraid to put forward the figures without qualification and a request that they may be accepted with some reserve.

Equipment.

24. The equipment of the Engraving Department consists of eight electrically driven presses, including one used for pulling transfers from copper plates for laying down on stone or zinc. A press is now worked with three men including the printer. One plate only is worked at a time. If another man were added to each press and if four plates were worked at one time so that one man would be continually inking, a second cleaning, a third polishing and the fourth printing, a much larger output might be obtained. Possibly a hundred impressions per diem should be obtained from each press, but here and in later instances when an idea is expressed of the amount of work which might be expected from workmen or machines, such opinion is given with some diffidence. Allowance can be made for the shortness of the hours worked and also for the inferiority in physique compared with European labour. But other elements enter into the question. The native while accepting low pay possibly accepts it in exchange for little work. It is possible that, with few exceptions, his output of work would not be enlarged by any increase of pay, and that he would merely throw up his work, if he is what he considers to be unduly pressed. Under such conditions it will of course always be difficult to get from him a moderately honest day's work. This question will be again referred to.

Storing and issue of maps.

25. The racks upon which the maps in stock are stored are open and this leaves the maps liable to discolouration by exposure to light, and to damage by dust and dirt. A few copies of each sheet might be kept at the Headquarter Office whilst the stocks of sheets covering the area of each Provincial Government might be kept, and the issue of sheets made, locally. Some arrangement of this sort would, in addition to facilitating the issue of maps in the areas where they are most likely to be required, also give more room, if required, in the Calcutta office.

Storing of original manuscript documents.

26. The value of the original documents—plans and records of observations and calculations—must by this time be very great, but the provision for their safe keeping and security from fire does not appear to me to be adequate. The arrangements made at Debra for storing these documents were not noted, but at Calcutta the original documents are stored in the same building as that in which the maps are stored. A fire might consume both original and copy when possibly no record of the mapping, other than impressions found by chance in the hands of officials and the public, might remain.

Drawing Department.

27. It will be convenient to take as a basis for some of my remarks on this office, the notes on the Drawing offices contained in the Series of Notes prepared by the Surveyor General for the use of the Committee.

Since the drawing of the fair plans of the current field work is done by the field parties, the chief work which remains for this office is (*a*) the correction and re-compilation and drawing of work which has already been once published, (*b*) the drawing of plans for reduction required in the preparation of the general and special maps of the Survey on reduced scales, and (*c*) the drawing of maps, sketches and plans required for preparing maps specially required by Departments of the Government other than that of the Survey. This last work will hereafter in this report be referred to as extra-departmental work, a term which has been applied to it in previous reports.

Drawing of Survey maps.

28. As regards (*a*) the work consists in (1) compiling and drawing, in complete standard sheets, work previously printed and published in two or more partially completed sheets; and (2) making additions and corrections to the original plans of previously published complete standard sheets of which reprints are required and for which additional material is in the hands of the Department. The arrears of (*a*) may be taken as about 360 sheets and of (*b*) roughly 280. The sheets referred to in the third column of the general abstract of the arrears of drawing given in paragraph 9* of Major Bythell's evidence,—the number of sheets awaiting completion to margin by photography,—will not throw much work on the Drawing Department and do not affect materially the question of any necessary increase of personnel. The work on the sheets referred to above under (1) and (2) would, should the work be executed, require some increase, but the Committee in its report may possibly recommend that this work be not continued and in that case the amount of arrears will be so reduced that no increase on their account will be requisite, especially if, as afterwards recommended by me, the Survey be relieved of all drawing of extra-departmental work.

As regards (*b*) the drawing for reduction is a legitimate work for this office and must continue to be provided for.

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* *Vide* p. 104 of Part II of the Report.

Extra-departmental drawing.

29. We now get to (*c*) the drawing of extra-departmental work or that referred to under heading 4 only, and not 3, in paragraph 9 of this report. For this it appears necessary to make some special arrangements. The present system is objectionable because:—

(*a*) The amount of work that may be asked for is very variable; requisitioning departments generally want their work done urgently and the Survey can often only do this to the detriment of their own work.

(*b*) Unnecessary work is probably often asked for, or,—what is much the same thing,—work is asked for in an unnecessarily expensive form. This is perhaps not unnatural when the applicant has not to bear the expense. It is to be recommended therefore that all the larger departments such as Railways, Public Works, Post and Telegraph Offices, etc., should arrange to make their own drawings and forward them ready for photographic reproduction—either on the same or on a reduced scale.

The Survey should allot a small definite number of draughtsmen for drawing work for the smaller departments which cannot economically employ a trained draughtsman. It should be understood, however, that applications from such departments cannot be treated as urgent, but that the work will be taken up in turn as it is received, and that should greater expedition be necessary other arrangements must be made.

Unlimited decentralisation of the drawing is recommended because draughtsmen can be practically found or trained anywhere, and for the drawing no expensive and heavy plant is required, but undue decentralisation is not recommended for the reproduction by photography and zinc printing, for which work the plant required is expensive, the labour skilled, and the supervision difficult to be obtained.

General remarks.

30. Many of the points noticed by me in visiting this office have been referred to in Major Bythell's evidence,* and to those, such for instance as that of the further use of photography for enlarging and reducing, upon which no difference of opinion exists, it seems unnecessary to make further allusion here.

The outline drawing now being done is good and the typing is generally clear enough for reproduction by the camera, but it is not sufficiently uniform in blackness and density for satisfactory reproduction by the Vandyke process. For present methods of reproduction it is very essential that the original manuscript plans should be kept as clean as possible; it is always difficult to effect this even in England, but I notice that here, where the means are the more necessary, they are not so apparent. One means is the plentiful supply of fine tissue paper, so that the back of the plan, and those portions of the front not being drawn on, may be kept covered up. But more important means are the liberal supply of basins, water and soap, the constant use of the same by the draughtsmen, the continual driving in of precepts inculcating cleanliness and possibly the imposition of fines or reduction of pay for dirty work.

Many plans in course of preparation were of very large dimensions. Requisitioning officers do not appreciate the inconvenience caused by their not being content with sheets of normal size. A plan to print on a double elephant sheet of paper (41″ × 27″) should, except under very exceptional circumstances, be large enough.

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* *Vide* pages 103—109 of Part II of the Report.

Some of the first proofs being examined were printed on hard thin paper, such as would not lift an impression sufficiently good to show correctly the state of the work on the plate.

One or two special maps were being prepared by methods other than those which might have been preferable. The sheets had been prepared by photographic transfers and three blue prints were being inked up for the colour plates. I should have preferred to photograph the originals, which were good enough for photography and which could have been cut and readjusted to form new plates if necessary, and to duff out the three negatives to make the colour plates. This method would have been the more expeditious and possibly the cheaper. I also noticed the preparation of thirty small maps of Native States for the Bengal Government. These were being prepared by cutting the areas out of impressions, mounting on paper and completing the margins and titles for photography. They might, I think, have been better prepared by laying down transfers from copper and completing the titles and margins on the stone or zinc plate. If, however, copies have to be printed periodically, there might be much in favour of getting the maps on negatives and keeping the same as well as the plates.

Co-ordination of drawing and printing departments.

31. The quality of photographic and Vandyke reproductions depends so much on that of the original drawing, that it seems to me desirable that the officer responsible for the final result should have undivided responsibility of the work from its beginning. This would necessitate the amalgamation of the photographic and printing departments with that portion of the drawing department which draws for reproduction in those departments. Such an arrangement has a drawback; it forms a large charge for one officer without an assistant, and this disadvantage is more than an ordinary one in the Calcutta offices where, I think, the departments employing labour should receive a very large amount of superintendence on the part of the officer in charge. With much official correspondence, one officer could not, in my opinion, give sufficient time to the personal supervision of all the work-rooms of the amalgamated department. However, these duties appear to me to be at present too widely separated, the drawing from the photography and printing, and, if during any re-arrangement of the office it be possible to bring them more in touch with one another, it would be to the advantage of the work. The officer in charge of the printing should be able to influence the drawing, and he in charge of the drawing should be well acquainted with all the printing methods. At Southampton these departments, with others, used to be under an officer with an assistant. It was found desirable to relieve the senior of some of his responsibility, and a measure of responsibility direct to the Director General was given to the junior The line between their duties is very lightly drawn by them, they work much together and in the absence of one, even temporarily, the other carries on the work of both. It is only by some system such as this that the responsibility can be divided whilst the influence of both officers makes itself felt through the whole work. It might be urged against making any change that nearly all the drawing is done in the field parties and only a very small portion in the Central Office. This is so, but in order that the officer in charge of the printing may be in a position to write to the field parties to explain how their drawings fail in their requirements, and to make suggestions for their improvement he should have all the experience he is likely to gain from an office of his own.

Photographic department.

32. The photographic department is equipped with one large camera and four smaller ones. The work done is that of photographing plans for the preparation of zinc plates by either transfers or direct contact printing, and for making reductions and enlargements. Up to one or two years ago all the photo-zincographic work was done by transfers, but since then the system of helio-zincography has been introduced. A great deal of transfer work is still done, as in some instances it is rendered necessary on technical grounds, but the better method should be substituted for it whenever possible. To obtain the best results from helio-zincography the original should be drawn for reduction to two-thirds or one-half the scale. Very little improvement of style can be expected so long as reproductions have to be made from the old manuscript drawings, which are on the same scale and in some instances are much damaged and repaired, or from printed impressions.

The present demand on the office is for only about 2,000 negatives a year. It can easily turn out twice that number, and so it may safely be inferred that it can meet all requirements likely to be made upon it in the immediate future. It may require some modification in the existing equipment, or possibly some additional equipment may be required, but this is discussed under the heading of *Cameras* later on.

In many instances advantage is not taken of the means offered by photography of bringing back to scale drawings which may have become distorted by irregular expansion, or contraction of the paper upon which they are prepared. Owing to the comparatively small scale of the survey, as well as to the expansion and contraction which will certainly take place in the paper after printing, this refinement may possibly appear unnecessary, but errors are so apt to occur in every stage of surveying and map-making that correction of them should never be omitted whenever it can be made.

The system of helio-zincography as employed in India differs from that used at Southampton. The English method has never been tried in India, as it has apparently been assumed that the film of insoluble albumen which remains between the ink and the metal would not stand the damp climate of Calcutta. This assumption is possibly an erroneous one. If the metal plate be etched before coating, and the coating solution be made up and put on exactly as it is done at home, there is no reason why, if care be exercised in the manipulation, results equal to those obtained at home should not be obtained here also.

When blue prints of drawings for inking up are required accurately to scale, they should be prepared not by printing on ferrotype or other paper which requires washing for development, but by printing in blue on good paper from a heliographed zinc plate. If the negative itself be to scale, the prints will be to scale also.

Negative retouching.

33. This is a section of the photographic branch. The number of retouchers is at present ten with an average monthly salary of about Rs. 30. The possibilities of this duty are not made the most of at Calcutta. It is seldom that a negative is suitable for making either a helio plate or a transfer without more or less retouching. The negative, moreover, offers great facilities for the correction of errors and insertion of omissions, and when proof or other corrections are many, it is often better to carry them out on the negative instead of on the plate itself. In the

zinc printing room I noticed a plate of a Cachar sheet which was an example of this. The duty is an important one, and although mere duffing is a simple duty and correction of detail not difficult, the touching up of writing or writing new names requires good draftsmen. Bad workmanship will probably spoil rather than improve the negative. Any further introduction of colour printing will throw more work on this duty, and the number of retouchers or glass engravers will require increasing to possibly double its present state.

Negatives, upon which a large amount of work has been expended, increase in value and their retention becomes a matter for consideration. The extent to which this storing of negatives will be economically justified should be determined, and more suitable racks for storing the negatives in the stores should be provided.

Vandyke printing.

34. This process was originated in the Calcutta office and it is being, or will be made use of, not only in the central office but also in the provincial offices for the reproduction of cadastral sheets and miscellaneous work. The necessary equipment does not cost much and natives can very soon be instructed to work it sufficiently well for practical purposes. In this country it has been used chiefly for those maps in the reproduction of which a fine class of work is neither looked for nor necessary. It has, however, been more extensively used in England, and the reproduction of the manuscript sheets of the Ordnance Survey cadastral plans by printing through Whatman's hand-made paper of 216 lbs. to the double elephant ream is in advance of any work produced by this process in India. The methods employed at home and here differ slightly. It is explained that the methods adopted here are simpler for the native and the results are sufficiently good; this may be true, but is it not reducing the methods, and consequently the quality of the finished work, to the level of the average or possibly the worst workman and not raising the workman to the full capacity of the process? In any Department in which a high ideal of work is aimed at, inferior methods, or rather inferior workmanship, should find no place. Vandyke printing at its best will never give results equal to those obtained from heliographed plates prepared from reduced negatives.

In more than one of the offices the printers were printing from Vandyke and other plates on damped paper. This possibly saves the printer trouble, but it has many objections, and there should be no necessity for it if paper suitable for surface printing be used.

Zinc and litho-printing department.

35. The equipment consist of five power machines and 29 hand-presses. Allowing 15 hand-presses be continually employed in proving plates and transferring, 14 remain available for printing. Assuming that each press turns out from 80 to 100 pulls, and each machine from 1,000 to 2,000 pulls a day, the whole department should provide an annual output of at least from 1,500,000 to 2,000,000 pulls. By "pull" is meant one impression made in the machine. A map printed in black and three colours would require *four* 'pulls'; two or three small maps can be laid down on one stone and an impression of all three can be obtained by *one* pull. The number of pulls in a year may be taken approximately as a measure of the work done in the whole department. It is true other considerations come in, but it is simpler to ignore them, and for the purposes of the present report the deductions based on that assumption will be sufficiently correct. In forming the estimate of 1,500,000 or 2,000,000 pulls for the

Calcutta office, allowance has been made for the short daily hours of work, and the excessive number of holidays, and feast days. It is not desirable to press for too large an output which would be obtained only at the expense of good printing.

The total number of printings pulled in 1902-03 was 1,299,617 and in 1903-04, 1,276,681. In round numbers 1,300,000 may be taken as the present annual requirement in the Calcutta office alone. This number may be divided up as follows:—

Regular topographical work which must be printed at Calcutta	360,000 pulls.
Extra-departmental work based on topographical maps which can be more economically produced at Calcutta than elsewhere	177,000 ditto.
Extra-departmental work which could be prepared and printed in any other office	763,000 ditto.
TOTAL .	1,300,000 ditto.

It is apparent then that Calcutta has sufficient printing power to continue for the present all the work which it has been heretofore called upon to do. Should, however, the Committee recommend an increase in the number of field parties as well as the adoption of additional colours in the printing of the maps, these recommendations will appreciably increase the amount of printing required for the regular topographical work, and a time may come when the printing done equals the maximum possible output. It will be then necessary to get rid of some of the extra-departmental work, and this can be done by sending it to either Poona or Roorkee, who are both willing to take it, and are capable of increasing their output, within limits, without any great expenditure in additional machinery. The former, with a few additional draughtsmen only, can increase its output by about 300,000 pulls. The latter also would only have to increase its staff of draughtsmen to enable it to turn out at once an increase of work. The question of any necessary outlay for machinery at Roorkee has already been alluded to. The printing offices can meet without difficulty any practically possible increase in the strength or number of the field parties. If the area surveyed be doubled it should necessitate only one or two hundred thousand pulls of extra-departmental work being transferred from Calcutta to Poona or Roorkee.

Quality of work.

36. Regarding the quality of the work done at Calcutta and in the other offices visited by me, one or two directions in which improvement may be looked for have been already suggested in the remarks dealing with the photographic office, helio-zincographic printing and glass retouching, and later on more may be suggested under graining and other heads. It may be possible and easy after a brief inspection of an office to detect and point out specific instances in which the quality of the work is being sacrificed, but to say exactly how it is to be improved is more difficult. The final print of a map depends upon many processes each one of which requires care, skill and a capacity for taking pains on the part of the workman employed. One careless or unskilled man in the chain of production can spoil all the care and skill expended by others. The Indian Native, taken from the bazaar, cannot reasonably be expected to possess without training those attributes necessary for the production of good work, and, above all, an ideal to work up to. It is possible that many of the workmen in the office have never seen a good impression in their lives, and have no ideal beyond that supplied daily by their own work.

Specimens of continental work are hung up in the Headquarter block of the Calcutta office, but I saw none in the rooms used by the native workmen.

If the quality of the work is to improve, quantity must for a time be kept subservient to quality. Samples of the best continental work should be within sight of every man, and he should be constantly encouraged to work up to it. Increase of salary should be made to depend upon quality of work. More than ordinary care should be taken in the selection of superintending workmen obtained from England, who should be not only workmen of the highest proficiency, but should possess the quality of being able, and should be willing, to impart their knowledge to others. The quality of the supervision is much more important than its quantity. The office at Poona, which is not half the size of that at Calcutta, made an output of about 750,000 pulls in six months, being at the rate of 1,500,000 pulls a year, or actually more than that turned out at Calcutta. The quality of the work is very good, but in comparing this out-put with Calcutta reservations are necessary. Some portion of the Poona work, I do not know how much, consisted of forms, and when I visited the office one machine was running on forms uninterruptedly at a speed that could not have been made use of for plans or maps. The work at Poona was also smaller generally and easier to prepare than that at Calcutta. At Poona, besides Mr. Lemesurier, the Superintendent, there is, I believe, only one European from England and only one other white foreman, but the whole working appeared to me to be methodical, the arrangements orderly, and the rooms and shops clean.

NOTE.—The Annual Reports of the office examined by the Committee after Colonel Grant's departure, show that in 1902-03, three-fourths, and in 1903-04 a still larger proportion of the work consisted of forms.

I do not, however, attribute all these results to supervision only. Some allowance has, I am informed, to be made for the superior qualifications, and characteristics of the natives of Poona as workmen. My opportunities of forming independent opinions on such questions have been insufficient.

With reference to one or two points in Mr. Pope's evidence* which have not been remarked upon by me:—The Southampton map printed by heliozincography is better than that printed here, not, as he suggests, by reason of the amount of work put on the negative as there was probably very little in this case, but on account of better work all through; the original drawing was probably better; the negative was better, although taken with a similar lens; the heliographed plate was naturally better, and the map is printed on a better printing paper.

Mr. Pope would like to have a European printer at each machine. He may be right, but his five printers at, say, forty-two shillings a week at home would amount to 210*s.* a week. I should prefer to bring out one good man at 60*s.* a week in England to superintend generally the machines with native or Eurasian minders in charge of each machine. In the one case the printing would never rise above mediocrity, whilst in the other case it would possess the possibility of reaching a higher level.

37. The only well grained zinc plate which I have seen in India was at Roorkee. This plate had not been grained by hand but by a simple adaptation of the machine introduced in England by Mr. Block, and it is worked by hand. As a good grain can be obtained on a hand-grained plate only by the expenditure of a good deal of muscular work, and since the native whom I have seen in the offices, is either unable or unwilling to expend this force, the box as

Graining plates.

* *Vide* pages 113—118 in Part II of the Report.

constructed at Roorkee and used there, might well be adopted in the other offices.

The sand for graining plates at Calcutta is purchased in England. It must, I should think, be possible to obtain a suitable sand locally.

The plates at Madras are not of a sufficiently good quality for printing purposes. Many of those at Calcutta have done their work and, if good results are desired, should be condemned and replaced by new ones.

Tracing for transfer to stone or zinc.

38. A good deal of this work appears to be still carried on. Any tracings required might well be made on tracing paper for Vandyke printing as the results will be as good, if not better, and the danger of having to make a second tracing should the first not go down well, is obviated.

Preserving plates.

39. At Southampton all zinc plates of Ordnance Survey sheets and other sheets, of which copies may be required, are preserved, so that reprint editions can be struck off without trouble or loss of time. The expense is little more than the amount of the interest on the capital value of the zinc and presses. It is worth consideration how far the adoption of the system is advisable under Indian conditions.

Correction of proofs.

40. An unnecessary amount of undesirable work is at times thrown on the printing department by laxity in other departments, both in and outside the Survey, in not properly preparing originals sent for reproduction, necessitating on this account alterations not only on first proof but also on revise. The correction of zinc plates invariably injures the work. The only way to stop continual offenders outside the office is to be chary of sending proofs.

Letter press printing.

41. The staff of the letter press printing department consists of one Superintendent and 33 workmen, and its equipment consists of 2 wharfdales and 2 platen machines. It prints, in addition to the imprints, transfers and miscellaneous work required for the actual preparation of maps and plans, all or a large quantity of the forms used by the Survey Department. For the former work, transfers, etc., three or four compositors should probably suffice. By transferring the latter work, the printing of forms, to the Government Press the department could be materially reduced. This would save space and lessen the amount of supervision which is at present diverted from the work of map printing proper. It would allow of one wharfdale and one platen being cleared out of the machine-room; this would be a good thing as that room is now somewhat crowded. The one wharfdale and the platen which should be retained might possibly be transferred from the machine room to the composing room.

Photogravure department.

42. The photogravure department employs 28 officials altogether and is fully equipped with cameras, printing presses and everything required for the production of photogravure or heliogravure plates and impressions. The work done has been always of a very high quality, and the Survey of India has reason to be proud of it. It is not however required for map production and might without any difficulty be separated from the Survey Office. Its retention in India will probably be advantageous for the same work upon which it has heretofore been employed, namely, illustrating scientific books, reports and pamphlets issued under Government authority. It might very well be attached to the Central Press or to some office where it would be under better climatic conditions than it is in Calcutta.

The officer in charge of the lithographic department objects to the removal of this department on the ground that it may, in the near future, be made use of for preparing photo-etched plates of hills. There may be something in this, but if this department is fully employed on its legitimate work it may very well be kept at that work entirely, and when the screen hill work may be started, new men might be trained, for it differs considerably from that of heliogravure. For the screen hill work artistic hill engravers are necessary. It is the supply of this labour which will so limit the output that the work of photography will not be much, and might very well be done by the Superintendent of photography.

V. Cameras and Lenses.

Cameras.

43. The general adoption of helio-zincography in substitution for photo-zincography will probably necessitate the provision of larger cameras in place of some of the small ones now found in the different offices. In the latter process a map could be photographed in portions and the transfers joined up together for laying down on the plate or stone. In the former process, however, the whole map must be contained on one negative. The length of the present standard sheet is about 37 inches inside the margins. With the margins themselves and marginal writing the total length requiring to be photographed is about 40 inches. The only cameras capable of taking a plate sufficiently large for this is one at Calcutta and one, a camera room, at Dehra. The question of reducing the size of the standard sheet has, I believe, been raised and will be discussed by the Committee. Should the size be reduced the dimensions of the new cameras will be governed, firstly by the size of sheet decided upon, and, secondly, by the size of any other work of which reproductions may be required.

Where opportunity exists it may be desirable to arrange or construct a camera room rather than to purchase a camera itself. A camera room entering directly into the dark room has many advantages; in the hot weather working in a camera room may be uncomfortable, but if properly ventilated it need not be any more uncomfortable than working in a glass house or in a developing room. It is possible that cameras could be made more cheaply at Roorkee than they could be procured from England.

Lenses and prisms.

44. In the two cameras before mentioned as being sufficiently large for reproducing the present sized standard sheets are fitted Zeiss lenses of 52 inches focus and four or four and-a-half inches diameter. To cover satisfactorily a circle 40 inches in diameter the focus of the lens should, I think, be approximately 60 inches and the diameter not less than 6 inches. If the present dimensions of the standard sheet be retained, new lenses of the diameter given by me should be obtained. The existing ones can be used in the smaller cameras for reduction. Their focal lengths will perhaps render it difficult to adapt the cameras for reproduction. A modern lens of 60 inches focus can now be purchased for a sum varying from three hundred to four hundred guineas, and a prism suitable for use with such a lens will cost from one to two hundred guineas; more than one-half of the cost of the lens is occasioned probably by the correction of the secondary spectrum and this correction, although desirable for colour work, is not essential for map work, and lenses of this quality may reasonably be considered somewhat expensive for placing in the hands of native workmen. One hundred or one hundred and fifty guineas should purchase a first class lens corrected for one colour only.

Prisms, when they get as large as six inches, have disadvantages which are obviated by the use of mirrors. The troubles experienced in the working of silvered mirrors are got over probably in the newly patented solid metal Kuhlbaum mirrors. They are about one-half the cost of prisms, and look as if they ought to answer their purpose satisfactorily. However I am not speaking from experience, but one will be shortly purchased for trial at Southampton. They will undoubtedly require careful handling and possibly for map work will require more careful adjustment to the lens than that provided for general trade purposes. When purchasing lenses advice could probably be obtained from Dr. Glazebrook, the Director of the National Physical Laboratory at Bushey. A new lens testing machine is being constructed under his direction for use at the Laboratory, and all lenses purchased in England might advisedly be sent there to be tested before being accepted. The Laboratory, although a Government Institution, has, I believe, to justify its existence from a commercial point of view and fees are charged for all testing carried out.

VI. Printing Paper.

45. The three properties required in paper for the Indian Survey maps are probably—

Requirements in paper.

(1) Power to resist the discolouring and the disintegrating effects of time.
(2) Capacity of lifting a good impression from the plate or stone.
(3) Sufficient strength and toughness to stand the handling to which the map is likely be subjected.

Unfortunately it is difficult to obtain a paper combining to any satisfactory degree all these properties combined. In England the sheets of the 25-inch and 6-inch maps are much used for estate maps, for illustrating legal documents, and for other purposes rendering it desirable that the paper and ink should resist the ravages of time. If it be considered that the maps of the Survey here are to answer similar purposes, it is necessary that all paper purchased should be examined to ascertain that its constituents are such as will in all probability fulfil the necessary conditions. There is now so much competition in the paper trade, and so many chemically unstable articles are used in the manufacture of paper, that unremitting care is necessary to guarantee that the paper supplied is always up to the specification. Unfortunately for the military map maker it is very difficult, if not impossible, for the paper maker to make a paper which will stand the treatment which most soldiers consider it should do. And if such a paper could be made it would probably be difficult to print on it satisfactorily, for strength and toughness are not often found combined with good printing qualities. The paper upon which many standard sheets are printed has been chosen probably in consideration to those who like a hard paper in preference to a good impression. Some of the extra-departmental work is printed, on a better lifting class of paper, but still, if improved results are to be obtained all round, this question of paper requires more consideration than, so far as I can see, it has hitherto received.

The drawing paper for making original drawings should be the best obtainable. Whatman's hand made paper is used, but the few sheets handled by me do not appear to be so heavy as they might be. That used at Southampton weighs 216 lbs. a double elephant ream of 480 sheets.

Seasoning paper.

46. Practically no arrangements are made in India for seasoning the paper before using it. For ordinary rough work seasoning may be an unnecessary refinement. But for maps intended to retain their scale after printing it is essential, and for colour printing well seasoned paper will register better than that green from the mills. When the desirability of seasoning paper by hanging it up in sheets and exposing it to the air has been suggested, doubt has been expressed whether it would stand the hot damp season in Calcutta; in fact this particular season has been held up as such a bugbear that no recommendation can be made without some misgivings. In the Survey Report for 1901-02 it is explained that the method of helio-zincography had to be changed, because gelatine would not stand, and yet many things containing that article must have sufficient constitution to withstand the putrefying effects of the Calcutta climate. However the sizing ingredient in the better class papers is gelatine, and if it be an absolute fact that this article will not remain good, then resin-sized papers should be obtained. There, however, the compromise comes in, resin-sized papers will not keep so well as those sized with gelatine.

VII. Buildings and fittings.

Provincial offices.

47. The buildings at the district offices visited by me are well adapted for their purpose and for the work they are now turning out. The fitments also appeared to be satisfactory, or at all events the offices being comparatively small, the absence of necessary fitments was not so noticeable as they would be in a larger office.

Calcutta office.

48. As regards the Calcutta office, mention has already been made of the necessity of a zinc plate store and suitable racks; a glass negative store exists, but it is insufficiently fitted; a proper plate graining room should be provided, the work being now done in a verandah; a room should be found and suitably fitted as an expense store for the immediate issue of paper to the machine room, and the enclosures now used for this purpose might be cleared away. Wash-hand basins, water taps and soap should be provided.

Hot plates and electric fans should be fitted for drying off zinc plates in any room where such plates are worked, and a hot plate for the man employed in pulling transfers from copper plates. This man, whose work it is to pull transfers from copper plates, must often require to heat the plates, and he should in all reasonableness have access to a hot plate, yet when I saw him he had to make up a fire of paper scraps and heat his plate over that. Space and fitments for hanging paper when seasoning are wanted, and probably many other things, the absence of which I have not noticed in the short time available.

In the damp seasons many occasions must arise when a general drying room would be useful for hastening and increasing the output of work.

Some of these additions may be considered unnecessary, but, if their provision will tend to train the workmen in habits of orderliness and cleanliness, the money expended upon them will be well spent.

VIII. Removal of the office to another station.

Climatic requirements.

49. If the original documents of the survey, the printed impressions in stock, and the work on the zinc plates will keep in Calcutta there would appear to be, from a technical point of view, no absolute necessity to move the office to another station.

Better atmospheric conditions might however be obtained, and if another station is to be selected the following points should be considered,—a moderately dry atmosphere would be best for the preservation of documents, the storage and seasoning of paper, and the working and preservation of zinc plates. Rapid changes from dry to moist or moist to dry make good registering difficult in colour printing.

Labour requirements.

50. But a more important question in the selection of a new station is that of labour. If all the labour, which can be got out of the Calcutta native, is being obtained in the office at present he is not worth much. At a hand lithographic press it takes four or five men to do one-half, or even one-third of the work that two men will do at home. At machines and platens two men are doing the work which a boy or girl would do at home, and the girl would do more than the two men. In drawing and typing the progress is not one-half of what it is in England, and this is a duty requiring no muscular energy, which there is no apparent reason why the native should not do as well as the European. Again graining zinc plates, two men do about one-quarter as much as one man does at home, and so probably it runs on through all the duties until it strikes one as possible that native labour is not really so cheap as it looks. The possibly little difference between the cost of copper engraving here and in Europe has already been referred to. The only remedies for all this, if the office remain at Calcutta, are firstly, either summary dismissal or decrease of pay for inferior or insufficient work, and increase of pay as a reward for satisfactory work, or secondly, working piecework. I cannot agree with the Assistant Surveyor General in charge of the Lithographic Office that piece-work could not be applied in the printing section. Printing both on hand-press and on machine is often paid for by that method. In the drawing department both drawing and typing, the latter especially, can be pieced out: in the correction however of drawings, stones or plates, the application of piecework rating is more difficult. The same official has, in his evidence, apparently misunderstood the meaning of "overtime" work; but the reasons given by him against lengthening the normal hours of work apply equally against working occasionally overtime. But would not increased hours with increased pay obviate the necessity for the lower paid employés having to work in the bazaars before coming to or after leaving the office? By increasing the hours of work and at the same time increasing the rates of pay, the output might perhaps increase proportionately, but on the other hand it might not. On the whole, if any place could be found where all these difficulties of labour would be ameliorated, it would go far to justify the expenditure of money required for moving the office from Calcutta.

Mr. Pope's arguments against overtime and piecework may or may not be valid, but an office which cannot increase its output by temporarily working its employés on one or other of these methods, must be singularly inelastic and incapable of meeting any temporary pressure of work.

IX. Printing Schools of the Sappers and Miners.

Work required for presses.

51. I visited the school of the Sappers and Miners at Roorkee, and possibly similar schools exist at Bangalore and Kirkee. My only object in mentioning these schools here is to point out that, if any instructions were to be issued definitely directing all extra-departmental work from specified areas to be sent for reproduction to specified offices, some arrangement should be made that sufficient work to enable these

presses to be kept going for training purposes should be allocated to them. The Officer Commanding Sappers and Miners at Roorkee was a little afraid lest, if orders were issued that all work from the Punjab and United Provinces was to be sent to the Thomason College, he should find difficulty in getting work to keep his two hand presses running.

Conclusion.

52. Some apologies are due for this report. Opinions have been expressed and recommendations made with many reservations. My time in India has not been long, and the field of enquiry has been wide. Though all officials have given information readily, it has nevertheless taken time to collect, and questions of climate and local conditions of labour influence to so great a degree many of the problems to be solved that it is difficult, for one with so slight an experience, to advise more dogmatically than has been done.

S. C. N. GRANT,
Colonel, R. E.

CALCUTTA;
21st February 1905.

Tabular Statement of the number of employés and average salaries obtaining in the offices visited. (The Superintendents are not included.)

Office.	The number of employés whose salaries are				Average monthly salary of those receiving less than Rs. 100.
	Rs. 300 and over.	Rs. 200 and up to Rs. 300.	Rs. 100 and up to Rs. 200.	Under Rs. 100.	
					Rs.
Madras	...	...	1	165	10·2
Poona	1	1	2	106	16
Thomason College	...	...	1	105	12
Survey Office, Calcutta:—					
Drawing	10	2	6	62	35
Map Issue	...	...	1	25	33
Photography	1	1	4	33	16·7
Zinc printing	4	...	6	209	13·1
Photogravure	1	...	1	26	16
Engraving	7	1	6	57	21·5
Letterpress printing	...	1	...	33	17·1
Dehra Dun	...	1	2	104	16·8