REPORT

OF THE

INDIAN SURVEY COMMITTEE.

1904-05.

PART II.—APPENDICES.

CALCUTTA:
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1905.

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CALCUTTA:
GOVERNMENT OF INDIA CENTRAL PRINTING OFFICE,
8, HASTINGS STREET.

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REPORT

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SECTION I.

Description of the maps and surveys of the Provinces and States of India, with estimates of the method and cost of bringing the topographical maps up to date or preparing new maps.

MADRAS.

Early survey work.

1. Very complete accounts of the history and methods of the Survey Department in Madras are to be found in the Chapter on "System of Survey" in the Administration Report of the Presidency for 1901-02, and in the Manual of the Administration, Volume I, Chapter II, page 96. It was in Madras, as already stated in Chapter II of Part I of this report, that the first sustained attempts were made both to place survey work on a scientific basis, and to conduct regular topographical surveys. The Presidency has always had a separate Survey Department of its own; but no regular revenue survey was instituted till 1855. The necessity for such a survey had for some time engaged the attention of the Government, and when proposals on the subject were made, the Surveyor-General of India strongly represented that no general survey should be undertaken without complete arrangements for making the materials subservient to the general purposes of geography. His views, though disputed at first, were eventually adopted, and in 1857 Colonel Priestley was appointed Superintendent of the Revenue Survey, with which the other surveys in progress were amalgamated. It was decided that topographical surveys should be prosecuted in non-ryotwari lands, in hill ranges and large waste tracts, while in villages paying revenue on the ryotwari system, a survey on a much larger scale was to be made.

Surveys on which existing maps are based.

2. Almost the entire area of the Presidency has been surveyed either by the revenue or, as they are now called, cadastral parties, or by the topographical branch, but the Atlas sheets are still based on very old surveys, and such attempts as have been made to utilise the results of more recent surveys for incorporation in the standard maps of India have not been satisfactory. Nor has the Survey of India itself attempted much work in this Presidency. Between 1860 and 1877 it surveyed a considerable part of Ganjam and Vizagapatam over areas covering 11 complete standard sheets and portions of a large number of others, but it was not till 1886 that it definitely undertook the responsibility of completing the topographical work in the Presidency. In 1884 proposals had been made for strengthening the local Survey Department, which were referred to the Surveyor-General of

India for opinion. That officer criticised the maps produced by the Madras Department very unfavourably, (a criticism which it is only fair to state was not fully accepted by the Secretary of State,) and after some correspondence and discussion it was decided, with the full consent of the Government of Madras, that the Survey of India should undertake the further topographical work required in the Presidency. A survey party was accordingly sent there in 1886-87; a comparatively small area was surveyed in the neighbourhood of Madura, and a considerable area was triangulated in the State of Travancore with a view to further surveys, when at a subsequent conference at Ootacamund in July 1888, it was decided that the survey party should be transferred to the control of the Madras Government for forest work, and that topographical work should be postponed till the Government of India could spare another party for the Presidency. This time has, however, not yet arrived. The total area which was expected in 1886 to require survey by the Imperial Department was 13,000 square miles, but out of this in addition to the small areas surveyed before the survey party was diverted to forest work, some portions have since been surveyed cadastrally, and others in the course of forest surveys. The total area which has not been surveyed at all up to date is now 6,079 square miles, but the Board of Revenue consider that owing to defects in the old surveys, a new survey will be necessary in other areas as well, and place the total area requiring new survey at 27,141 square miles in the districts of Ganjam, Vizagapatam, Tinnevelly, the Nilgiris, Malabar and South Canara and in certain hill tracts in the Zamindaries of the Presidency. These figures, with some modification on account of the further extension of forest surveys, may be accepted as giving with sufficient accuracy the area that will require an entirely new survey, though it is not possible to show on the index map the exact boundaries of all the tracts concerned. In the rest of the Presidency, assistance will be obtained from the old Imperial Surveys in Ganjam and Vizagapatam, and from the cadastral or topographical surveys made by the Madras Survey elsewhere. The topographical work is in all cases of old date. The Madras parties have discontinued such work since about 1884, and the maps based on surveys made before that date will require operations little less expensive than a new survey to bring them up to the standard of modern requirements. The same is the case with the work done in Ganjam and Vizagapatam by the Survey of India. In these the hills are pure sketch work, and we are informed that inaccuracies have in some cases been found in their position. No heights are given beyond a few fixed by the Trigonometrical Survey; contouring is not attempted, and the revisional operations must be comparatively tedious and expensive.

Value of Madras revenue survey maps.

3. To check the value for topographical purposes of the cadastral work throughout Madras would be impossible without detailed investigation in different parts of the Presidency. Test surveys were carried out in three places for the information of the Committee by the officer in charge of the party now surveying the Madras Forests with results which are creditable to the general accuracy of the Madras mapping. But, apart from some actual inaccuracies, the Madras maps reduced from cadastral maps have been found to be defective in their delineation of topographical features. In one case, for example, in which the position of some points was correct,

others were found to be wrong by about a furlong—a defect which is attributed by the Superintendent of Madras Surveys to the system of compilation of taluk maps in force between 1887 and 1894, and to the contraction and expansion of the paper on which the map tested by Captain Robertson was printed. Some hills were omitted, the drainage lines were incorrect, telegraphs, roads, railways and milestones were not shown, or were not always accurately delineated and classified, and some names were omitted. The Superintendent has examined the original village maps, and states that they do in fact contain all the details of the omission of which complaint is made. The sparseness of detail in the reduced map he explained to be owing to the fact that village boundaries, and other information of administrative importance, had to be shown, and that the additional topographical detail would have over-crowded the map. The explanation is no doubt correct. Defects similar to those found would be brought to light in Survey of India maps prepared from cadastral surveys of old dates in similar ground, *e.g.*, in the North-West Frontier Province; and in these cases, as in Madras, it is not possible to produce a satisfactory map by the simple process of supplementary survey. The elaborate traversing done in Madras will be of great assistance to the surveyor, and he may be able in many cases to use the reduced cadastral map for the delineation of the main features of the ground, but the nature of the country makes it impossible that he should proceed by the same easy methods as in the plains of Upper India. It will be advisable, therefore, to class the whole of this work as resurvey, leaving it to the Surveyor-General to determine the manner in which the Madras maps can be best utilized.

The Native States.

4. In the Native States of this Presidency, Travancore, Cochin and Pudukotta, a new survey will be necessary. Revenue surveys are being made in all three States, but there are no topographical maps at all of recent date, those in use in Cochin and Travancore being based on surveys of 1817-20. A new survey of Travancore and Cochin was considered urgent as far back as 1887, and was agreed to by the States on condition that the expense fell on the Imperial Government.

Locally prepared maps.

5. The Madras Government has a large and well organised Drawing Office and an extensive reproducing establishment, where not only are the results of its surveys published, but much extra-departmental work is undertaken ranging from plans and diagrams to illustrations of books. Plans of villages are now issued on the scale of 8″ to the mile, taluk maps generally on the 1″ scale, and district maps on the $\frac{1}{2}$″ or the $\frac{1}{4}$″ scale. For ordinary civil administrative purposes these maps appear to be found quite sufficient, though a few officers report that the want of maps showing topographical features more completely and accurately is felt; and in some cases it appears that the Indian Atlas sheets based on surveys of the first half of the last century are preferred for their topographical accuracy to the larger scale maps provided by the local Survey Department. The local maps show village boundaries, and in this Presidency there will be no imperative necessity for the Survey of India to issue maps showing such boundaries.

Estimates for producing new topographical maps.

6. The survey of many parts of Madras will, as the recent experience of the Forest Party has shown, be expensive, and the rates given below are the lowest that can safely be applied in making a rough estimate of the cost of the survey most of which will probably be on the 2″ scale:—

—	Square miles.	Rate.	Cost.
		Rs.	Rs.
New survey in Malabar, South Canara, the Nilgiris, the Native States, and in scattered blocks in Ganjam, Vizagapatam, Godaveri, Anantapur and Tinnevelly.	27,000	40	10,80,000
Re-survey in the greater part of the Presidency...	108,200	30	32,46,000
Revision of work done by the Survey of India, chiefly recent Forest Surveys, with the 1,448 square miles done by the Madura Survey in 1886-88.	16,500	5	82,500
	151,700	...	44,08,500

MYSORE.

Previous survey.

7. The State of Mysore is more fortunate in its maps than any other complete province of India, and affords an example of the excellent results that can be obtained when the Survey Department is allowed uninterruptedly to carry out the survey of a tract of country on a definite programme and on a single system.

The standard sheets of this State are numbered and catalogued along with those of the Madras Presidency; and its maps cover in whole or part 70 of these sheets, the survey in all cases extending to the border of the State.

The survey of Mysore commenced in 1874-75, and was completed in 1886. It included, besides the survey of the whole area—29,444 square miles—on the 1″ scale, a few sheets of forest survey, and town surveys on large scales of Bangalore and Mysore. The exceptional good fortune of Mysore was no doubt due to the fact that the State itself paid for the survey, which was thus unaffected by the orders for the reduction of survey expenditure.

State of the maps.

8. Mr. McHutchin, the Secretary to the State in the Public Works Department, has given a most favourable account of the accuracy and utility of these maps. He found it possible to lay out the railway line from Bangalore to Harihar on the map with such closeness, that little change had to be made in the alignment when he actually went over the ground to locate it, and the maps can, in his opinion, hardly be improved. Changes have been entered on the maps locally when they occurred, but it is admitted that such entries are not altogether accurate, and that it would be an advantage to have the maps revised professionally and republished from time to time. In some sheets there have been many alterations since the maps were prepared—as, for example, in the country round the Kolar Gold Fields, but many of the sheets require little change, and Mr. McHutchin considers that, as a whole, the maps could be used for another ten years without revision. It may be said, therefore, that revision, though desirable, is not urgent.

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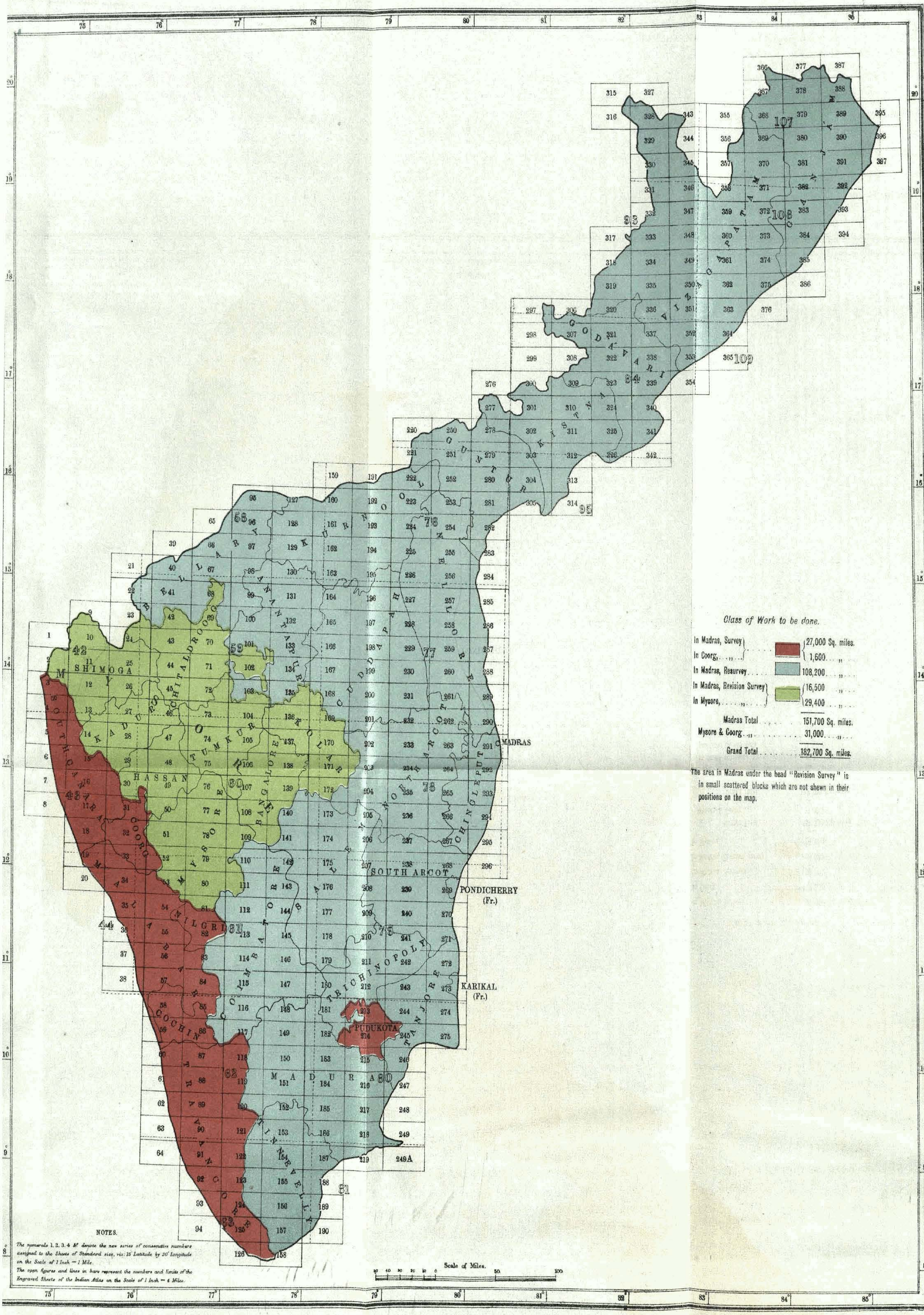

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Revision required.

9. Before revised maps can be published it will be necessary to redraw the sheets. Most of the survey was finished before the clinometer was brought into use, and it will be desirable to increase considerably the number of heights and levels shown on the maps. But nothing more than the revision of the existing sheets in the field is necessary, and the work should neither be tedious nor expensive. Much of the country is easy to survey, and the cost of the revisional operations should not exceed Rs. 12 per square mile. The total cost may therefore be provisionally estimated at Rs. 3,53,328, for the 29,444 square miles comprising the State.

Locally prepared maps.

10. For civil administrative purposes taluk maps on the scale of 1″ or ½″, and district maps on the ¼″ scale are or will be compiled from the 8″ revenue surveys. There would appear, therefore, to be no necessity to show village boundaries on the topographical maps, unless the State specially desires that an edition with boundaries should be prepared.

COORG.

Previous survey.

11. No topographical survey of this small province has been carried out by the Survey of India. Between 1872 and 1879 a topographical survey was made on the scale of 2″=1 mile, and taluk maps on that scale were published, but are now out of print. From these and from the local cadastral maps on the 8″ scale the local Land Records Department has recently compiled a map of the whole province on the ½″ scale.

State of the maps.

12. The existing maps, while suitable for the revenue officials, do not meet the requirements of the Public Works and Forest Departments, and the absence of good maps has been felt both in connection with the working out of irrigation schemes and with the preparation of the project of the Madras-Tellicherry Railway. There can be no doubt that a new survey of this small district of 1,582 square miles is required.

Estimate for new survey.

13. The Surveyor-General estimates the cost at probably Rs. 30 per square mile, on the 1″ scale, provided that the work is undertaken as part of a large programme for the whole of India, and the total expense would in this case be Rs. 47,460.

HYDERABAD.

Previous survey.

14. The one-inch topographical maps of Hyderabad are made from older surveys than those of any other part of India. When the early surveys of Southern India had been completed, Colonel Mackenzie extended his operations into the Nizam's Dominions, and the maps still in use are the results of work commenced by him in 1816, and continued with interruptions to 1866.

State of the maps.

15. For mapping purposes the total area of Hyderabad is divided into 194 standard sheets. The latest catalogue shows 24 such sheets as practically complete and 32 which are incomplete. For the rest of the territory no maps

in standard form have been published, but the whole or a considerable part of the country was mapped by *circars*, administrative areas which are now obsolete or of little importance.

The maps appear from the evidence given to have been fairly accurate, as far as they went, when originally prepared. But they did not go very far, no systematic attempt being made to do more than indicate the hills roughly ; and the changes of over half a century have rendered them almost obsolete. Existing boundaries of taluks and districts are not given : many of the villages shown are no longer in existence or are not known by the names given on the map, while many new villages have since been formed and are not shown. As regards roads, the maps are entirely misleading, existing roads not being shown at all, while roads marked as main channels of communication on the map have disappeared altogether or are mere cart tracks. It is surprising that with all these defects the maps should be found to be of any use, but Mr. Perram, Superintending Engineer to the State, who was deputed to meet the members of the Committee who visited Hyderabad, finds them of considerable assistance in the consideration of his irrigation projects ; though he would greatly prefer maps such as are available for Bombay and Mysore.

Locally prepared maps.

16. For administrative purposes taluk maps are made by joining together the village cadastral plans made by the Revenue Department, but these do not profess to show topographical detail, and will be of little use for a new survey.

Estimate for new survey.

17. It would neither be satisfactory nor economical to attempt to bring these very old maps up to date by merely revising them in the field, and a new survey of this State is unavoidable. The country is for the most part open with numerous hills, and the survey should be comparatively inexpensive, except in the forest tracts to the east and south.

The total area is 82,698 square miles, and judging from the cost of the work done in the Southern Mahratta country it should be possible to carry out the survey on the 2″ scale at the rate of Rs. 30 per square mile. The total cost would thus be Rs. 24,80,940.

BERAR.

New survey already commenced.

18. A new survey of the Berars has already been commenced by No. 2 party, consisting of young officers, Imperial and Provincial, who are undergoing a training as topographical surveyors.

State of the maps.

19. Maps of a portion of this country on the 1″ scale were published by Stanford, London, in 1880-81, prepared by lithography. They were compiled partly from surveys made by Mr. Mulheran between 1856 and 1866 and partly from the old surveys of the Hyderabad Circars. Fifty-seven of these sheets would cover the Province, but 19 of them appear never to have been prepared ; and for these blanks the only Survey of India maps are those of the Circars.

Captain Rich, who superintends the officers under training, states that he finds the maps useful, the main features being fairly accurate, but the hills and rivers are much exaggerated in the drawing, and village names

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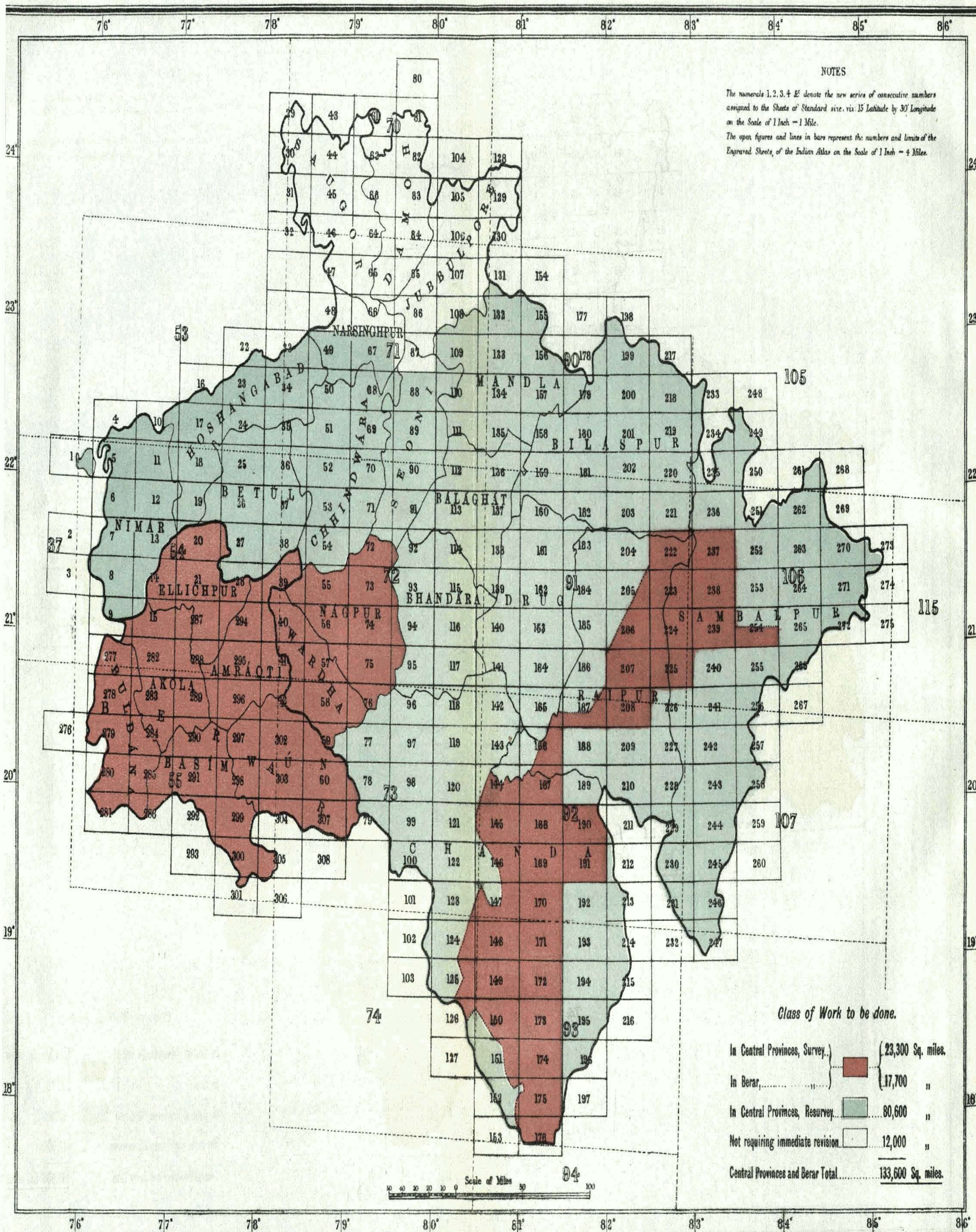

No. 38, S. I.—Jan. 06.—100.
No. 275 Sur. Com.—June 06.—200
No. 487 E., R. & A.—Nov. 06.—400.
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can hardly be recognised ; and, as in Hyderabad, roads and villages have changed much since the surveys were made.

Locally prepared maps.

20. These one-inch maps appear not to be known locally ; the Deputy Commissioner of Amraoti was unaware of their existence and they are not mentioned in the replies received from other officers consulted. For administrative purposes taluk maps compiled from village surveys are used, and there are district maps on the scale of three miles to an inch, prepared at Poona, apparently by reduction and compilation of the taluk maps.

Estimate for new survey.

21. A new survey is, in the case of Berar, as in that of Hyderabad, absolutely necessary. The total area is 17,710 square miles, and the cost rate may as in Hyderabad be taken at Rs. 30 per square mile. The survey may therefore be expected to cost Rs. 5,31,300.

CENTRAL PROVINCES.

(Excluding Berar.)

Central Provinces not visited by Committee.

22. The Committee were unable to visit the Central Provinces, but had an opportunity of examining the officer in charge of the party now employed in revisional operations in the Saugor District ; while a very useful account of the state of the maps is to be found in the Chief Commissioner's letter to the Government of India of 2nd November 1904, and in the replies received to the questions put to local officers.

Previous surveys.

23. The maps, with the exception of those which have quite recently been prepared by the party now employed in the Province, are based on old surveys dating from 1863 to 1883. In the districts of the Nerbudda valley and those lying to the north of it, and in the centre of the Province from Betul to Raipur the surveys were made by revenue parties ; in the hilly belt from Betul to the north of Bilaspur by the Central Provinces Topographical Survey ; and in Sambalpur and other tracts in the east and south by the Ganjam and Orissa, or Vizagapatam Agency parties. Cadastral surveys by local agency, and professional forest surveys of a later date, have extended over a considerable part of the Province. To provide a basis for the cadastral surveys, a traverse survey party was sent to the Provinces in 1885, and having completed this work, it has since 1900 been employed in preparing new standard sheets from the varied material which is available. The cadastral surveys cover nearly a quarter of the Province, chiefly in the west, and the forest surveys extend over a very large and very scattered area of 19,000 square miles in all.

State of the maps.

24. For mapping purposes the Province is divided into 271 standard sheets, but only about 130 sheets have been issued in standard form, and the majority of these are very fragmentary. For other parts of the Province there are sheets on the 1″ scale not in standard form in some parts, compilations known as congregated village plans and main circuit maps in others, and maps on the ½″ scale only in Nagpur, Wardha and Saugor, and in a considerable tract chiefly in native states in the south and east of the Province.

The existing maps, as the dates of survey show, are out of date, and they are also defective in many other respects. The maps of the Survey of India appear to be used extensively in the Central Provinces possibly because the Administration has not been able to supply locally made maps so freely as in some other provinces; possibly on account of the character of the country. The replies to the questions put by the Committee are those of persons who have experienced in their actual work, the inconvenience caused by the absence of good maps. It is complained of the topographical portions of the maps that they do not show village boundaries, and of the revenue portions that they are deficient in topographical detail. The topographical survey maps are said to be more out of date than the revenue surveys, because it is in the hilly tracts that there has been most alteration of detail. In the matter of roads, tanks, villages and village names and in the delineation of hill features, much work will be necessary to bring the maps satisfactorily up to date. From some of the opinions received, it would appear to be thought that, with the aid of information as to changes given by local authorities, and with the assistance of cadastral surveys, it will be a comparatively simple matter to bring the maps up to date, and some sheets have already been corrected and reissued in the manner suggested. The result has been most unsatisfactory. The Survey Department should not in future make itself responsible for the issue of maps as corrected up to a certain date, unless they have been thoroughly revised. The limitation of the use of cadastral maps in such a country as the Central Provinces for the purpose of revision is illustrated by some remarks of the Commissioner of Nagpur which may be quoted :—

"An endeavour was made in the time of Colonel Strahan to bring maps up to date with reference to cadastral maps. The method was very cumbrous and liable to errors and omissions.....It sufficed fairly well to show the alignment of a new road, but for no other purpose, and it was not feasible, where the existing Survey of India maps contained no village boundaries. Hundreds of village traces were sent to the Survey of India Office, and there the matter ended. I believe that the experiment of bringing maps up to date by this method has been abandoned."

Re-survey now required.

25. In the operations now going on, cadastral maps are used where possible, but a very large amount of fresh survey has to be done. The officer in charge of the Central Provinces party is in favour of using reductions of cadastral maps, where possible, and the cost rates of his work show that it is distinctly more economical to do so, in the country he is now employed in, than to make a fresh survey. But it is not possible to produce good topographical maps of such a country as the Central Provinces by such supplementary survey as is sufficient in Bengal, though the utilization of reductions showing trijunction points, boundaries, roads and main streams will greatly facilitate the work of the surveyor, and enable him to proceed at a much more rapid pace than would be possible in a new survey. Work of the class now being done may, therefore, be classed as re-survey throughout, while in the districts and tracts where there are only $\frac{1}{2}''$ maps at present a new survey will be required. The total area of the Province, including native states, is 115,894 square miles. The party now at work has recently revised the maps of some 12,000 square miles in Jubbulpore, Saugor, Damoh, and Narsinghpur. The cost rate of the work now to be done, which will generally be on the 2″ scale, after making allowance for the assistance that will be obtained

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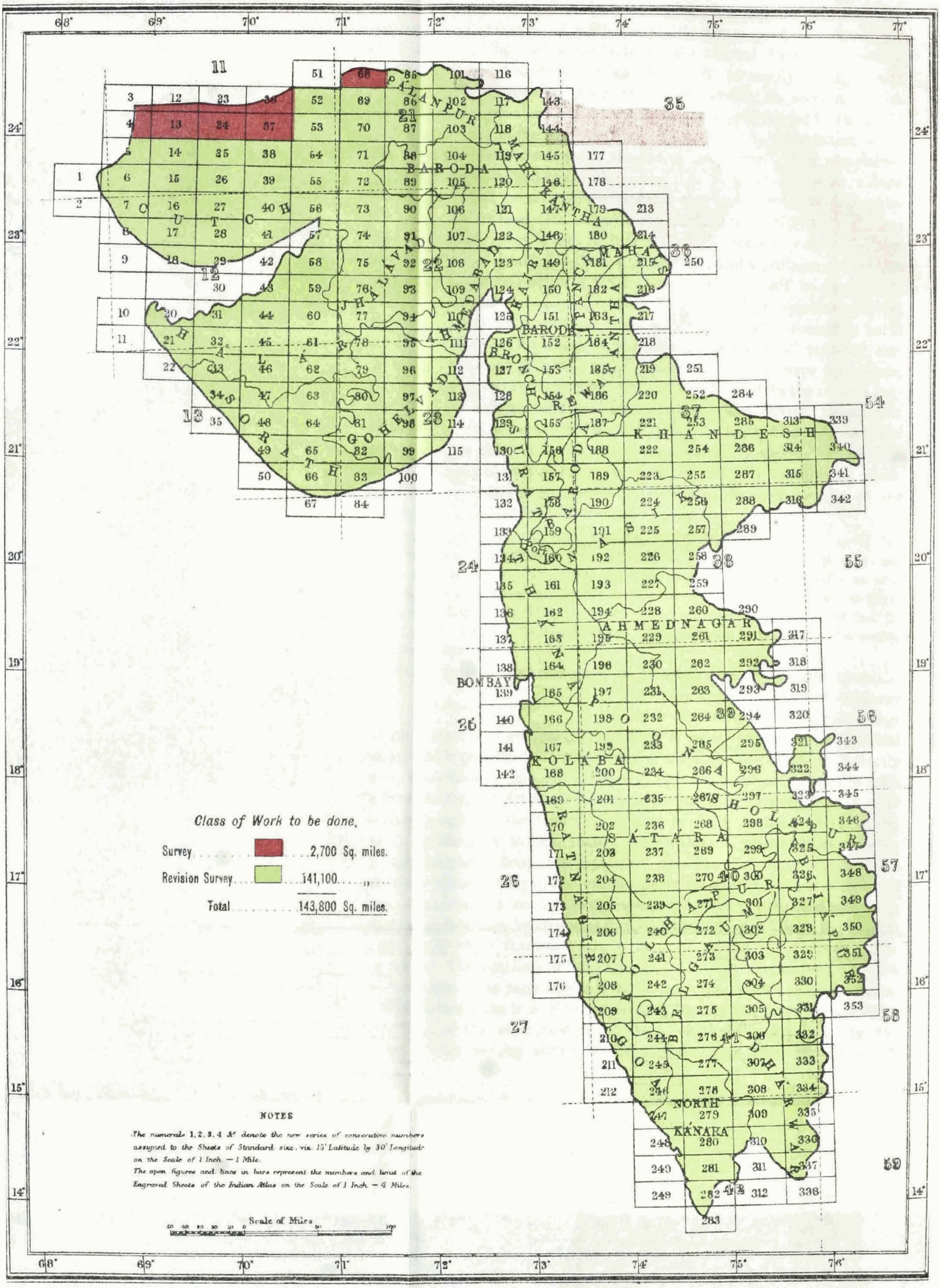

Helio. S. I. O., Calcutta.

No. 59 S. I. – Feb. 05.—100.
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No. 327 ... B ... —Nov. 05.—300

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from forest and cadastral surveys over large areas, may be put provisionally at Rs. 18 per square mile for resurvey and Rs. 30 for new survey. The production of topographical maps for the Province will therefore cost about 21½ lakhs.

Locally prepared maps.

26. The Central Provinces have no local arrangements for the production of maps. Maps on the ½″ scale appear to have been occasionally prepared by the Survey of India for the Administration in places where there have been revenue surveys, and traces on the 1″ scale of tahsils have been made for the use of subordinate officials. These latter contain no topographical detail, and merely show the collection of villages included in the area dealt with. While some such plans are no doubt required by local officers, their use has not been without disadvantage, and the Commissioner of Nagpur remarks :—

"In many cases, however, great errors in appropriate subdivision have occurred from trusting these *mujmili* maps. The same want of maps combining village boundaries with topographical detail has caused many inappropriate boundaries between tahsils and districts."

BOMBAY.

Previous surveys.

27. The Presidency of Bombay (with which for survey purposes the State of Baroda may be included) is better equipped with standard topographical maps than any part of India excepting Mysore. To the north in Cutch, Guzerat and Baroda the maps are indeed based as a rule on very old surveys, dating in some cases as far back as 1869; but even in those parts some of the sheets are the results of surveys made after 1880 and the whole of them are excellently drawn and well reproduced. Further south the comparatively modern maps prepared by the Southern Mahratta Survey party which was at work up to 1896 become available. Some of the sheets in Cutch are published only on the ½″ scale and here a new survey will be required. In the extreme south there is a small area extending over one standard sheet and portions of four others, for which no maps exist.

State of the maps.

28. While it has not had the advantage of a systematic and continuous survey throughout its entire area, Bombay may be considered to have been exceptionally fortunate, as compared with other provinces, in the arrangements made for it by the Survey Department. The surveying done by the Southern Mahratta party, as well as some of the work of other parties, was on the 2″ scale, and a number of sheets have been published on that scale as well as on the 1″. Of the usefulness of these maps, especially those of more recent date, there is information from all classes of officers. A special feature of Bombay is the extent to which the maps have been used by Irrigation Officers, from whom—and especially from Mr. Beale, the Superintending Engineer on special duty,—opinions have been received to which the detailed examination, which they have made of the maps in the course of their duties, lends special value. Even the maps of Cutch are favourably reported on by the Political Agent though, being old, they stand in need of revision. Officers of the Railway Branch have given similarly favourable opinions; and the criticisms of the Bombay maps generally assume the form of suggestions for their further improvement. In some cases inaccuracies have been pointed out which are owing, as a rule, to changes in roads or village sites since the

maps were made. The majority of the maps have not been contoured, even roughly, at any definite vertical interval, as they were executed before any instrument suitable for the purpose was introduced; and the most urgent demand made is for more levels. The great insistence with which the request for additional levels has been pressed by almost all the engineers, whose opinions have been received, may be taken as showing the direction in which even the best and most modern topographical maps of India require most revision.

Revision required.

29. There seems to be no doubt that, in practically the whole of this Presidency, the maps may be accepted as thoroughly satisfactory provided that they are brought up to date by revision.

The total area of the Presidency with Baroda but excluding Sind is 143,800 square miles, of which 141,100 square miles may be classed as requiring revision and 2,700 square miles as requiring original survey. The cost may be taken as Rs. 12 per square mile throughout, involving a total expenditure of 17¼ lakhs.

Locally prepared maps.

30. Owing to the possession up to four years ago of a Revenue Survey of its own, and to the existence at Poona of a well organised reproducing office, the Presidency of Bombay is unusually well supplied with maps other than those issued by the Survey of India. The village maps of the revenue survey, prepared on the scale of 8″ or 16″ to the mile, have been used in the compilation of taluka maps on the ½″ scale, and these again have been incorporated in district maps. In other cases district maps have been prepared on the ½″ scale by reduction from the topographical maps of the Survey of India, with corrections made from information supplied by local officers to keep them up to date. It is not claimed for the locally prepared maps that they are topographically complete or accurate; but these maps, some of which are issued with vernacular as well as English names, are useful for administrative purposes.

Small scale maps.

31. Of small scale maps, the only one which has been prepared for Bombay, apart from the Indian Atlas sheets, is the $\frac{1}{32}$″ map of the whole Presidency, though an outline map on the $\frac{1}{16}$″ scale is in course of preparation. Large maps of a number of towns and cantonments have been prepared on various scales ranging from 6″ to 80″ a mile. The survey of the town of Bombay itself is not amongst those that have been undertaken by the Survey of India.

SIND.

Previous survey.

32. The whole of Sind was originally surveyed between 1855 and 1870 by a Revenue Survey party on the 4″, 2″ or 1″ scale. These surveys were published on the 1″ scale on sheets measuring 30′ Long. × 20′ Lat. The maps are now quite out of date.

Topographical survey now in progress.

33. In 1895 No. 12 Party and a detachment of No. 15 commenced a new topographical survey. Previous to this, from 1892 to 1895, a special detachment had surveyed the Indus on the 1″ scale. The state of the mapping of

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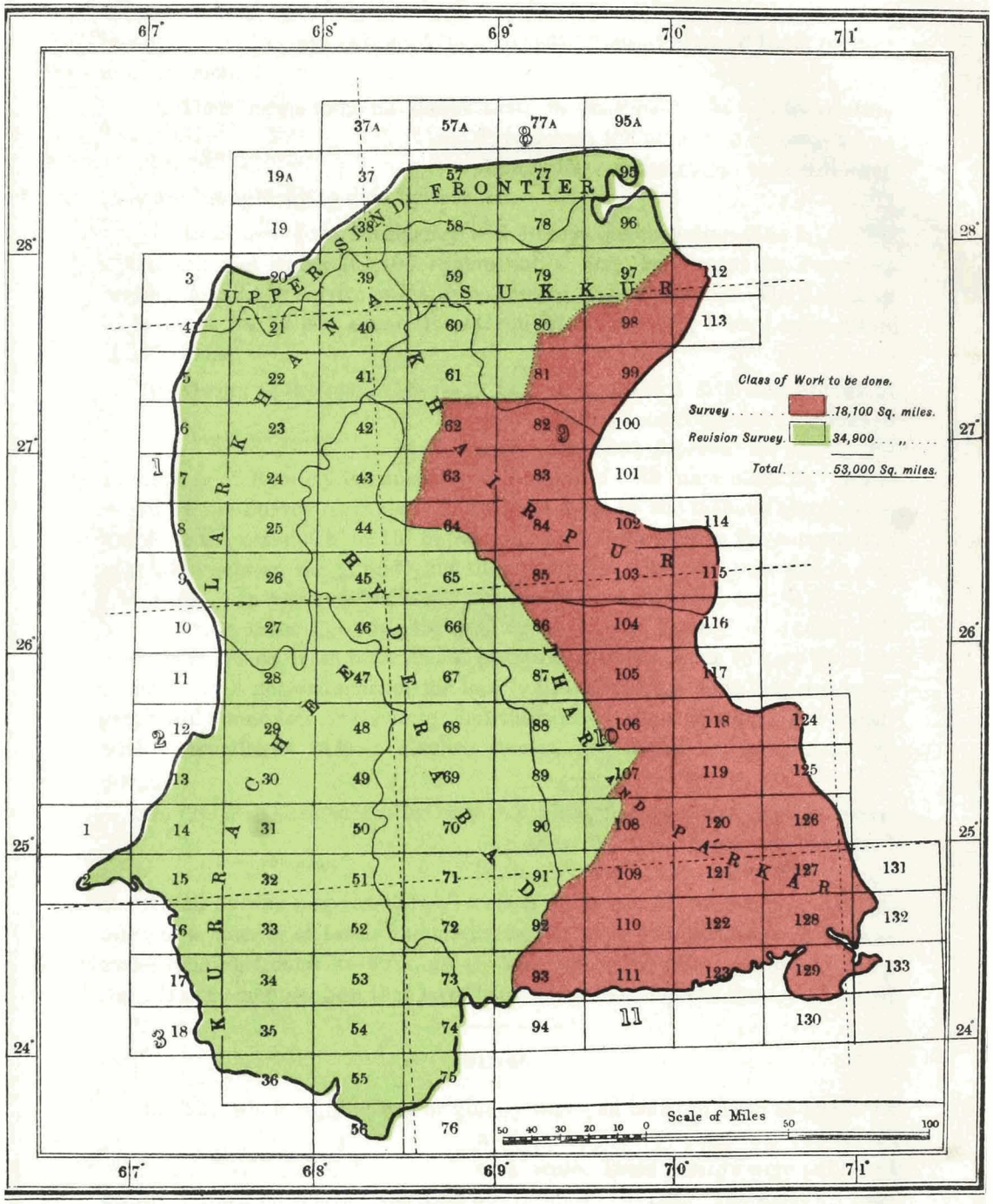


NOTES

The numerals 1, 2, 3, 4 &c. denote the new series of consecutive numbers assigned to the Sheets, of Standard size, viz: 15′ Latitude by 30′ Longitude on the Scale of 1 Inch = 1 Mile.

The open figures and lines in bars represent the numbers and limit of the Engraved Sheets of the Indian Atlas on the Scale of 1 Inch = 4 Miles.

o. 56, S. I.—Feb. 05—200

o. 275, Sur. Com.—June 05—300.

No. 387 E., R. & A.—Nov. 05.—900

Hsho. S I O., Calcutt

Reg. No. 653-S. O

the Province now is as follows, taking it by districts, and allowing for work which will be done by the end of this field season (1904-05):—

Karachi all surveyed lately on the 2″ or 1″ scale	11,971	sq. miles.
Larkana all surveyed lately on the 2″ or 1″ scale	5,051	„ „
Upper Sind Frontier all surveyed lately on the 2″ scale	2,631	„ „
Sukkur—part recently surveyed on the 2″ scale (about)	3,300	„ „
Sukkur—and remainder surveyed on the ½″ scale (about)	2,099	„ „
Khairpur State—a small part recently surveyed on the 2″ scale (about)	1,200	„ „
Khairpur State—remainder surveyed on the ½″ scale (about)	4,850	„ „
Hyderabad—whole recently surveyed on the 2″ scale	8,248	„ „
Thar and Parkar.—a small part surveyed on the 2″ scale (about)	2,500	„ „
Thar and Parkar.—remainder triangulated for ½″ survey which will be completed next year (1905-06)	11,193	„ „

None of the ½″ work (all desert) has been published.

Some 75 standard sheets have been published on the 1″ scale, and of these some 23 have also been published on the 2″ scale at the request of the Irrigation Department.

Work remaining to be done.

34. Out of the total 53,043 square miles comprised in Sind, there is therefore material for mapping about 34,901 square miles on the 1″ scale, revision only being required. The remaining 18,142 square miles will have been surveyed both by the revenue survey, and on the ½″ scale, so that a new survey will be required if 1″ maps are to be produced, but as the country is all desert there is no urgency in the matter.

The approximate cost rates per square mile will be—

	Rs.
Survey (chiefly desert)	15
Revision (if undertaken at once)	2

Locally prepared maps.

35. The Canal Engineers are unanimous as to the extreme use to them of good topographical maps with plenty of levels—2″ scale, if possible. The District Officers generally find the extremely rough maps or plans prepared by the Superintendent, Land Records and Agriculture, Sind, more useful than the Survey of India standard sheets, owing to the absence of revenue detail on the latter.

Collectorate maps on the ½″ scale for reduction to the ¼″ scale are being prepared by No. 12 Party.

Atlas sheets.

36. The ¼″ Atlas sheets of Sind are quite out of date, and the results of the recent surveys have not been incorporated in them.

BALUCHISTAN.

Existing maps.

37. The area of this Province may be taken at 132,300 square miles. The following maps exist:—

(*a*) 1 inch=16 miles, of the whole Province, published in 1901.

(*b*) 1 inch=8 miles, of the whole Province, compiled from ¼″ maps and published in various years from 1897 to 1903.

(*c*) 1 inch=4 miles, of the whole Province, published in various years from 1893 to 1903. The area west of 66° longitude (65,600 square miles) was reconnoitred on that scale. East of 66° longitude the maps were compiled by reduction of the $\frac{1}{2}$".

(*d*) 1 inch=2 miles. The part of the Province to the east of 66° longitude (66,700 square miles) has been surveyed on this scale.

All the above maps are generally accurate as regards physical features, but some of them require more heights, classification of roads, and additions from the recent surveys on the 2"=1 mile scale. They also require corrections regarding names of localities and villages. Political boundaries and approximate tribal limits also requires examining.

A small portion of the country round Quetta was surveyed between 1884 and 1887. No. 15 Party commenced to extend this survey in 1903, and also to revise the sheets of the 1884—87 survey. By the end of this season (1905) 2,740 square miles on this scale will have been surveyed, and this is the only material available for the publication of 2" or 1" maps. This leaves 129,560 square miles to be surveyed. The cost may be taken at Rs. 75 per square mile, giving a total approximate estimate Rs. 97,20,000. The cost of survey is much increased by the necessity for escorts, and we think it would be reasonable not to charge such expenses against the Survey estimates.

Work remaining to be done.

38. The military authorities have asked for maps to be published on the 2" scale of the area north of the general line Dera Ismail Khan-Loralai-Kalat, along latitude 29, taking in Chagai. This may be taken as 34,000 square miles. Having regard to the nature and importance of the remaining 98,300 square miles, it would seem sufficient if they were surveyed on the scale of publication, *viz.* :—1"= 1 mile.

The approximate cost would then be—

2" survey.—34,000 *minus* 2,740=31,260 square miles @ Rs. 75= say, Rs. 23,45,000.

1" survey.—98,300 square miles @ Rs. 40=say, Rs. 39,30,000—a total of Rs. 62,75,000.

Three parties would take about $6\frac{1}{2}$ years to complete the 31,260 square miles considered urgent by the military authorities.

CENTRAL INDIA AND RAJPUTANA.

(*Including Ajmer-Merwara.*)

Central India not visited by the Committee.

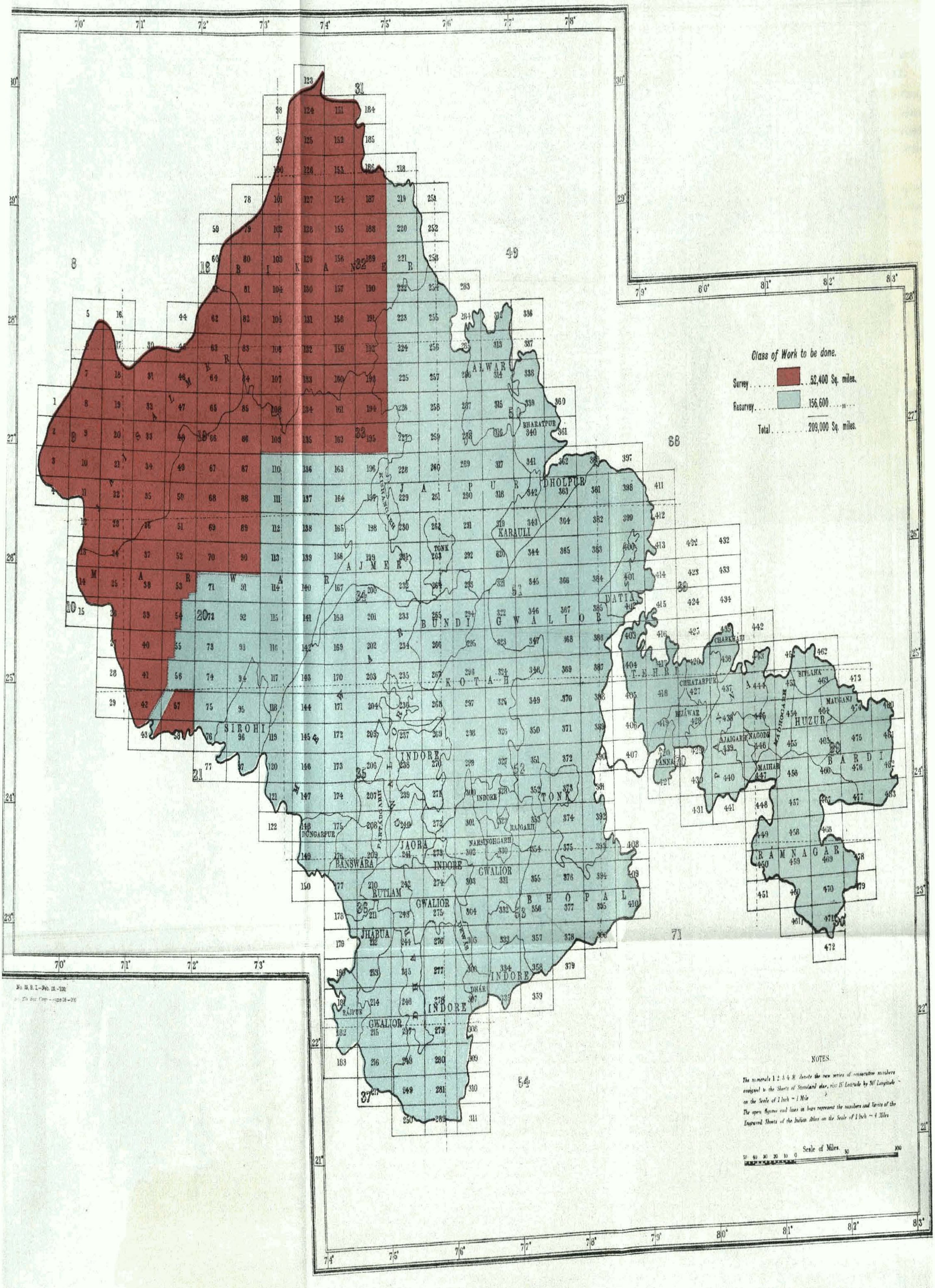
39. The Committee were unable to visit this part of India, but deputed Colonel Kelly to consult the local officials. In this large area no question can arise either as to the advisability of bringing the maps up to date or as to the measures required for the purpose.

Existing maps.

40. Apart from the standard sheet mapping, there are of Central India and Rajputana the following maps :—

(*a*) a general map on the $\frac{1}{16}$" scale of the Central India Agency;

INDEX TO THE STANDARD SHEETS OF CENTRAL INDIA AND RAJPUTANA.



Reg. No. 561-S. 08.

(*b*) a similar map of the Rajputana Agency;

(*c*) 1″ district maps of Ajmere (1876), Merwara (1876), Luni (1879), Bhurtpore (1882), Tehri (1885);

(*d*) numerous cantonment and city plans on large and very varied scales;

(*e*) ¼″ Atlas of India sheets for most (but not all) of the area. All these are out of date.

As regards the standard sheets, it appears that out of 483 sheets into which the country has been divided for mapping purposes, 132 have not been published at all on the 1″ scale. About three-fourths (38,900 square miles) of the area comprised in these sheets has been mapped and published on the ½″ scale; the remainder, 13,500 square miles, has not been surveyed. These 132 sheets refer chiefly to the desert country in the west of Rajputana —in Jesalmir, Bikanir, Jodhpur, and other States.

Previous surveys.

41. The surveys of the 1″ maps (on the same scale) date from 1856 to 1882. The maps are out of date, wanting in much topographical information, the hills are merely conventional, few heights are shown, the table of symbols is frequently omitted, and the reproduction is very rough.

Estimate for new survey and re-survey.

42. A re-survey of the whole of this area, 156,600 square miles, will be necessary. The work should not be very expensive, but the original surveys were not very detailed, and were pushed on with great rapidity to supply material for the Atlas sheets of India, while in some places inaccuracies have been discovered. The cost may be taken at Rs. 30 per square mile for a 2″ survey.

	Sq. m
Ajmere-Merwara ...	2,711
Central India ...	78,772
Rajputana ...	127,541
Total ...	209,024

The ½″ survey was made from 1875 to 1883 (published in 1878 to 1884), and of the area for which only ½″ maps exist as well as of that unsurveyed, new surveys will eventually be necessary. The whole of this area (52,400 square miles) is, however, desert, and there is no urgency in the matter. The work will be inexpensive, the 1″ scale being sufficient in such country, and its cost may be taken at Rs. 15 per square mile.

Cadastral surveys have been or are being made in a few States, but it does not appear that they are as a rule based on professional traverses, and it is highly improbable that any assistance can be expected from them in the topographical mapping of the country.

Locally prepared maps.

43. In Ajmere ½″ district maps in vernacular are made by compiling reductions of village maps; there is no information as to how far the same procedure is followed elsewhere.

PUNJAB.

Preliminary.

44. The annexation of the Province of the Punjab took place in 1849. Its maps have therefore not had time to attain the antiquity of those of parts of Southern India, but it is perhaps true to say that this very lateness of its acquisition has resulted in a comparatively more rapid development, and in few parts of India are the existing maps of the Survey of India more out of date, or less calculated to meet the necessities of the administration of the present day.

In the Cis-Sutlej territories maps had been made between 1832 and 1849, some of which still form the basis of the present maps of these districts. But immediately after annexation, the attention of the Board of Administration was directed to the two points which still, after the lapse of more than half a century, are the main objectives of the maps of the Province, *viz.*, military requirements and the development of the tracts in the plains. Within the first year of British rule, scientific surveys were conducted for the Grand Trunk Road to Peshawar, and for the Bari Doab Canals. Among the main reasons for having good maps in the Punjab are still the prime importance of the North-West Frontier from a military point of view, and the assistance such maps give to the extension of canal irrigation.

Early surveys.

45. The first British rulers of the Punjab not only came from the North-West Provinces, thoroughly trained in an advanced system of revenue administration, but inherited from the Sikhs an efficient and, for the time and circumstances, extraordinarily good revenue system. The necessity of preparing reliable maps of the country for revenue purposes was therefore at once forced upon them. Survey parties belonging to the Revenue Branch of the Survey of India were promptly detailed to carry out this work, and with such energy was it pushed on that between the years 1849 and 1863 complete village maps on the 4″ scale were prepared for the whole of the plains country east of the Indus. The features of the hilly, and in parts mountainous, districts of Jhelum and Rawalpindi rendered this part of the Province unsuitable ground for revenue surveys; they were accordingly topographically surveyed on the 1″ scale during the years 1851-59. The survey of the frontier districts was then undertaken; between 1863 and 1870 Peshawar and Hazara (hilly portion on the 2″ scale); in 1870-74 Dera Ghazi Khan, and in 1873-82 the trans-Indus portions of Bannu and Dera Ismail Khan were surveyed on the 4″ scale up to the foot of the border hills. The survey of the Kohat District, like Rawalpindi and Jhelum, was not attempted by the Revenue Survey parties owing to its comparatively small cultivated area and the hilly nature of the country; it was finally surveyed topographically in 1881-83 on the 1″ scale.

Excluding, for the moment, the Himalayan districts of Kangra and Simla and the hill portions of Gurdaspur, Hoshiarpur and Umballa, the above account explains the early surveys of the districts of the Punjab, as they stood till quite recently. The newly formed districts of Mianwali, Attock and Lyallpur are included in the districts from which they have been carved. There remain the Sikh States in the east of the Province and the Mahomedan State of Bahawalpur on the south. The survey of the Sikh States was a 2″ *pargana* survey conducted during the years 1847-49, while in Bahawalpur a 4″ survey of the riverain tracts and a 2″ survey of the desert portion were carried out in 1869-74, the result being published in 48 sheets on the 1″ scale in 1876. The production of a map for the whole of the Punjab, excluding the Himalayas, was therefore completed with the end of the Kohat survey in 1883-84.

It will have been noticed that practically over the whole of the Province the surveys were undertaken in the interests of the revenue administration. The nature of the country where, with the exception of the large rivers and

the recent artificial extension of railways and canals, there are few topographical details of much importance, lent itself to this treatment. If proper steps had been taken to ensure the keeping of the Revenue Survey maps up to date, and the insertion by supplementary survey of the slight amount of topographical detail required, the Punjab should now possess perfectly serviceable maps for most of the districts in the plains.

Work of the Punjab Traverse Party.

46. The Survey Resolution of September 1882 has been referred to on several occasions. The completion of the 4″ revenue survey of Dera Ismail Khan and Muzaffargarh, and the Murree and Kahuta hill forests in Rawalpindi, set free a party for the topographical survey of the Hissar district where the first attempt was made to carry out one of the main objects of the Resolution, *viz.*, the establishment of a direct connection between the work of the Survey of India and the cadastral work of the village patwaris. The Hissar Survey was a topographical one on the 2″ scale, but it included the determination by traverses of points, (to be permanently marked,) in the interior of the village lands, at intervals of about half a mile, as well as the ordinary traversing of the village boundaries usually carried out in 4″ *mauzawar* surveys. These points were to furnish a basis for the cadastral survey, and the plan was expected to greatly facilitate the mapping of changes and the keeping of the maps up to date generally. The district (as it was then bounded) was completed in two field seasons during which time 3,443 square miles were surveyed at an average cost of about Rs. 33 per square mile. The traversing was estimated to have cost about Rs. 20 per square mile. The maps were published in 1885 on the 2″ and 1″ scales in standard form.

The cost of this elaborate traverse was, however, felt to be excessive, and it was decided to restrict the scientific work to the lowest necessary limit. The professional survey work was therefore confined to—

(1) the skeleton traversing of villages for the purpose of determining the co-ordinate distances of trijunction points; and the projection of maps of trijunctions on the scale of two inches to the mile;

(2) the insertion of topographical details on these maps by reduction from the settlement survey village maps;

(3) the testing and correcting (where necessary) the reduced map by examination in the field;

(4) the drawing of fair maps on the two-inch scale.

It was found that the reductions from the settlement survey maps, when tested, were very correct representations of the ordinary topographical features, and only a few omissions had to be supplied by new surveys. The errors of survey were not greater than were found to become eliminated in the process of reduction. The omissions which had to be inserted at the time of the test were the high banks of rivers, bridges, temples, milestones and the correct limits of village sites.

Work on this system was carried on in the plains districts for six years from 1884-85 to 1889-90. During this period 30,145 square miles were traversed (*i.e.*, trijunction points were fixed,) at an average cost of Rs. 7 per square mile, and 13,822 square miles were tested and finally mapped on the

2″ scale at an average cost of Rs. 7-2-0 per square mile. The traverse and test survey covered the districts of Ferozepore, Jullundur, Ludhiana, the plains portions of Umballa and Hoshiarpur, part of Jhang and the Native States of Kapurthala and Faridkot; while the traverse was extended over the districts of Lahore, Amritsar, Gurdaspur, Sialkot, Gujranwala, Gujrat, Shahpur and the remainder of Jhang. In the Phulkian States of Patiala, Jhind and Nabha a 1″ canal survey was executed, but the party employed in the Punjab was disbanded in 1889-90 in pursuance of the orders for the reduction of survey parties. With the exception of an area covering about five standard sheets in the Jhang District, the whole of the traverse work done between the Sutlej and the Jhelum has been lying unutilized up to the present time. The rapidly developing central districts of the Punjab have had to put up with maps fifty years old, when a very little extra work and expenditure would have given them new maps later than 1890. The result of the traverse party's labours was the publication of revised maps in standard sheet form of the districts of Ferozepore, Hissar, Umballa (part), Ludhiana, Jullundur and Hoshiarpur (part), and the states of Kapurthala, Faridkot, Patiala, Jhind and Nabha. This area was mapped in 51 complete sheets, and portions of 18 others, out of the 340 sheets which cover the Punjab and North-West Frontier Province.

Recent supplementary survey.

47. Supplementary work of this nature was not resumed until 1901-02, when the topographical party which had been surveying in the Kangra and Simla Hills since 1884-85 (its work there will be noticed immediately) was moved down to the plains. During the last three years supplementary survey has been completed in the Lahore District, and in portions of Amritsar, Montgomery, Ferozepore, Multan and Muzaffargarh. This area measures roughly 12,600 square miles. Standard sheets on the 2″ scale have also been published of a small tract along the Chenab River in the Multan District. These areas have been omitted from the calculations for the future survey programme.

Cadastral material available for supplementary survey.

48. A very large amount of cadastral material has been prepared by the Punjab Settlement Department within the last fifteen years, which might have been utilized in the compilation of new topographical maps, had the system inaugurated in 1884 been persevered in. The districts of Lahore, Amritsar, Gurdaspur, Gujranwala, Sialkot, Gujrat, Shahpur, Dera Ghazi Khan, Muzaffargarh, Montgomery, Multan and Jhelum have been mapped since about 1890. The Government of India in their Agricultural Resolutions of 1896 noticed favourably the Punjab system of keeping land records and cadastral maps up to date. The mapping of the fields is carried out by the local patwaris, or village accountants, to whose training in survey work the Local Government attaches great importance. From the experience of the Survey officers who have done supplementary work on the Settlement maps, the results appear to be sufficiently accurate to be of considerable assistance in preparing revised maps, provided the mapping of the local agency is confined to villages in the plains, and is connected with the professionally ascertained triangulated points. But a rigid supplementary survey is required in all this tract, to ensure the proper classification of roads, streams and nullahs, and to secure the entry of such topographical detail as the patwari omits as being unnecessary for revenue purposes.

For the whole of Sialkot, Gujranwala, Gujrat and Shahpur, the plains portion of Gurdaspur and the remaining part of Amritsar, complete traverse data are available. A supplementary survey should be carried out in these districts as soon as possible, before the cadastral maps—now already 10 years old—become any further out of date; the area is about 14,460 square miles and the cost of reducing the patwari's maps and carrying out the supplementary survey should not be more than Rs. 10 per square mile when the parties are in full working order.

In the remaining portions of Montgomery, Multan and Muzaffargarh in Dera Ghazi Khan, which have recently been settled, and in the new Mianwali District, at present under Settlement survey, where traversing will be required—the cost will be somewhat greater. It will suffice to take a rate of about Rs. 15 per square mile for 18,800 square miles.

In the Cis-Sutlej part of the Punjab plains there are four districts, Delhi, Karnal, Rohtak and Gurgaon, with an area of 8,224 square miles, where the only maps are 1″ district sheets, compiled previous to 1850 from the 4″ revenue village surveys. Gurgaon and Karnal are at present under cadastral survey, and it is understood that Rohtak and Delhi will come under re-survey by the settlement staff within the next two years. In these districts supplementary survey will suffice, but it is advisable that a preliminary traverse should be made to form a check on the cadastral operations. Under this category may be placed the Native State of Bahawalpur with its 15,000 square miles of territory. In the parts of this State in which a re-survey is required the cost will probably not exceed that of supplementary work.

Re-survey required.

49. In the three northern districts of Jhelum, Rawalpindi and Attock the maps are 45 to 50 years old. This is the most important part of the Province from the military point of view, but, although Rawalpindi is the constant scene of military manœuvres, no reliable military maps exist, with the help of which an officer could lead troops accompanied by guns and baggage with certainty from any one point to any other point across country. This grave defect should be remedied as soon as possible. The broken nature of the country makes it unsuitable for the compilation of maps from cadastral material. The contouring and delineation of the hill features must be accurate and all topographical details must be mapped. A new topographical survey of these three districts, covering an area of 8,845 square miles, is therefore necessary. The cost of re-survey on the 2″ scale will probably be Rs. 45 per square mile.

The new district of Lyallpur covers that portion of Jhang which was traversed, but not tested and mapped, in 1889-90. But the creation of the Chenab Canal Colony and of the similar colony on the Jhelum Canal in the Shahpur District, has rendered the previous traverse data quite out of date and insufficient. From the evidence received, there is reason to believe that the squares, which were laid down by the Irrigation Department for colonization purposes, were extended over too large an area from a single base, and have in places become distorted. The whole face of the country has been entirely changed since any of the existing maps were made, and in the two Colonies it will be better to make a complete re-survey at once, using the available material as far as possible rather than attempt supplementary work. The re-survey will include a traverse of the trijunction points of the newly

formed villages, so as to assist future cadastral surveys, but will not cost nearly so much as the work in Jhelum. A rough estimate at the Jhelum rate for 4,000 square miles will cover the expenditure.

Revision required.

50. The districts of Umballa, Hissar, Ferozepore, Ludhiana, Jullundur, Hoshiarpur (plains portion), part of Jhang, the Sikh States of Patiala, Jhind, Nabha and Faridkot and the State of Kapurthala and other minor states, such as Maler Kotla, have 1″ maps which were prepared after the supplementary surveys of 1884-89. These maps are of comparatively recent date, and are reported to be sufficiently accurate as to details. In this area of roughly 24,600 square miles it will be quite sufficient to revise the maps.

Survey work in the Himalayas.

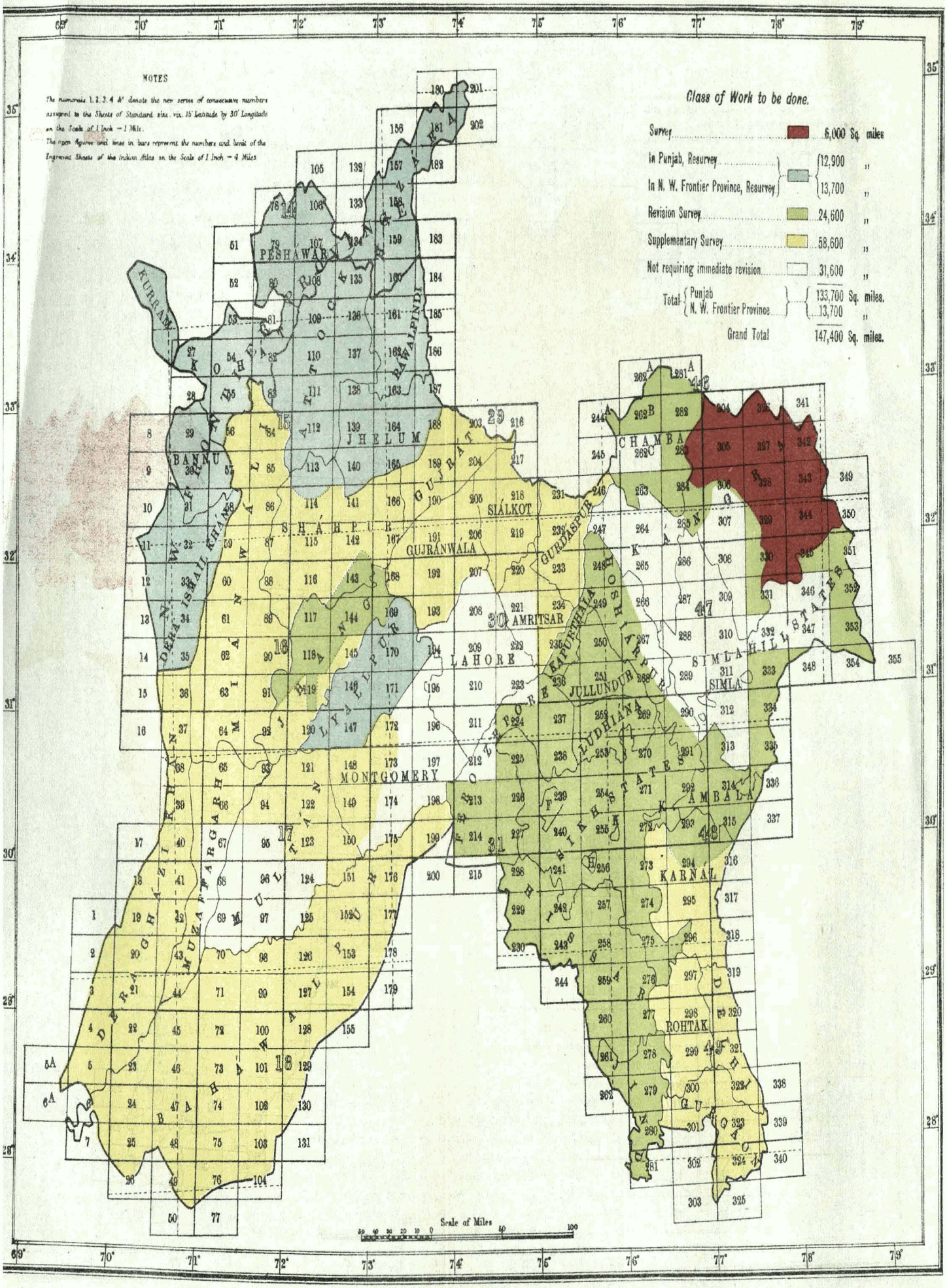
51. There remains the tract in the Himalayas covered by the districts of Kangra, Simla and the Simla Hill States, Lahoul and Spiti, and the montane portions of Umballa, Hoshiarpur and Gurdaspur. The triangulation of this area was commenced by the Himalaya, subsequently No. 18 Party, in 1884-85. Up to 1900-01, when the original programme of the party was completed, the hilly portion of Hoshiarpur, Simla and the Simla Hill States, along with Mandi and Suket and a portion of Kangra had been surveyed on the 2″ scale, while the hills of Umballa and Gurdaspur, the State of Sirmur, and the remainder of Kangra and Kulu had been surveyed on the 4″ scale; on the northern and eastern edges of this wild and inaccessible country a 1″ survey was carried out for small tracts here and there. The decision to survey these mountainous tracts on such large scales was arrived at in connection with the possible requirements of the Forest Department, but it involved an expenditure quite out of proportion to the value of the country being surveyed and a great waste of time. The work of issuing fair maps was also allowed to fall into arrears, and the officer now in charge of the party can give no clear idea of when these arrears will be overtaken. Up to date only 3 full standard sheets and portions of 5 others have been published on the 1″ scale, 5 full sheets and portions of 10 others have been mapped on the 2″ scale and 3 full sheets and portions of 18 others have been prepared on the 4″ scale. Practically all this 4″ work is included in the maps issued on the 2″ scale, but the publication of the results of these 17 years' survey work in the Himalayas is still very patchy and incomplete. Most of the work is quite recent, and there can have been practically no changes in the features of the country. Special arrangements should now be made to secure the publication of maps on the 1″ scale of all the country which has been surveyed, and in the estimates an allowance of Rs. 5 per square mile has been made to cover the work on the 19,000 square miles referred to. There still remains an area roughly estimated at 6,000 square miles towards Tibet of which no regular survey has ever been made, though $\frac{1}{4}$″ reconnaissances exist. There is no urgent need for maps of this country which can be taken up at the end of the Punjab programme. The cost of survey on the 1″ scale will probably be about Rs. 40 per square mile.

Summary of requirements.

52. The requirements of the Punjab are summarised below:—

Survey	6,000 square miles on the 1″ scale at Rs. 40.
Re-survey	12,900 square miles on the 2″ scale at Rs. 45.
Revision	24,600 square miles on original scales at Rs. 10.

INDEX TO THE STANDARD SHEETS OF THE PUNJAB AND N.W. FRONTIER PROVINCE.



No. 97. S. I.—Feb. 06.—100.
No. 378. Stat. Circ.—June 06.—200.
No. 367 C. H. & A.—Nov. 05.—600.

Hello S I O, Calcutta.

Reg. No. 649-S. 05.

Supplementary survey.	44,140 square miles 14,460 square miles	on the 2″ scale at Rs. 15. Rs. 10.
Mapping of	19,000 square miles in the hills on the 1″ scale at Rs. 5.	
No work required at present in	12,600 square miles recently brought up to date.	
Total ...	133,700 square miles.	

The total expenditure should not exceed twenty lakhs.

Special and locally prepared maps.

53. The Punjab Government has a complete system for the local preparation of maps for revenue purposes. The detailed field maps on the 16″ or 24″ (or even larger) scales are reduced by scale to 4″ village maps, known as index maps. Where fresh cadastral surveys have been conducted, those maps take the place of the old 4″ maps of the Revenue Survey. The index maps are grouped together on the same scale on convenient sized sheets to form tahsil maps, and from these reductions are made by pentagraph to the 2″ or 1″ scale for the use of district officers and their subordinates. The larger scale maps are prepared in the vernacular, the smaller in English. When necessary, a further reduced map on the $\frac{1}{2}$″ scale is prepared for a whole district.

The majority of these maps are mere skeletons or indices, and do not profess to show any topographical detail beyond the administrative details required by district officers. They, however, answer all the immediate requirements of revenue administration, and are in constant use in preference to the obsolete maps of the Survey of India. From the replies to the Committee's questions it is evident that throughout the Province there is a desire to have maps showing full topographical details, and it is only because of the absence of such maps that so much reliance is placed on the locally prepared reductions of the field maps. These maps are not published, nor is there any establishment in the Punjab for their reproduction on a large scale. A few copies only are printed by rough lithography at a Native Press in Lahore.

District maps.

54. There is a consensus of opinion that the most useful map for the district officer is one on the $\frac{1}{2}$″ scale, showing as much topographical detail as possible. Owing to the inconvenience caused by the absence of up to date maps for almost every district in the Province, the Punjab Government in 1895 made arrangements which are detailed in the joint reply received from the Financial Commissioner, the Settlement Commissioner and the Director of Land Records, to select one map for each district which should be revised every ten years, or in the case of railway or canal extensions every five years. The map selected is generally on the $\frac{1}{2}$″ scale.

NORTH-WEST FRONTIER PROVINCE.

Composition of Province.

55. The country designated by the name of the North-West Frontier Province divides itself into two portions, *viz.*:—(*a*) the area inside the administrative border, and included in the five districts of Hazara, Peshawar, Kohat, Bannu and Dera Ismail Khan with the outlying Agencies on the Malakand and in the Kurram, Tochi and Gumal valleys; and (*b*) the tract outside the administrative border, but inside the Durand line and within the sphere of British influence.

56. The methods and dates of the original surveys of the five districts of the Province have been already described in paragraph 45 relating to the Punjab. The existing maps of Peshawar, Bannu and Dera Ismail Khan are compilations from 4″ village surveys, and that of Hazara from 2″ village surveys, all executed between 1863 and 1882 by Revenue Survey Parties. The sheets of the Kohat map are the result of a topographical survey conducted in 1881-83.

Previous surveys.

57. Since these dates the whole of these five districts have been re-surveyed cadastrally. The measurements of Peshawar were completed by the Settlement staff in 1896, of Dera Ismail Khan in 1903, and of Kohat in 1904, while Hazara and Bannu will be finished in the course of a year or so. But in country of the nature of the North-West Frontier, much assistance cannot be expected from cadastral maps. There are stretches of flat level country, especially towards the Indus in Peshawar, Bannu and Dera Ismail Khan, but along the border the face of the land is covered with mountains and hills, and broken by ravines and hill torrents. From the military point of view, it is more important to have good maps of the North-West Frontier than of any other part of India, and the features which the cadastral surveyor omits are precisely those which are of importance to the soldier.

Cadastral mapping.

58. Of the incompleteness and untrustworthiness of the existing maps ample evidence has been received. The Chief Commissioner in his letter dealing with the Departmental Committee's Report gives several instances of inaccuracies in some standard sheets of the Peshawar District, issued within the last four years, which the Committee had an opportunity of examining at Peshawar. They appeared to have been compiled by the incorporation on the old 1″ maps of the new detail given in reductions of the cadastral maps, but apparently no supplementary survey of topographical details, or test in the field was carried out. The consequence is that the roads are not properly classified, important canals are not correctly shown, and the names of villages are printed without due regard to their relative importance. Owing perhaps to the fact that the original maps are based on revenue surveys now 40 years old and carried out at a time when there was considerable danger involved in survey work on the border hills, the delineation of the hill features and of the ravines and streams is very vague and difficult to follow. The evidence received shows that even the recent issue of the 1″ standard sheets of Peshawar gives a map which is positively misleading both to the civil and the military officer. The condition of the maps of the Bannu and Dera Ismail Khan Districts is said to be worse. In Bannu the map does not show one of the most important features of the district, the canal system which irrigates over 150,000 acres. This has necessitated quite recently the local preparation of a new map of the canal area by an engineer of the Public Works Department. In Dera Ismail Khan the changes in the course of the river Indus and the destructive action of the hill torrents are continually causing changes in the face of the country, so that the old maps are now hopelessly out of date. In Kohat, with the exception of the construction of the railway and a few roads, and the advance of the boundary of the district to the top of the Samana Range, there have not been many changes since the excellent

State of the maps.

topographical survey twenty years ago. Nor have the changes in Hazara been very numerous, but in this mountainous tract a map compiled from a 2″ revenue survey, now 35 years old, hardly satisfies modern requirements.

Estimate for re-survey required.

59. These remarks indicate the action which should now be taken. All five districts should now be re-surveyed topographically on the 2″ scale, if only because a thorough topographical survey has never been executed in this important tract, and the Commander-in-Chief requires 2″ maps. In Kohat, where the existing map is the result of a topographical survey, a revision would have sufficed, but as maps on the 2″ scale are required for military purposes it will be necessary to have a resurvey. In this district a professional traverse was carried out in 1899-1900 for the settlement maps which will greatly facilitate the work. Some assistance will also be afforded in all the districts by the settlement maps.

The area thus indicated for resurvey is:—

	Square miles.
Hazara	3,391
Peshawar	2,605
Kohat	2,609
Bannu	1,680
Dera Ismail Khan	3,403
Total ...	13,688

This work will occupy a full strength topographical party for about four years and will cost about Rs. 45 per square mile. The total expenditure may be estimated at a little over six lakhs.

Trans-border territory.

60. The maps in use in the Agencies and for the country across the administrative border are the ½″ standard sheets of the North-West Trans-Frontier Series. These have been compiled from various reconnaissance surveys made at different dates, as the opportunity of sending surveyors with expeditions offered itself. They are published in modern style with the hills in brown, and afford what information is available of this part of the country. During the past field season a topographical party has been at work surveying the Tochi and Gomal valleys on the 2″ scale. It is estimated that along with this area the tract round Wana and the strip of country between Thal and the Tochi, covering in all 1,440 square miles, will be finished in 1905-06. This work should not be interrupted on any account. A similar survey should be carried out in the Kurram Valley, and in the tribal area outside the administrative border as opportunity offers. The area to be thus dealt with is estimated at 25,000 square miles, but no cost rates of any value can from the nature of the case be assumed.

Locally prepared maps.

61. There is little to say under this head which would not merely repeat the remarks already made in the section on the Punjab. For general use the district officers have been making use of the ¼″ district maps furnished by the Survey of India, but in Peshawar this map is so incorrect that the civil officers at least have had recourse to a collection of small scale maps made by the settlement officer and incorporated in the District Gazetteer.

The settlement officers prepare, under the rules in force in the Punjab, reductions from their field maps on the 4″, 1″ and ½″ scales. These show village boundaries and all the chief administrative details, and are more useful than out of date Survey maps. However, all the officers serving on the Frontier, who have been consulted, agree unanimously in stating that maps containing full topographical details are absolutely essential to them in their everyday work.

KASHMIR.

Early surveys.

62. The survey of Kashmir and the mighty mass of mountains up to the Tibetan frontier was commenced by the trigonometrical branch of the Survey in 1855. Along with the triangulation the topographical filling in of the map by plane table was carried out chiefly on the ½″ scale. The Kashmir series of triangles was completed in 1864, by which time 70,000 square miles of country, covering Jammu, Kashmir, Kaghán, Ladák and little Tibet, had been surveyed. In the valley of Kashmir the map is full and detailed, but in the wilder mountain regions it is in many places compiled from rough sketches. In the annual reports of the Survey of India the whole of the map of Kashmir is shown as based upon geographical reconnaissances on various scales. As these reconnaissances are more than forty years old the map is now out of date.

Recent surveys.

63. Since these early days little or no survey work has been carried out in the east of Kashmir, but to the north-west the placing of outposts in Gilgit and Chitral has led to the mapping of the country between Chilas and the Pamirs and westwards to the borders of Kafiristan. Since 1898-99 survey detachments have been steadily employed on this work in the hot weather. All this recent work has been on the ½″ scale, and so far most of the maps published have been on the ¼″ or ⅛″ scale.

Survey requirements.

64. There is at present no 1-inch map of Kashmir, nor has any survey ever been executed on that scale. There is, therefore, no question of the class of survey work now required. Part of the tribal area beyond Kashmir is of importance from a military point of view, though the military authorities do not place it so high in the matter of urgency as the rest of the North-West Frontier Province. In Kashmir itself there has been great development and new maps are required. New villages have sprung up in large numbers and the making of roads has been actively pushed on. There is at present no map in existence showing correctly the boundaries of administrative divisions. The Conservator of State Forests has brought to notice the want of a topographical map on the one inch scale to enable him to work the forests, while the Chief Engineer of the railway survey, now being carried out, reports that an immense amount of work has been caused by the absence of accurately contoured maps.

An up to date 1-inch map should now be provided, and to produce it a new survey must be undertaken. In view of the rugged nature of a great part of the country it will not be necessary to survey on a larger scale than the 1-inch, except perhaps in the main valley. The cost of the survey will be about Rs. 30 per square mile, giving a total expenditure of Rs. 24,27,000 in the 80,900 square miles at which the area is estimated.

UNITED PROVINCES OF AGRA AND OUDH.

Preliminary.

65. A very complete account of the existing standard sheets of the United Provinces has been prepared by the Superintendent of Provincial Surveys, and has been supplemented by excellent summaries made by the Board of Revenue and the Director of Land Records. These will be found in Sections VI and VII of this volume; and it is unnecessary here to do more than state the method by which the mapping of each class of districts referred to in these papers can best be dealt with.

Recent surveys.

66. The three districts of Allahabad, Fatehpur and Cawnpore may be excluded from the estimates altogether, as they have recently been topographically surveyed by No. 14 Party on the 2″ scale. Their area is 6,830 square miles.

New survey required.

67. An entirely new survey will be necessary in the Native State of Tehri Garhwal, area 4,180 square miles, where there are no 1″ maps. The cost may be estimated at Rs. 30 per square mile. A portion of Etawah may possibly also require a new survey, but part of the district has recently been cadastrally surveyed and it will not substantially affect the estimates to class the whole as requiring only supplementary survey.

Re-survey required in the plains.

68. The standard sheets of Bijnor, Budaun and the nine southern districts of Oudh, Hardoi, Sitapur, Unao, Lucknow, Rae Bareli, Fyzabad, Sultanpur, Partabgarh and Barabanki are based on old revenue surveys of an earlier date than 1870, and the changes, since the maps were prepared, in the matter of roads, railways and extensions of cultivation have been numerous. The Oudh Revenue Survey, on which the existing standard sheets of the nine southern districts of Oudh are based, was pronounced at the time by the Surveyor General to be a particularly good one, but the recent operations of No. 14 Party have fortunately enabled an examination of its accuracy in topographical details to be made in the extreme south of the Province; and have left no doubt that the revenue surveyors did not consider it necessary to delineate the natural features with the accuracy now required. Captain Crosthwait estimates that the cost of revising the old maps would be as great as that of re-surveying the country; but the operations required will not be so expensive as an entirely new survey, since triangulation and traversing can be to some extent dispensed with. For the districts of Bijnor and Budaun there is no equally definite information, but it will be safe, having regard to the date of their survey, to place them in the same category. The total area of these 11 districts is 19,392 square miles.

Re-survey required in the hills.

69. The hill districts of Naini Tal, Almora and Garhwal were surveyed topographically on the 1″ scale between 1867 and 1886, and Captain Coldstream states that on the whole the maps require little correction. His opinion is, however, based on his knowledge of sheets in the lower hills; and it is in evidence from Mr. Watts, who has used the maps up to the Tibet boundary, that the maps of the higher ranges are not equally accurate, while it is clear from an inspection of the maps themselves that they were much more roughly prepared. The correction on any system of these maps, with the addition of heights in sufficient numbers to make them of use to

engineers and others, will be expensive, and the work must be classed as re-survey rather than revision. The area is 13,703 square miles.

The rates of re-survey may be roughly estimated at Rs. 30 per square mile in the hills and Rs. 25 in the plains districts.

Supplementary survey required.

70. In 24 districts the existing maps are based on cadastral surveys made either by entirely professional parties or by patwaris working under professional supervision. As the surveys have been made at very various dates extending from 1871 to the present time, the material is necessarily of very different quality. The later surveys have been very carefully carried out, and in some cases such natural features as ravines have been surveyed in much detail by the patwari surveyors. But in the earlier surveys less attention was paid to topographical features, and, apart from this, the changes that have occurred since survey, are in some cases extensive, and a good deal of revision will be necessary. The districts in which a supplementary survey will or should be sufficient, are the following, in all of which there have been cadastral surveys during the last ten years :—

	Sq. miles.		Sq. miles.
Lalitpur	1,059	Etah	1,731
Bareilly	1,591	Farukhabad	1,719
Pilibbit	1,373	Mainpuri	1,697
Shahjehanpur	1,747	Kheri	2,963
Azamgarh	2,147	Gonda	2,819
Jalaun	1,477	Bahraich	2,657
		Rampur	899

the total area of which is 23,879 square miles.

The districts of older date, the cadastral surveys in which were made at various times between 1871 and 1888, and in which the work might be classed either as revision or as supplementary survey, are the following :—

	Sq. miles.		Sq. miles.
Moradabad	2,303	Jaunpur	1,551
Muttra	1,457	Benares	1,009
Agra	1,856	Ghazipur	1,391
Hamirpur	2,289	Ballia	1,249
Banda	3,061	Gorakhpur	4,596
Jhansi	2,528	Basti	2,753

with a total area of 26,043 square miles. Of these districts it will probably be better to class Muttra and Agra as requiring revision.

Revision required.

71. The Meerut district might have been added to the number of those requiring a supplementary survey only, as it has recently been cadastrally surveyed, and the maps prepared by the patwaris have in a part of the district been reduced as a preliminary to a supplementary survey. But in the portions of this district where such reductions have not yet been made, it will probably be simpler to revise the old topographical sheets direct and a similar procedure must be followed in the districts to the north and south, in which there has been no recent cadastral survey. The maps of Meerut and the adjoining districts of Dehra Dun, Saharanpur, Muzaffarnagar, Bulandshahr and Aligarh and of Mirzapur are comparatively modern, being based on topographical surveys conducted between 1875 and 1884, and they may be classed as requiring revision only. The area of these seven districts is 16,522 square miles.

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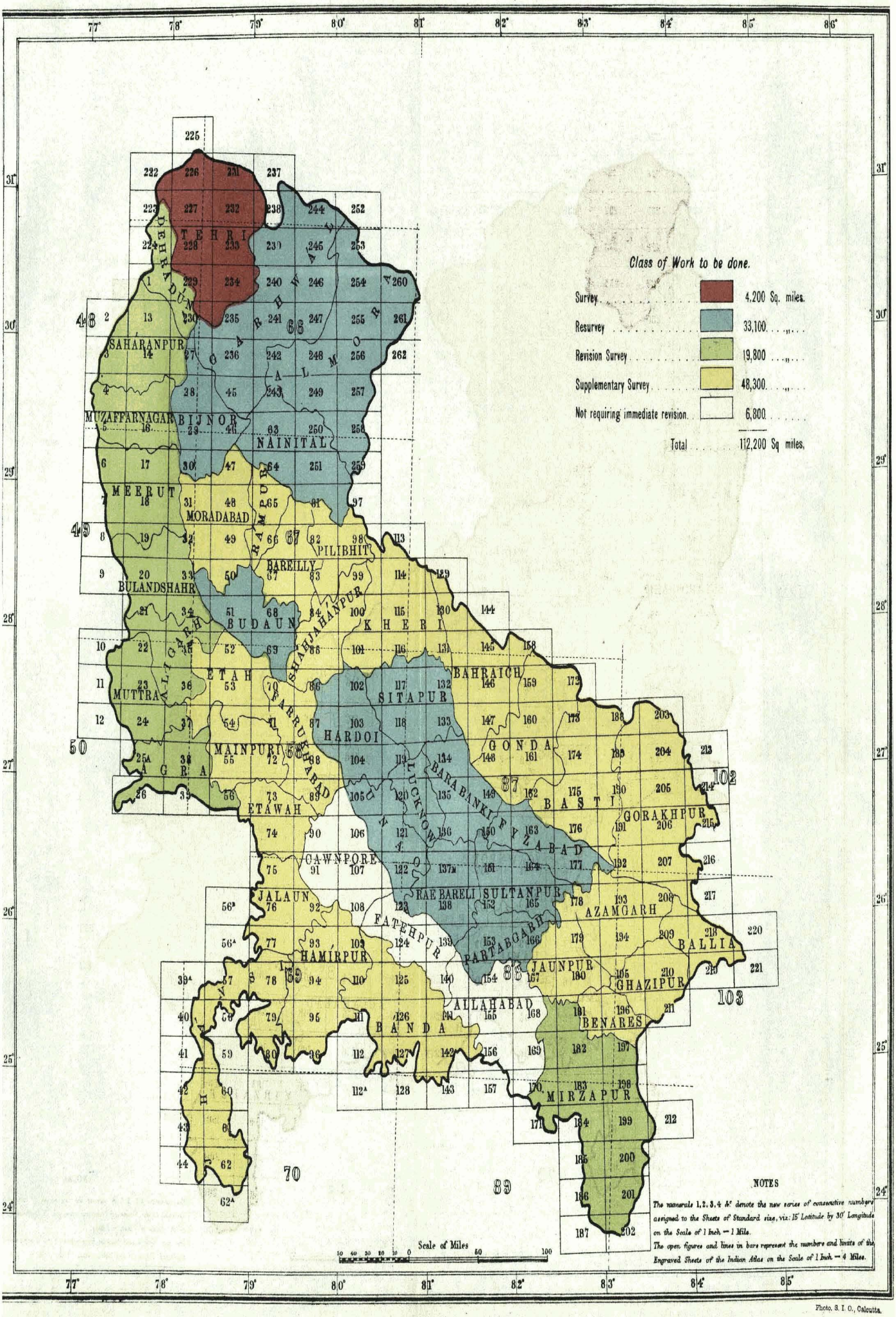

Photo. S. I. O., Calcutta.
Reg. No. 646-S. 05.

72. The probable cost of revision and of supplementary survey in this Province has been carefully examined, and Captain Coldstream has furnished very detailed estimates of the different processes involved, which, however, he desires to place on record are necessarily conjectural. Where cadastral maps exist, there can in the plains districts be no question as to the economy effected by utilizing them in place of making a fresh survey. The cost of compiling in office a standard sheet from the cadastral maps does not amount to more than Rs. 3 or Rs. 4 per square mile, and to this has only to be added the cost of supplementary survey in the field. There are no data on which to estimate the cost of this work, but in all flat districts it should be low. In the more broken country in the south of the Province, the work will be more difficult, and where the surveys were of old date, there will be a considerable number of changes to be entered. Allowing for all these considerations, there will probably not be much difference in the expense of supplementary and of revision work in this Province and the cost may be provisionally estimated at Rs. 12 per square mile throughout.

Estimate of cost.

The total amount of work to be done is therefore :—

	Square miles.		Rs.
Survey	4,200	@	30
Re-survey	13,700 (hills)	@	30
	19,400 (plains)	@	25
Revision	19,800	@	12
Supplementary survey	48,300		
Not requiring immediate revision ...	6,800		

and the total cost may be estimated at about Rs. 18,40,000.

73. In the United Provinces arrangements have from a very old date been made by the Board of Revenue, independently of the Survey Department, for the supply to district officers of the maps that are absolutely necessary for the purposes of administration. At one time the work was done in the Board's office, at another the assistance of the Survey Department was obtained; more recently, the publication of such maps has been arranged for at the Thomason College, Rurki. These appear to have been prepared by reducing and joining together the village maps made at the time of Settlement. The reductions were first combined to form tahsil maps on the scale of one mile to one inch, and from these again district maps on the $\frac{1}{2}$" scale were prepared. All the maps show village boundaries, and in addition, a map on the scale of 4 miles to an inch has been prepared for each district locally. It may happen that a district has two $\frac{1}{4}$" maps, one prepared locally, and another by the Survey Department from the Indian Atlas sheets. The maps so provided vary much in style and quality. The tahsil maps are very rough ; they appear to have little pretension to strict geographical accuracy ; they are useless for the purposes of the engineer, and the addition of vernacular names has often a confusing effect. The district maps on the $\frac{1}{2}$" scale are convenient in providing wall-maps of a reasonable size for each district, and they can be roughly kept up to date in the matter of roads. The $\frac{1}{4}$" maps are convenient for showing boundaries of parganas and tahsils and the main routes of communication ; but some of those locally prepared are badly executed, while the district maps on this scale, taken from the Atlas of

Locally prepared maps.

India, are often inconveniently crowded with names of unimportant places. The Board of Revenue question the utility of preparing these $\frac{1}{4}$" maps, but at present they probably serve some useful purposes. Tahsil maps would be improved by the omission of vernacular names, or by the preparation of a separate vernacular edition if that is necessary; but it would seem very advisable that, when the revisional survey of the Province is complete, these maps should be prepared from those issued by the Survey Department, and not from old settlement material. The extent, to which the locally prepared maps of the Board of Revenue have taken the place of Survey of India sheets in these Provinces, may be judged from the fact that few of the officers, who have replied to our questions, make any reference to the latter. On this point the Superintendent, Provincial Surveys, remarks:—

"Under existing conditions the Civil officers of the Provinces do not as a rule use the standard sheets, and are frequently ignorant of their existence. It would appear from the number of cases that have come within my experience that this is because they do not know what sheets to write for, nor to whom to apply, not because they are unable to appreciate the value of a one inch map. All Military and Civil officers of a certain standing should be entitled to free issues of the standard sheets of their neighbourhood, and should be able to procure additional copies for any reasonable Government purpose. It would lead to a more general use of the sheets, if their issue formed one of the duties of the survey staff in the Provinces. * * * * * * * *

"Many district officers, however, have a partiality for tahsil maps. The best tahsil maps I have seen offer no obvious advantages, not possessed by the standard sheets (except the doubtful one of giving names both in English and Urdu). If it is considered that the inclusion of extraneous areas is a disadvantage, by cutting out the tahsils required from the standard sheets concerned, and mounting them in book form, tahsil maps superior to those in use can be prepared with very little trouble."

BENGAL.

Obsolete character of maps.

71. In its reply to the Circular of the Government of India, forwarding the report of the previous Departmental Committee on the subject of bringing up to date the topographical maps of the country, the Government of Bengal stated that "all officers are agreed that the old topographical maps are obsolete and inaccurate;" and this opinion is very fully borne out by the replies received by the Committee, and by its own enquiries and examination of existing maps. Though the whole of the Province and the Native States attached to it have at some time or other been surveyed or reconnoitred, and the catalogue of the Survey Department contains a large and, at first sight, very complete list of maps on various scales, yet it may safely be said that no part of India is worse off for up-to-date maps of the country. Even Madras, much of which has never been topographically surveyed, is better supplied with maps that are useful to its administrative officers.

This result is due partly to the fact that the original surveys of Bengal were made at a very early date, and have never been revised, but partly also to the variety of systems followed both in making surveys and in the drawing and reproduction of maps.

Four-inch revenue maps.

75. Before the topographical maps are dealt with, it may be mentioned that in many districts portfolios still exist of the 4" maps of the old revenue survey, which have never been published. These maps are distinct for each village.

They are in some cases beautifully executed, and, though often fifty years old, are still found useful by district officers in the settlement of boundary disputes, and even by engineers in connection with irrigation projects. In a considerable part of Bengal such topographical maps as now exist, are based on these old 4″ surveys.

One inch maps in Behar.

76. The map of Bengal on the 1″ scale covers 438 standard sheets.

In the extreme north-west of the Province cadastral surveys have been in progress since 1886 ; and maps on the 1″ scale have been prepared by reduction from the 16″ village maps. The cadastral work, as described elsewhere, has been executed under professional supervision, and the maps prepared by reduction are admirably suited for administrative purposes, though they have not been revised in the field, and cannot rank as entirely satisfactory topographical maps. There was at the outset some delay in publishing the reduced maps, but, since 1901, 28 sheets (some of them fragmentary) have been published of the districts of Saran, Champaran, Muzaffarpur, and Darbhanga, and arrangements are being made to secure prompter publication in future. A programme has now been submitted by the Local Government to the Government of India for the extension of the cadastral survey to all parts of the Province. It is hoped to complete the cadastral programme in 25 years, and the Committee assume, for the purposes of their report, that effect will be given to the proposals of the Bengal Government.

One inch maps in Central and Eastern Bengal and Orissa.

77. Of the country lying to the east of Darbhanga, as far as Purnea and Bhagalpur, as well as of the districts of the Patna Division south of the Ganges—Shahabad, Gaya, and Patna—no maps in standard sheets are available, but district maps on the 1″ scale, without lines of latitude and longitude, have been compiled from revenue surveys of as old a date in some cases as 1841. In the country south-east of Bhagalpur and in Midnapur there are also district maps on the 1″ scale reduced from old revenue surveys, not published in standard sheet form, and still another form has been adopted in the case of Krishnaghur, Jessore, and Khulna. In a considerable part of the country near Purulia and Bankura, Dacca and Comilla such maps as exist consist of what are known as main circuit maps, which do not necessarily represent any administrative division of the country.

In Orissa again and in the plains country of Chittagong there have been cadastral surveys, the results of which, after a delay regarding which serious complaints have been made, have been published as standard sheets.

Supplementary survey sufficient in above tracts.

78. While the necessity of accurate maps throughout the part of the country hitherto dealt with is much felt, it will be possible to prepare them cheaply and expeditiously as the cadastral survey proceeds, and the opinion of the Hon'ble Mr. Hare, Member of the Board of Revenue, may be accepted that while " maps correct topographically would be a great improvement, their necessity for administrative purposes is not so urgent as to render necessary any immediate expenditure in anticipation of the re-mapping which will accompany the regular programme of survey and record-of-rights for the Province." As this programme proceeds the topographical maps can be prepared and published after supplementary examination in the field of the reduced maps prepared by the cadastral surveyors.

79. In the south-western part of the Province—in Chota Nagpur and the Native States bordering the Central Provinces—the standard sheets are somewhat more regular, and are as a rule based on somewhat more recent surveys. In some cases it is true that the whole or some portion of a sheet is compiled from very old material, dating back as far as 1841, but most of the maps are the result of topographical surveys on the one inch scale made after 1860 by parties known as—the Bengal survey, or the Chota Nagpur Topographical survey, or the Ganjam and Orissa Topographical survey.

One inch maps in Chota Nagpur and Tributary Mahals.

The country covered by these maps is hilly, and it is clear from the appearance of the maps that the hills have been somewhat roughly sketched, and the method of execution and even the symbols used vary from sheet to sheet. Some of the sheets are fragmentary, extending only to the provincial borders, in others a portion has been surveyed by a revenue party, and the topographical map contains only the portion topographically surveyed, the practice of the time being apparently for each party to publish only its own work.

The dates of survey of these maps vary, but range as a general rule from 1861 to 1871. If the delineation of the natural features were accurate, it should be possible to bring them up to date by revision in the field, though the work to be done would be considerable owing to improvement of communications, changes of villages and cultivation, and the necessity of entering heights and levels. There is unfortunately, however, considerable doubt about the accuracy of some at least of the maps. The Superintending Engineer, Northern Circle, Bengal, reports that according to his information the delineation of the hills is entirely unreliable, and the Inspector of Works, Bhagalpur, mentions inaccuracies which he found in the maps in the south of Ranchi, when using them in the course of a survey. The positions of streams and ridges had not been accurately marked, ridges being sometimes a mile or more from their true position, and streams being shown in the map as flowing in the wrong direction. The Superintendent of Provincial Surveys, Bengal, confirms these complaints of inaccuracies, and mentions a case in which a hill has been entirely omitted. The inaccuracies of the maps have also forced themselves on the attention of Settlement Officers.

80. It is impossible, therefore, to assume that these maps can be brought up to date and made reliable by merely revising them on the ground, and even if cadastral maps existed, their use for topographical purposes would be limited. How far the existing maps will prove of use can be determined only in the course of actual survey work. But there can be no doubt that the correction of the maps will involve operations little less elaborate than a completely new survey. Some assistance will be obtained from the old triangulation, but more than this it would be unsafe to count on, and the operations must be treated as re-survey.

Re-survey necessary.

81. The standard sheets of the Darjeeling District are based on surveys made on the scale of 4″ or 2″ to a mile in 1861-62 and 1880-81, and there are a number of other maps in use, all of which are in one respect or other

One inch maps in other hilly tracts.

unsatisfactory. In the most recent edition of the standard sheets, published in 1895, the hill shading is very dark, and fails altogether to give an accurate idea of the relative height of the hills. Few heights are marked, and few, if any, levels given. A re-survey will be necessary to produce a satisfactory map of this district.

For the State of Sikkim, and for the hilly country west of Orissa, the only maps are on the $\frac{1}{2}$" scale. The Sikkim maps belong to the North-East Frontier series, and are based on somewhat rough reconnaissance surveys, with additions from the larger scale surveys of the Darjeeling District. The maps are very inferior, and are briefly pronounced by the Political Agent to be of no use for administrative purposes. If maps of this country are to be provided at all, a new survey is indispensable.

The $\frac{1}{2}$" maps of the hilly tracts west of Orissa have been prepared from materials of various periods, dating back to a topographical survey of Orissa and Ganjam in 1850. Some parts have been enlarged from surveys on the $\frac{1}{4}$" scale, others reduced from the 1" scale. A small portion of the country has been cadastrally surveyed. The provision of new maps cannot be regarded as urgent, but a fresh survey will at some time be indispensable. Of Hill Tipperah and the Chittagong Hill Tracts only $\frac{1}{4}$" maps exist. There has been no regular survey of these tracts.

Requirements of officers consulted.

82. Leaving aside the question of cadastral maps, the great mass of opinion in Bengal is in favour of the provision of maps on the 1" scale for detailed work, and of maps on the $\frac{1}{4}$" scale for general purposes. The Local Government would be glad to have maps on the 2" scale in tracts irrigated by canals, and Mr. Hare has expressed a doubt as to the possibility of accurately delineating topographical features on so small a scale as the 1" in parts of Eastern Bengal. Some opinions have been expressed in favour of a $\frac{1}{2}$" map for Local Boards, the $\frac{1}{4}$" scales being found to be too small. Thana maps are being issued as the cadastral surveys proceed, and these will undoubtedly be of great use for administrative purposes and for distribution to local officers. The Local Government proposes to issue them in future on the $\frac{1}{2}$" scale. The insertion of village boundaries is everywhere considered essential by the civil officers; and in this Province it is considered of importance to show the boundaries of the revenue *mauzahs* as they originally existed.

Work to be done in Bengal.

83. On the assumption that the programme of cadastral survey in Bengal is carried out, a rapid and inexpensive supplementary survey is all that is necessary to allow of the compilation of good topographical maps from cadastral materials in the level plains of Bengal, that is, in the country between the Himalayas and the hills of Chota Nagpur, and between Assam and the sea, as well as in Orissa and in such tracts of Chittagong as have been cadastrally surveyed.

In Chota Nagpur, on the other hand, and in the south of the Province generally, with the exception of the cadastrally surveyed parts of Orissa, much of the country is hilly or covered with forest, and here the cadastral maps will be of comparatively little assistance. Similarly in the Sonthal Parganas, where the cadastral survey is being carried out by the Settlement Officer with a local staff, the cadastral maps require extensive re-survey to make

them suitable for topographical purposes. In all those districts it is true that some assistance may be obtained from the cadastral maps, when they are prepared, but it is impossible to estimate its extent, and in some parts the topographical survey must be entirely independent of the cadastral.

Estimate of cost.

84. The area falling under each class of work to be done and the probable cost-rate of the operations are as follows:—

A. New survey—26,400 square miles—at Rs. 40 per square mile.

B. Re-survey—49,700 square miles—at Rs. 35 „ „

C. Supplementary survey—120,300 square miles—at Rs. 10 per square mile.

The division which is shown in the index map is necessarily not absolutely exact. In some of the tracts falling under class C., as for instance the south of Gaya, a certain amount of re-survey or even of new survey will be necessary, while there are tracts in class B., where considerable assistance may be derived from the cadastral maps. But for the purposes of our estimate the classification is sufficiently close: and it would be impossible to go into further detail without a minute examination of the class of country in different parts of each district. The total expenditure in providing a 1″ map of Bengal should not exceed 40 lakhs.

Work not urgent.

85. As compared with some other parts of India, the requirements of Bengal are not urgent, and the tracts in which a new survey is required are so low in the order of urgency, that it is only for the sake of completeness that we think it necessary to enter them in the programme. The maps prepared by the Superintendent of Provincial Surveys are so good, that only a very slight revision is necessary to see that roads are correctly classified and that important natural features have not disappeared in the course of reduction. A low rate for the work has therefore been taken.

Small scale maps.

86. Of the Atlas sheets for the Province 12 full sheets and 13 quarter sheets were examined by the Committee. The full sized sheets were all engraved in London, as well as a number of the quarter-sheets, the remainder of the latter being engraved by the Survey of India. The sheets are admirably engraved, but the maps are based on old surveys. They are too closely crowded with names, and the spelling employed is antiquated. From the Atlas sheets district maps on the same scale have been provided. These will now be replaced by the "degree" sheets.

Divisional maps on the $\frac{1}{8}$″ scale have been prepared for most of the divisions. These are very rough photozincographed maps, often little more than outlines, and showing little topographical detail. For Orissa there is in addition to the outline map an engraved divisional map on the $\frac{1}{12}$″ scale, a well-executed map, though, of course, not up to date. For the Rajshahi Division there is a map on the $\frac{1}{16}$″ scale as well as on the $\frac{1}{8}$″, and Chittagong has a rough outline map on the scale of $\frac{1}{24}$″.

Outline district maps on the $\frac{1}{8}$″ scale have been published for a number of districts, and there are provincial maps on the scale of $\frac{1}{16}$″, $\frac{1}{32}$″ and $\frac{1}{80}$″.

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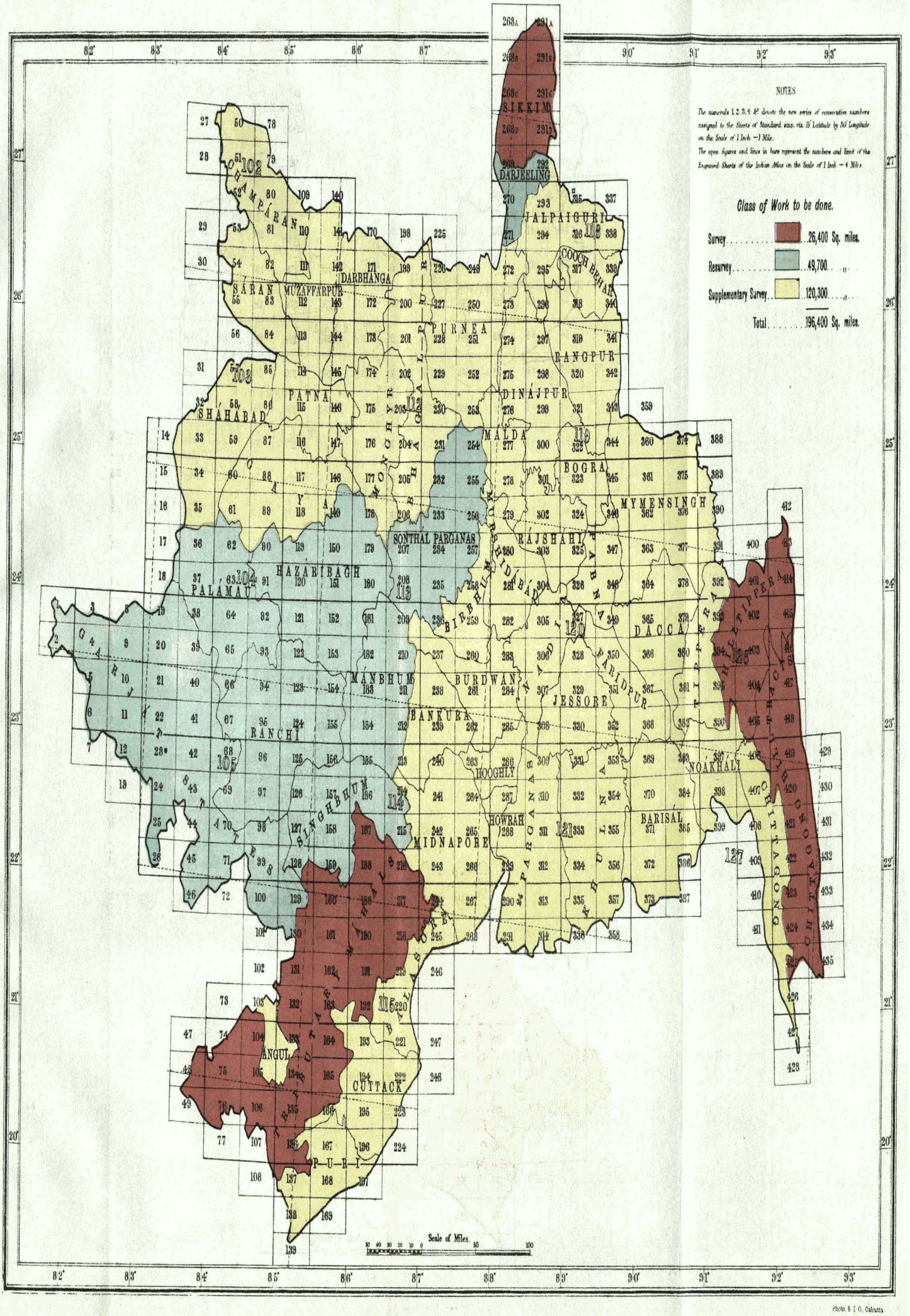

ASSAM.

Previous surveys.

87. In Assam there is the same difference of system as in Bengal in the method in which various parts of the Province have been mapped. In the plains country of the Surma and Assam Valleys revenue surveys on the 4″ scale were carried out between 1860 and 1875, and were used for the compilation of maps on the scale of 1″=1 mile. In the Assam Valley these maps were prepared in standard sheet form, but for each district separately, each series of maps showing one district only, and the border sheets of each district being incomplete.

In parts of two districts,—Goalpara and South Sylhet—there have been subsequent topographical surveys (executed on the 2″ scale) between 1873 and 1883. In Goalpara the results have been published as standard sheets on the 1″ scale, while in South Sylhet they have been published on the 1″ scale, but not as standard sheets. More recently the cultivated portions of the Brahmaputra Valley, and small portions of Sylhet and Cachar have been cadastrally surveyed on the 16″ scale, and the work of reducing these maps by pentagraph and fair drawing them on the 2″ scale for reduction by photography to the 1″ scale, is now proceeding, and has been brought nearly up to date. It may be noted, however, that these cadastral surveys rarely extend to a complete standard sheet. Many of the new sheets consist of a few scattered patches of cultivated land, and maps prepared from them and showing these areas only, are of no practical use. More recently the plan has been adopted of filling up the blank spaces on these sheets from the old maps, the details of the old surveys being printed in brown. For the Khasia and Jaintia Hills there are two sets of maps. A portion of the area round Shillong, covering six complete standard sheets and portions of two others, was surveyed on the 1″ scale at different dates between 1864 and 1879, while the remainder has been mapped on the $\frac{1}{2}$″ scale only, as the result of rough surveys on this scale made between 1866 and 1874. The Garo, Naga and North Cachar Hills and South Sylhet have similarly been roughly surveyed and mapped at different dates between 1878 and 1880. The north-western and south-eastern parts of Manipur were reconnoitred at the same time and on the same scale, but of the rest of that country and of portions of the Naga Hills, and the country occupied by the Miris, Daplas and Mishmis only $\frac{1}{4}$″ reconnaissances exist.

Of the Lushai Hills to the south a portion, covering 4 standard sheets, has been surveyed so recently as 1897-1901 and published on the 1″ scale in 1900-02, but only rough reconnaissance maps on the $\frac{1}{4}$″ scale exist of the remaining portions of these hills.

State of the maps.

88. As regards the quality of these maps it may be said generally that, with the exception of the recently surveyed tracts in the Lushai Hills, and of the portions of districts where fresh cadastral work has been carried out, there are no topographical maps of Assam with any pretensions to being up to date. The maps of Cachar and Sylhet are admitted on all sides to be useless, and the Chief Commissioner considers a new map to be so urgently required in Sylhet that he recommends that the work be taken in hand in anticipation of the cadastral survey, which will probably be made of this district in a

few years. Of the maps in the Brahmaputra Valley the following opinion expressed by a District Officer is concurred in by others, and is very fully confirmed by comparisons between old maps and recent cadastral surveys of the same areas:

"The existing 1″ and ½″ maps of the district are of very little practical value. There are no ½″ maps in my office. The 1″ and ¼″ maps are very incomplete in many respects, and from them very little information can be gathered as to the actual character of the country. This defect would not appear to be altogether due to any defect in the original preparation or in the drawing of the maps, although in some cases there would appear to be defaults in this respect. But these maps have lost their practical value, mainly owing to changes in topography. The face of the country has been greatly changed since 1875. Jungle has given place to cultivation, and tea gardens now occupy many areas of former waste. Rivers have changed their courses considerably, and with them the roads and ferries in the neighbourhood. The opening of tea gardens has resulted in the construction of many new roads, and sanitary improvements have added many tanks which do not appear on the maps. Railways, police outposts, and rest-houses have all been established, and *mauzas* have been amalgamated since the last survey was made. As a guide to the district, and as a map thereof, these maps are of little practical value. They afford no real clue as to the character of the country, and a stranger to the district, guided by these maps would be somewhat at sea."

Owing to their patchy character the cadastral surveys are of little value as the basis of new topographical maps, and even since these latest surveys, in many cases the face of the country is said to have been entirely changed owing to—(1) the earthquake; (2) the desertion of villages on account of *Kala-azar*; (3) the construction of the railway.

Of the maps of the hilly tracts those recently made of the Lushai country on the 1″ scale are on all hands admitted to be excellent, and require but to be kept up to date. The drawing is good and the heights are carefully and fully marked. The best of the others are the 1″ maps of a portion of the Khasia and Jaintia hills, which however contain but few heights, and are not drawn so as to show the character of the hills satisfactorily. They require to be thoroughly revised in this respect as well as in the delineation of village sites, and of roads and paths and in the spelling of village names. These maps will require a considerable amount of revision, though a completely new survey will not be necessary, and the work may be classed as re-survey. The maps of the remaining hill tracts cannot be regarded as satisfactory topographical maps in any sense of the word and a fresh survey will be necessary.

New maps required.

89. The inconvenience caused by the absence of good maps, especially in hilly tracts, is much felt in the Public Works Department. The existing maps give insufficient information as to heights, while village names and sites have changed and very considerable inaccuracies have been detected in the location of places of comparative importance, such as Dimapur. Great difficulty was experienced in laying out the road from that place to Kohima, and a large amount of survey was entailed on the officers carrying out the work, which would have been unnecessary had good maps on the 1″ scale been available. A smaller scale would not be of much use even in the hill tracts.

From the military standpoint there are no maps of Assam of any use for tactical purposes, except the four recently prepared standard sheets of a part of

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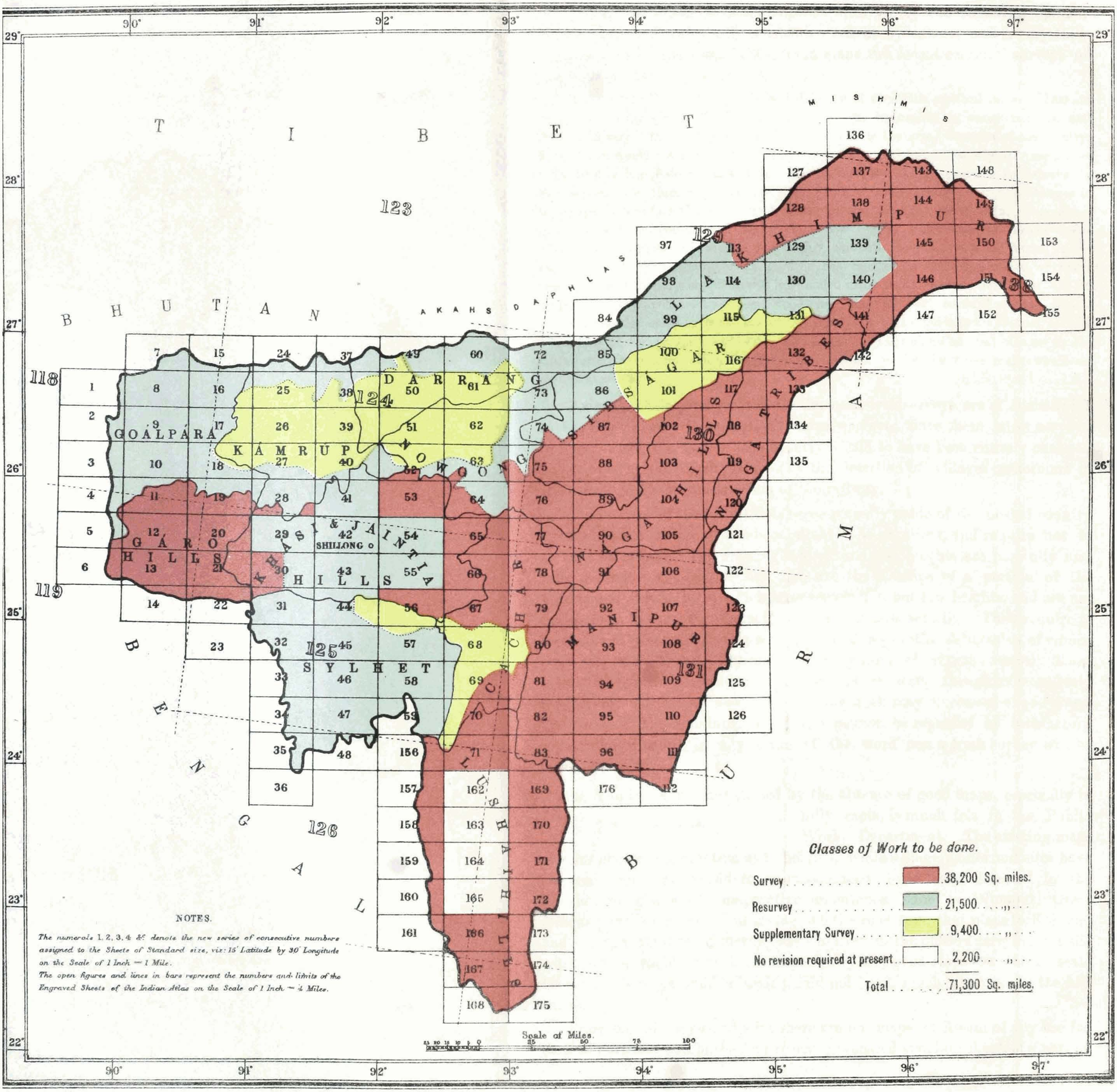

No. [illegible], S. I.—Jan. 05.—[illegible]
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No. [illegible], R. & A.—Nov. 05.—900

Helio., S. I. O., Calcutta.
Reg. No. 635-S 05.

the Lushai country. Elsewhere the maps are either so hopelessly out of date, or so wanting in topographical detail as to be tactically useless. For strategical purposes the $\frac{1}{4}$" Atlas sheets are available, but are too much out of date to be reliable.

Order of urgency of the work.

90. The Chief Commissioner considers that the most urgent requirement of his province, for administrative purposes, is the provision of good topographical maps for Sylhet and Cachar, portions of which have already been cadastrally surveyed. Next to these surveys in order of urgency he would place the survey of Manipur and of the Naga hill tracts in the eastern frontier, tracts for which maps are constantly required, especially of the hitherto unsurveyed country added to the district in 1904. The Manipur State would, he thought, be prepared to meet the cost of at least the survey of the low-lying tracts to the extent of say Rs. 50,000. It appears open to question whether the survey of Manipur and the adjoining tracts should not be considered the most urgent requirement of this Province. In Sylhet and Cachar it is possible that some years hence the necessary material for 1" maps may be available from cadastral surveys. Of Manipur and the hilly country beyond and north of it, no such material will be available ; the maps are required for military as well as administrative purposes, and the construction of the Assam-Bengal Railway has opened out the country, and has added to the necessity for a reliable map.

Of the country in the Brahmaputra Valley good maps would be of great value for ordinary administrative purposes, and it is advisable also that for military purposes the whole tract along the northern frontier of the province should be carefully mapped.

The survey of the remaining parts of the Province—the Garo Hills, portions of the Khasia and Jaintia and Lushai Hills and other hill tracts—may well stand over till the rest of the work is completed.

Estimate of cost.

91. Survey work in Assam is expensive owing to the climate, the foggy weather, the character of the country, and the necessity of importing labour. In the Lushai Hills the rate of a 1" survey was about Rs. 100 per square mile ; but the country was exceptionally difficult, and much of the work should be done at a much lower rate if a systematic programme be adopted. The index map shows the portions of the province in which fresh survey and re-survey appears necessary, and the probable cost of the work (omitting the four sheets of the Lushai country, already published on the 1" scale) may be estimated as follows :—

Survey—38,200 square miles at Rs. 40. . . Rs. 15,28,000.
Re-survey—21,500 square miles at Rs. 30. . Rs. 6,45,000.
Supplementary—9,400 square miles at Rs. 20. Rs. 1,88,000.
Not requiring immediate revision—2,200 square miles.

Should the cadastral survey of Cachar and Sylhet be completed before the topographical work commences, some reduction will be possible in these figures, as the area of supplementary work will be increased. For the present the cost of the survey work to be done in Assam may be estimated at 23$\frac{1}{2}$ lakhs.

92. Some minor points in connection with the Province require notice. The new topographical sheets lately issued are complicated by the entry of "village" boundaries and of the boundaries of tea-garden estates. The "villages" of the Assam Valley have no existence apart from the cadastral survey, each merely representing a block of country which could conveniently be included in a single cadastral sheet. A "village" may include two or three collections of houses, each bearing a different name. The entry of these boundaries is in the Chief Commissioner's opinion quite unnecessary, nor is there any necessity to show on topographical maps the boundaries of tea estates, the areas of which are gradually being expanded. The limits of blocks of cultivation should, however, in the Assam Valley be shown, and the boundaries of what are in Assam known as *mauzas*, which correspond roughly to parganas elsewhere, are required for administration purposes.

Village boundaries.

93. There are no systematic arrangements in this Province for the preparation locally of special maps on the 1″ or similar scales; but district and settlement officers occasionally have rough plans made for their own use, to supplement the Survey maps.

Locally prepared maps.

BURMA.

94. The earliest surveys of Burma, if they can be so called, and the only surveys from which the maps of the country as a whole have been prepared were of the nature of rough reconnaissances or explorations made as occasion offered, when the opportunity presented itself of attaching surveying parties to military or police expeditions. From the material so obtained maps have been prepared on the $\frac{1}{8}$″ scale for Lower Burma and on the $\frac{1}{4}$″ or $\frac{1}{8}$″ scale or both for Upper Burma, and these are published as maps of the North-East and South-East Frontier Series. These maps which extend to the country far beyond the northern and eastern boundaries of the Province are necessarily incomplete and sketchy and are frequently compiled from material of very old date—as far back as 1853 in some cases. New editions are published when fresh material becomes available, and in the parts of Upper Burma where no 1″ maps exist, the $\frac{1}{4}$″ maps are found to be of considerable use. The $\frac{1}{8}$″ maps of Lower Burma are on too small a scale to be of service for any purpose, except as rough index maps, and as they are in these parts more out of date than elsewhere they need scarcely be taken into account.

Early surveys.

95. In tracts of which a 1″ survey has been completed, the Survey of India are publishing preliminary editions of the degree sheets on the $\frac{1}{4}$″ scale prepared by the zincographic process. These degree sheets will eventually be engraved.

Degree sheets.

96. As a rule no small scale district maps have been published for Burma, but an exception has been made in the case of the following districts for which $\frac{1}{4}$″ maps have been prepared, based on surveys of the dates noted opposite each:—

Small scale maps.

Katha	1892-93
Ruby Mines	1893
Minbu	1888-89
Akyab	1853-61

and divisional maps of Pegu and Tenasserim on the same scale, and compiled from very old material, have also been published.

One-inch maps.

97. The survey of the Province on the one-inch scale is now steadily proceeding, but the material and the methods employed vary in different parts. In all districts in which there is much cultivation, the cultivated area has been or is being mapped on the 16″ scale either by cadastral parties of the Survey of India, or by special parties employed by the local Land Records Department. With one important exception, the original cadastral surveys were all done directly by the professional Department, and the cadastral maps have been reduced by pentagraph to the 2″ scale, and further reduced by photography for incorporation in the 1″ standard sheets. At the outset these reductions were used without any further survey to supplement the deficiencies of the cadastral survey in topographical detail; and it is no doubt owing as much to this cause as to their being now somewhat out of date, that maps of portions of the Irrawaddy Delta in Lower Burma are described as less satisfactory than others. It soon became clear that in a country like Burma mere reductions from cadastral survey would fail altogether to provide a map of the country and it was decided therefore to have the reduced maps carefully revised by topographical surveyors, before issue to the public. Two parties have for some time been employed on this work—No. 3 since 1899-1900, and No. 10 since November 1896. The work of the surveyors of these parties is partly purely topographical, where portions of standard sheets have been left entirely blank by the cadastral surveyors, and partly supplementary, where it is necessary only to go over the ground included in the cadastral map. Much of this supplementary work, however, as the Committee had an opportunity of seeing, is little less laborious than new survey. The work is at present being done in the field on the scale of publication, *i.e.*, the one-inch scale.

The greater portion of the Province, however, lies outside the cadastral area. A considerable part of this has been declared reserved forest and will, if existing arrangements are maintained, be topographically surveyed on the 4″ scale by the Forest Surveys, one party of which along with several detachments is now employed in the Province.

In addition to these parties, whose topographical outturn depends wholly or partly on reduction from larger scale surveys, there were till lately two topographical parties employed in the Shan States which surveyed directly on the 1″ scale. In the present year the last of these parties has been moved, with the consent of the Local Government, to undertake more pressing work in Baluchistan.

State of the maps.

98. The existing 1″ maps in Burma are, with the exception of those in Baluchistan, the latest and most up to date in the country, and the opinion of local officers as to their value is extremely favourable. The joint opinion of the Financial and Settlement Commissioners and the Director of Land Records, which refers apparently to the cadastrally surveyed districts alone, is that the maps are in good order except in the Irrawaddy Delta where they are based on old material. For Railway purposes they are pronounced to be invaluable, and for Irrigation works essential, though here as elsewhere the Irrigation engineers would prefer a larger scale map (4″ by preference,

and, if not, 2″). The opinion of Civil and Forest Officers is equally favourable, and the joint opinion already referred to states that it is most essential to map the entire country on the 1″ scale; this view is strongly pressed by the Lieutenant-Governor who would rather dispense with the 4″ maps of the Forest Surveys than delay the preparation of 1″ maps of the whole country.

Suggestions regarding the maps.

99. There is some difference of opinion as to the entry of village boundaries on the 1″ maps for administrative purposes. At present the maps show the boundaries of *kwins* by dotted lines, the *kwin* being apparently an arbitrary survey unit chosen for the convenience of mapping, and of importance for revenue purposes. Some officers would prefer to show the boundary of village headmen's circles, and others again think that on the one-inch map all these boundaries are unnecessary.

More levels are asked for in the maps and both Forest and Railway officers note the importance of showing, if possible, the heights of saddles between hills as well as of the hills themselves.

Work remaining to be done in Burma.

100. It is not altogether easy to estimate the amount of work to be done in Burma to provide the country with a 1″ map, both because the frontier is still in some cases indeterminate, and because many of the standard sheets have been completed in part only. The sheets already published, in addition to a few fragmentary ones showing parts of the country near Akyab, Tavoy and Mergui, consist of two main blocks of maps, one in Lower and one in Upper Burma. In Lower Burma the published sheets extend from Moulmein, Rangoon and Bassein to Prome and Toungoo, but many of them contain blanks, and it does not appear that the sheets hitherto published extend over the entire area of any one district in this part of the Province. The Upper Burma series is somewhat more compact, extending from Minbu, Mandalay, and the Ruby Mines on the west up to, or nearly up to, the line of the Salween on the east. A five years' programme has recently been sanctioned for the prosecution of further work, which if carried out will provide the Province with a complete 1″ survey of the country along the Irrawaddy from its mouth to Bhamo, except a tract of minor importance in the south and west of the Delta; of most of the country between the Irrawaddy and the sea in Lower Burma; and of a large and compact block between the Irrawaddy and the Salween in Upper Burma. There will still, however, remain an immense area for survey in the south in the Tenasserim Peninsula; in the west from Akyab to the Assam frontier, including the Lower and Upper Chindwin; and in the north and east to carry the surveys up to the Provincial boundaries. The Surveyor-General estimates the area still remaining for new survey at 141,500 square miles, in addition to about 30,000 square miles, chiefly in the Irrawaddy Delta, the maps of which will require a considerable amount of supplementary survey. A small area (2,700 square miles) surveyed some years ago in Mergui will require re-survey.

Estimate of cost.

101. Much of the country in Burma is very difficult and, even if the survey is done on the 1″ scale, it would be unsafe to assume a lower rate than Rs. 40 per square mile. For resurvey and supplementary survey the rates may be taken at Rs. 30 and Rs. 20 respectively; the latter rate appears to be justified

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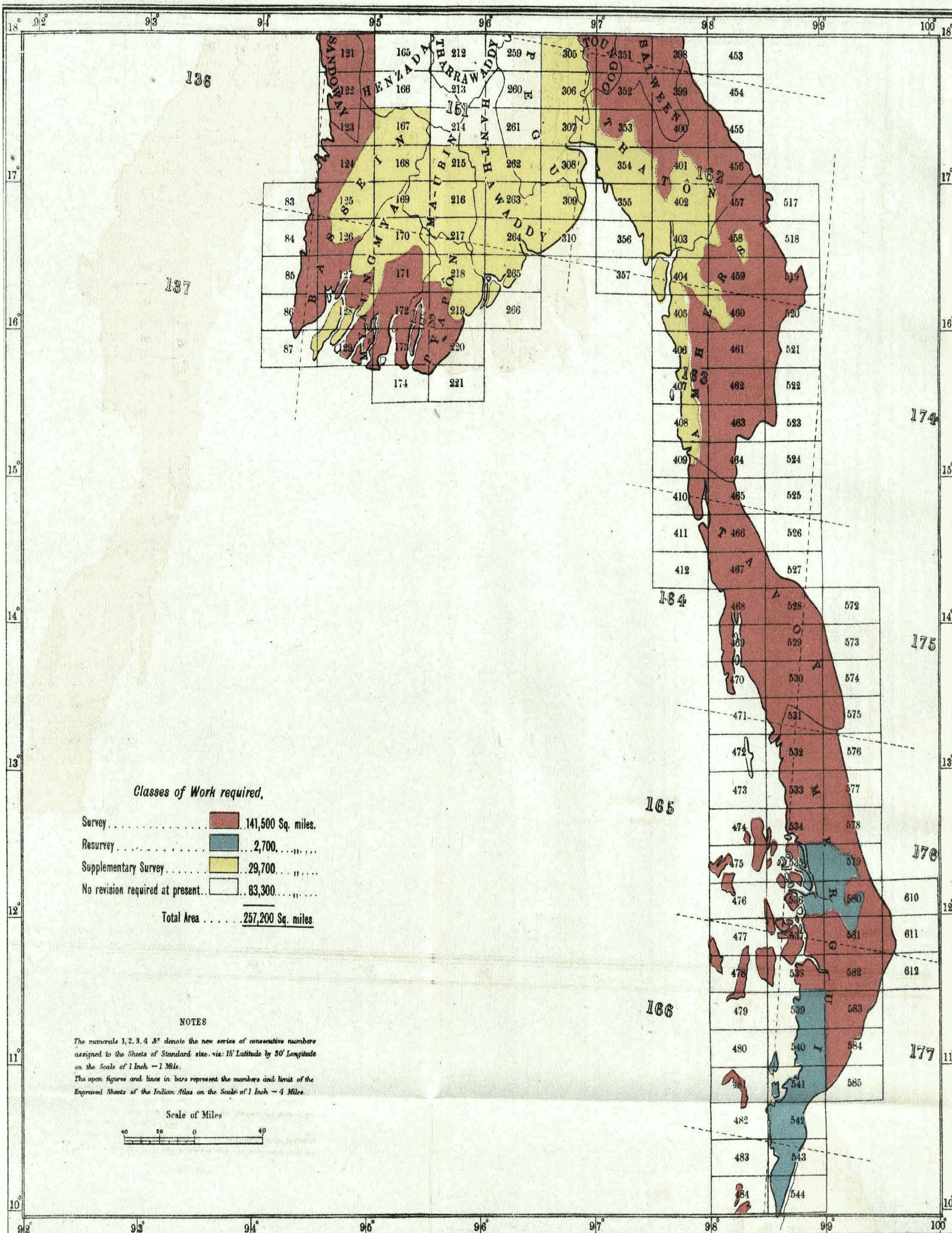

No. 83. S. I.—Jan. 05.—100.
No. 250 War Com. June 05—200
No. [illegible] Nov. 05. [illegible]

Helio. S. I. O. Calcutta.
Reg. No. 655-S. 05.

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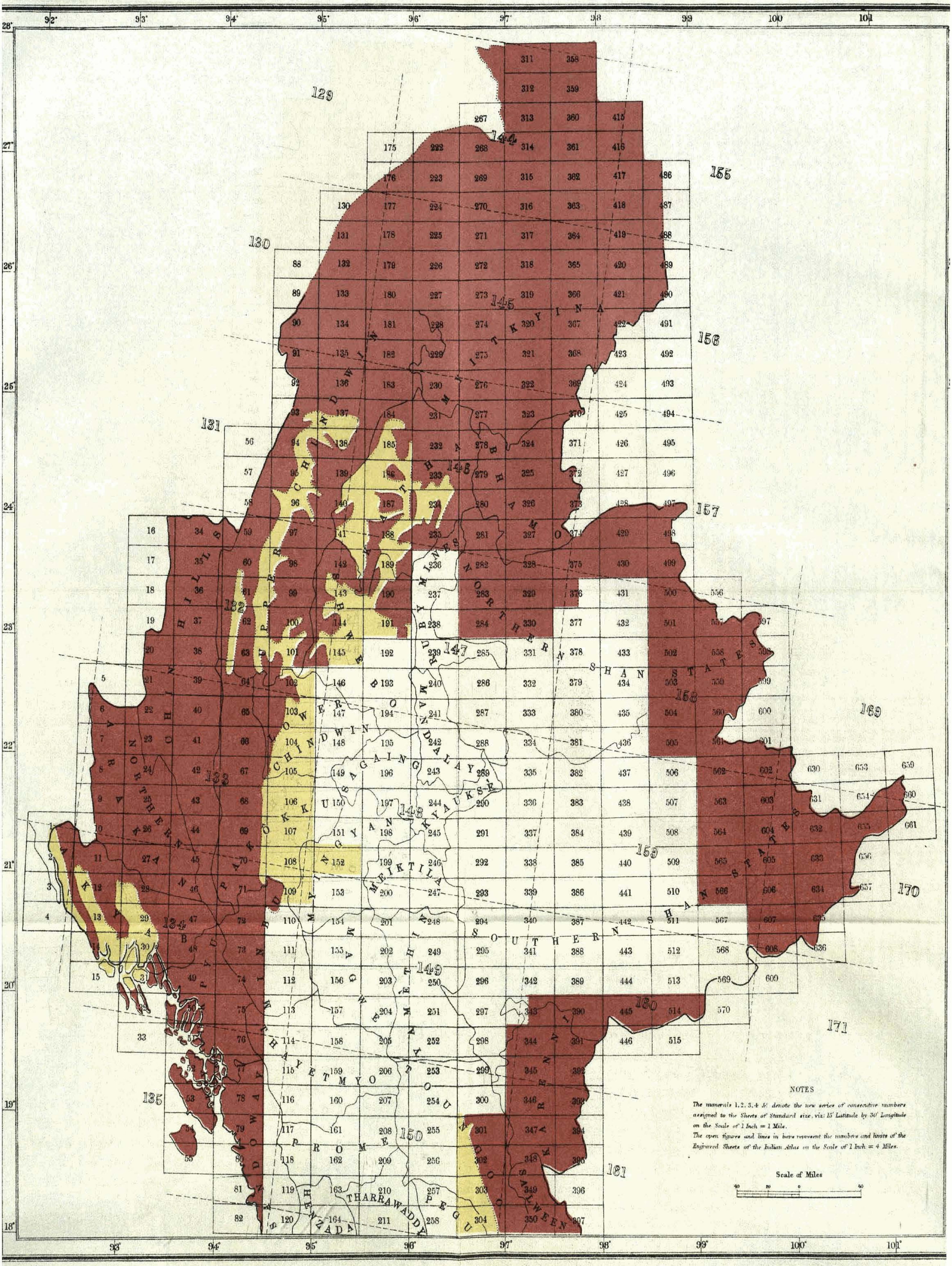

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No. 290. Sur. Com.–June 05.–200
No. 187 F. R. & A.–Nov. 05.–200

Helio. S. I. O., Calcutta.

Reg. No. 654-S. 05.

by the recent working of the parties employed in the Province, while the former must be conjectural. The estimated cost for the whole of Burma thus comes to nearly 63½ lakhs, the details being as follows :—

Survey	...	...	141,500 square miles at Rs. 40 per square mile.
Re-survey	...	...	2,700 „ „ at „ 30 „ „ „
Supplementary survey		...	29,700 „ „ at „ 20 „ „ „
Not requiring immediate revision			83,300 „ „
Total		...	257,200 square miles.

Locally prepared maps.

102. The excellent organisation for survey purposes of the Land Records Department in this Province has allowed of much work being done to supply the local officers with compilations from the survey maps, which are of great administrative convenience. For most, if not for all districts, maps on the ½″ scale have been prepared by reductions from the 1″ sheets supplemented where such sheets do not exist by enlargement from the ¼″ maps. These are rather skeleton plans than maps, but are of use to administrative officers, showing as they do the principal towns and villages (without boundaries), the roads and rivers, and the approximate position of hilly tracts, while it is possible to keep them roughly up to date. In some cases 1″ maps of sub-divisions or 2″ maps of townships have also been prepared, the basis of the maps being always as far as possible the standard sheets of the Survey Department. Arrangements for reproducing these maps by lithography or the Vandyke process are provided by the Government Press at Rangoon.

THE ANDAMAN AND NICOBAR ISLANDS.

Previous survey.

103. A topographical survey of the South Andaman Island was ordered by the Government of India in August 1883, and it was subsequently decided to extend the survey to the remainder of the Andaman Islands. The work lasted three years by which time the North, Middle and South Andamans with the adjacent small islands were surveyed ; in the Little Andaman Island the hostility of the savage inhabitants prevented the survey of more than about one-third of the area lying on the north side of the island. In the following year, 1886-87, the twenty small islands which form the Nicobar group were surveyed, their total area being found to be 678 square miles.

The only available datum on which to base the survey being the position of a point on Chatham Island, the latitude and longitude of which had been astronomically fixed by the Great Trigonometrical Survey in 1863, a base line about 960½ yards long was measured on the rifle range in Navy Bay at Port Blair, and on this the triangulation was based. The general survey of the Islands was executed on the ½″ scale. A portion of the South Andaman Island surrounding Port Blair, and the environs of the Settlement of Kamorta in the Nicobars, were however surveyed on the 4″ scale, to assist the further development of the Settlements. The two small volcanic islands of Narcondam and Barren Island were surveyed on the 8″ scale.

The total amount of work done and its cost are shown below :—

Season.	Triangulation.	Survey on the scale of			Cost.
		8″	4″	½″	
Andaman Islands. 1883-84	Sq. m. 928	6	28	...	Rs. 22,358
Andaman Islands. 1884-85	1,000	...	111	670	,, 40,567
Andaman Islands. 1885-86.	955	...	28	1,464	,, 27,540
Nicobars 1886-87	678*	...	6	678	,, 39,000
Total ...	Sq. m. 3,561	Sq. m. 6	Sq.m. 173	Sq. m. 2,812	Sq.m. 1,29,471

* A large expanse of sea was covered by the triangulation ; the area given is that of the actual group of Islands.

The total cost falls at a rate of Rs. 43 per square mile on the areas actually surveyed.

Nature of survey work in the Islands.

104. The work was extremely arduous and being scattered in a number of hilly islands presented exceptional difficulties. The surveyors had to work in boats and found the islands difficult to approach, a tug steamer, the "Reclaimer," being actually lost in January 1885 through foundering on a hitherto unknown rock. The islands were covered with dense primeval forest with trees 200 feet high, abounding in bamboo jungles and intersected by numberless creeks, with frequent and extensive mangrove swamps. The inhabitants were savages who were in places distinctly unfriendly. The procuring of supplies locally was impossible. Much of the survey work partook therefore of the nature of rough reconnaissance, especially in the Nicobars where again the time at the disposal of the party did not permit of much detailed survey. However the main objects aimed at—the correct delineation of the coast lines of the main islands, and the correct determination of the position of the groups on the earth's surface,—both objects having reference chiefly to the requirements of navigation, were attained.

The 4″ survey was particularly laborious as the surveyors had on South Andaman "to cut their way foot by foot through one of the most stupendous forests in the world." The system adopted at Port Blair and at Kamorta to show the hill features, was a modified method of contouring, the contours being obtained with the water-level along the ridges and spurs and the intermediate spaces sketched in by eye, each contour showing a vertical interval of 25 feet apart.

Survey requirements.

105. The Chief Commissioner of the Islands has been consulted regarding these maps. He has stated that it will probably soon be necessary to make a detailed and careful survey, on a large scale, of the whole of the North Andaman Island, of the northern half of the Middle Andaman Island and of the Great Nicobar Island, if, as is likely, these valuable tracts are opened up to private enterprise. The existing maps of these three islands are, except

on the coast line, chiefly conjectural, he thinks; but the maps of the other islands meet present requirements.

Seeing that the existing maps, though not on the 1″ scale, are only twenty years old, the Committee consider that, in view of the difficulties and expense involved in a large scale survey of these inhospitable little islands, covering a total area of 3,100 square miles, the re-survey, which will be necessary eventually, may await the opening up of which the Chief Commissioner speaks. There is no urgency in the matter, though the Committee have included the islands in their general estimate of all the work before the Survey of India Department. The re-survey when undertaken is not likely to cost on the 1″ scale less than Rs. 40 per square mile.

GCbI

G. C. Press, Simla.—No. 1 Sur. C.—12-9-05—900.—J.D.

SECTION II.

STATEMENTS BY MEMBERS OF THE COMMITTEE.

I.—Statement of views by Colonel Sir John Farquharson, K.C.B.

[*Calcutta, the 23rd to 27th February 1905.*]

Sir John Farquharson.

ORGANISATION.

Appointment of Surveyor-General.

1. The first question is as to the appointment of the Surveyor-General himself. I am not sure that I understand clearly in all its aspects the conditions regulating the appointment of the Surveyor-General. But as I understand, there is one of these conditions which practically requires that no officer shall be appointed Surveyor-General who is over the age of 50 for the reason that that officer has to retire at 55 years of age, and it is thought desirable that the post should be held for at least five years. That rule appears to me to bring into the considerations, which rule the appointment of the Surveyor-General, an element of chance which is surely excessive. With the limit of 55 years of age for retirement, the area of selection must necessarily be, for practical purposes, reduced.

2. Another point is that officers look forward to their prospects, and if they understand that those prospects are discouraging because they happen to be over age, it would certainly have a depressing effect on the carrying on of their work.

For instance, assuming that such a rule or such a practice, *although not actually laid down in any regulation*, exists as to the Indian Survey Department, I find that under its action no fewer than seven officers, ignoring casualties, who are now in the Department would, at the next vacancy about 1911, have to be passed over for the office of the Surveyor-General, and it is impossible to suppose that all of them are, or will be, incompetent to succeed the present holder of the office. I need hardly say that these observations have no personal reference whatever, but I think the appointment should be made simply and solely by selection, the element of age being only one of the points to be considered, although no doubt it is an important point.

Titles and position of the senior officers of the Survey.

3. Another question is about the senior officers. The somewhat magnificent titles which have been given to some of the senior officers of the Department seem to me rather out of place. I do not think it is necessary to call them Deputy Surveyor-Generals or Assistant Surveyor-Generals. It would be more suitable to give them titles applying more definitely to the executive offices of which they have charge. These appointments tend to some extent to reduce the position of the Surveyor-General. I am not sure that in India there is not a disposition to place the Surveyor-General (or for the Surveyor-General to place himself) somewhat in the position of what is called "*primus inter pares*" instead of his being supreme. In the first place, he is on the same level as the Deputy Surveyor-General and other administrative officers, in being himself the administrative officer for certain field parties. This seems especially objectionable for more reasons than one. In the second place, I have observed a case of an administrative officer giving periodical increases of pay to the men under his administrative control, a power which I consider should be entirely confined to the Surveyor-General. In the third place, it becam clear from the evidence of the Assistant Surveyor-General in charge of the Photographic-Lithographic Office, that applications for work outside the proper work of the Survey of India, were allowed to go direct to him and in most cases to be sanctioned and carried out by him without reference to the Surveyor-General. That power should be entirely and solely in the hands of the Surveyor-General; and not only so, but every application and every written communication from any other officer and Department in India should be addressed to the Surveyor-General, and not to any of his subordinates.

Head-quarters Staff.

Necessity for a Chief Staff Officer at head-quarters.

4. There is a third point as to which there seems to be a question as to the organisation of the Survey of India, namely, that there is apparently no officer at head-quarters, who might be called the Chief Staff Officer or the Executive Officer of the Surveyor-General. I think that for practical administration an officer in that position is a necessity in a large work like the Survey of India. One of the references to the Committee is whether there is in the Survey of India any system of comparison of the cost of the work done by the different parties all over the country, and also whether there are standards of work fixed for the various duties. On the Ordnance Survey in England there are standards of work fixed for every duty; these standards of work are fixed with reference to what is considered *medium* survey work, that is to say, work in a country of average closeness of detail and of average difficulty; and additions or allowances are then made to cover cases of special closeness or special difficulties. From the answers which the Committee has received from various officers, it is not clear that such standards have been fixed in India, or that the cost of the work done by the various parties is systematically and regularly compared, whereas such a comparison is one of the principal duties of the Executive Officer of the Ordnance Survey at Southampton.

5. I do not mean to say that the differences in the difficulties of survey work in the United Kingdom are equal to the differences in India. Nevertheless, it is clear that there

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must be a difference between the difficulties of survey work in a country like Kent and a country like Inverness or like Orkney and Shetland; so that the difference between England and India is merely a question of degree, and I cannot see why an endeavour should not be made to formally assess the difference between the difficulty of surveying a country like Burma, and a country like Madras or Bengal. For such detail work it seems to me that there is good reason for the establishment of a Chief Staff Officer or Executive Officer at the Head-quarter office in Calcutta.

6. I put in copies of the statements furnished by the Divisions of the Ordnance Survey to head-quarters to show the progress and cost of work, which it is one of the duties of the Executive Officer at Southampton carefully to examine. They are prepared quarterly.

7. The Executive Officer of the Ordnance Survey is also responsible for all accounts and correspondence in the head-quarter office and for the audit and check in the head-quarter office of all the accounts of the officers of Field Divisions. He deals with all letters which come into the office in so far as they affect merely points of routine, or the detail current work in the divisions. Sometimes he is next in seniority to the Director-General, and sometimes not; but in either case his decisions and orders on such points have to be accepted by all Survey Officers under the Director's command. In the absence for more than two days of the Director, he is authorised to act for the latter in all individual questions affecting pay or discipline; but all the periodical recommendations for increase of pay sent in by subordinate officers, and any large question affecting the Survey as a whole, are always referred by him to be dealt with by the Director-General alone.

8. One of the greatest responsibilities of the Executive Officer at home is to take care that the expenditure on the survey vote for the year approximates as closely as possible to the Parliamentary vote for the year, because on the one hand, if there is an excess of expenditure, the Government has to go to Parliament for a "supplementary vote" which may cause much loss of Parliamentary time; and on the other hand, if there is a saving in the expenditure the amount of that saving, however large, is entirely lost to the survey. This seems hardly to apply in the case of India, as I am now told that from the accounts of the five years 1898-99 to 1902-03, it appears that the annual saving on the Indian Survey vote amounts to £9,300. In England we should look upon that as an intolerable annual loss to the work of the survey. In the last two years I see the expenditure at home was only two or three hundred pounds less than the vote each year, on a vote of £237,000.

9. It will be seen from the above that the Executive Officer of the Home Survey relieves the Director-General of all administrative details, leaves him free to consider all large questions, and to deal with other heads of services and departments; and thus practically doubles the extent of the work and the numbers of the personnel whom the head of the Department can effectively control.

Appointment of young officers.

10. We have heard this morning the conditions which hold good for original appointments to the Survey of India. As to this point, I may perhaps state the rules, or rather the practice, which within my own experience applied to the Home Survey service and what in my opinion were its advantages, without presuming to say whether it would be applicable to the Survey service of India.

11. All first nominations of young officers to the Ordnance Survey were left entirely in the hands of the Staff Officer for Royal Engineers at the War Office: the Director of the Survey could not possibly know anything of their history and qualifications. There was always a sufficient supply of candidates, the service being a popular one. I can say that in my own time as Director, the appointments thus made were generally good.

No officer was appointed who had not completed a tour of Foreign service which generally extended from 3 to 5 years. The result was that they were at the time of their appointment men of some military experience, and were either probably senior Subalterns or junior Captains. The reason of this was that the Survey allowed great independence to its local officers in charge of country divisions, and it would not have done to place in that position a young officer straight from his training at Chatham.

The tour of service on first appointment was for five years, which might be extended for another two years on the recommendation of the Director-General. If there were no such extension, the officer left the Survey, and went back to the ordinary military or departmental work of the Corps at the end of the five years.

12. This rule of a five years' tour I consider to be of great advantage. Survey officers like everybody else after long employment in one capacity are apt to get into a groove, especially as many of them are detached all over the country, and are allowed a large amount of freedom in carrying on their duties, when away from head-quarters. I think a return to the stricter rule and more direct language used in army service was highly advantageous in the case especially of the younger officers, and if such experience is advantageous to the officer, it follows that it must be advantageous to the Survey, if that officer should be re-appointed to it.

13. There seems to be a second advantage in connection with this 5-year term of service, namely, that it gives to Director-Generals greater powers of selection in the case of senior officers who may wish to resume service on the Ordnance Survey. Good Survey officers generally leave their reputation behind them in the Department, and in the case of the re-appointment of senior officers to the Survey, the Chief Staff officer for Royal Engineers at the head-quarters (who was in my time Deputy Adjutant General for the Corps) always complied,

so far as Service conditions allowed him, with the request of the Director of the Survey that the most suitable officer should be appointed. This case entirely differed from that of the first appointment of young officers which the Deputy Adjutant General, rightly in my opinion, always kept in his own hands.

In the third place, the system of continuous service would appear of necessity to mean an excessive number of officers being employed in the senior ranks of the Survey, whereas, by the Subalterns or Captains being relieved at the end of their 5 years' tour, the Director-General at home was enabled to select later on only that very limited number which was all he required for carrying on the superior duties of the Survey. It would seem to be inevitable that, unless there is an abnormal number of casualties or retirements, there must be a larger proportion of senior men employed under a system of continuous service than under a system where only the number necessary to hold the higher appointments are brought in from outside. I do not know what the proportion of field officers employed on the Survey of India is, as compared with the proportion at home, where I think it is about $\frac{1}{6}$th of the whole; but I think it must be greater in the former service.

14. I see no reason why the above remarks should not apply to officers of the Indian army as well as to officers of the Royal Engineers. But I must again guard myself against being supposed to express any dogmatic opinion as to whether the conditions above stated are applicable to the case of the Indian Survey, although some, if not all of them, appear to be in principle applicable to any Survey service.

The training of young officers.

15. Next as to the training of officers: it seems to me from Colonel Longe's description of it, that the time spent in India on training is unnecessarily long, especially in the case of Royal Engineer officers. I am not sure what the exact course of survey training Royal Engineers now undergo at Chatham may be, and I have no knowledge as to what preliminary training Indian Army officers get. But in my time Royal Engineer officers in their training at Chatham went through a full course of surveying, not merely reconnaissance work, but through a course of what we call Cadastral Survey, that is, measurement of base line, triangulation, detailed survey by chain, theodolite and traverse, in fact they made the survey of a small area of the country on a comparatively large scale entirely by themselves.

16. In view of the above early training, Royal Engineer officers, when they joined the Ordnance Survey, were merely kept for two or three weeks at Southampton to visit the different departments of the office and to make notes of what was taking place there in connection with the reproduction of the maps. They would then go to a Field Division, to which they would be attached, I think, for a period not exceeding a month during which they would survey small triangles on the ground by the Ordnance Survey method. They were taught our system of accounts, and were taken out by the officer in charge of the Division for the purpose of examining on the ground his finished manuscript plans, and were instructed in and observed generally the organisation and working of a Field Survey Division.

They were then posted to the work for which they were originally nominated to the Survey, and were required to take charge of a division themselves.

They were not required to become expert personal workmen; that was in all cases unnecessary and would, in many cases, be hopeless. They were only required to know how to superintend others.

17. It appears from Colonel Longe's report that Royal Engineer officers on the Survey of India should be required to go through a preliminary training for 3½ years before they are allowed to be in direct charge of a Division. During this period they are, it is explained, doing useful work on the Survey as assistants, and they are also learning how to do the triangulation and the consequent computations. Even so, however, the period of training seems to be unnecessarily long, and a 3½ years' course of training is manifestly inconsistent with a 5 years' tour on the Survey. As regards the trigonometrical work, in the Ordnance Survey that branch of the work, as required by the system of division of labour which prevails, is entirely in the hands of one officer, usually called the Officer Commanding the Trigonometrical Branch. He is stationed at head-quarters, but superintends the men employed all over the United Kingdom in carrying out in the field the minor triangulations necessary for the Field Survey; and he has also to compute, and to send to all division officers his computations of the exact distances in feet of the trigonometrical points from the sheet lines of the various maps which those division officers have to prepare. It is therefore unnecessary to expend time in the instruction of every officer who joins the Survey upon that subject.

18. All the primary triangulations of Great Britain and Ireland were finished about 50 or 60 years ago. The detail triangulations have also been finished in Great Britain, but not in Ireland, where a 25-inch survey, to supersede the original 6-inch survey, is in progress.

Organisation and working of the Ordnance Survey at home.

19. As desired by the President, a short account will be given of the Ordnance Survey organisation in Great Britain.

Its basis is entirely military, consisting of some 24 officers of the Royal Engineers and four companies of Sappers. To these are attached a large number of trained civilians, called Civil Assistants, and several hundred labourers. As a rule, and with some superior exceptions, the class of civilians employed is the same as that of the Royal Engineer companies, namely, the artisan class. Nearly every man, military and civil, has been trained in the Department

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itself; only very rarely, for special technical duties in the reproduction of maps at Southampton, a trained man is brought in from outside. The organisation must in case of expansion be elastic.

20. About half the skilled men are employed in Southampton on reproduction and about half in the Field Divisions; but most of the Royal Engineers are employed in the field, where they are the backbone of the work.

21. With reference to a question by the President as to the total strength of the Ordnance Survey, I may say that in 1879-80 before the great increase was made consequent on the acceleration of the Survey, the number of skilled assistants—Military and Civil—was 1,274, the number of labourers 460 and the amount of the Survey vote £133,500. In 1880 an acceleration of the Survey was ordered by Government, necessitating a large increase of force. In 1885-86, at which time the increased staff reached a maximum, the number of skilled men was 2,348, the number of labourers was 900, and the amount of the Survey vote was £260,500. That was the maximum figure to which the Survey vote was carried. The reduction of cost then immediately commenced, and in 1890-91 when that acceleration had been completed, the number of skilled men was 1,816, the number of labourers 445, and the amount of the Survey vote £216,000. The reason why the numbers and cost did not in 1890 fall to the level of 1880 was that before 1890 the periodical revision of the maps had been sanctioned and taken up as a new work. I think the present vote is about £230,000.

22. There are about 12 Field Divisions which correspond to the Indian Field "Parties." Each Field Division has its officer, with, under him, a thoroughly trained Sergeant of Royal Engineers as Division Sergeant, who is in charge of accounts, correspondence, and the work of the Division generally. The maximum personnel might consist of about 28 chain surveyors with four superintendents, one or two clerks according to strength of division, 15 field examiners with four superintendents, 18 plotters and tracers with one superintendent, 15 draftsmen with one superintendent, 12 computers with one superintendent, and 32 chainmen. There are also six boys assisting the examiners. The rate of pay of surveyors is from three shillings and six pence to seven shillings a day; and of examiners from four shillings to seven shillings and six pence a day.

23. The above would have been the composition of the division for the original 25-inch or cadastral surveys, now completed for Great Britain, but still proceeding in Ireland. During the acceleration of the Survey from 1880 to 1890, above alluded to, it had to be nearly doubled, and each Division had two officers. The Division Sergeant, plotters, clerks, draftsmen, and computers, about 50 in number, are office men; the remainder are the field men always in the country, each section of seven or eight surveyors and chainmen, and each section of four or five examiners, being quartered successively in the villages most convenient for their work, and working up to a radius of four or five miles before moving to the next village.

24. The Division Office for the 50 office hands is established in a provincial town, selected for central situation as to the work, good railway communications, and facilities for getting accommodation. Large manufacturing towns are generally avoided on account of the greater cost of living and the greater difficulty of recruiting locally on low rates of pay, the boys and lads required for the office duties. A division thus established is not moved except when absolutely necessary; frequent moves disturb the work and the men, and lead to expense to the public and everybody else.

25. The course of the work is as follows:—

The Division Officer receives from the Officer Commanding the Trigonometrical Branch the lengths of the sides of each triangle as computed, and a diagram shewing the positions of the trigonometrical stations: the former he keeps in the office, the latter is sent to the Superintendent of chain surveyors, who "restores" on the ground, if they have been removed, the wooden poles showing the trigonometrical stations.

Each "chain surveyor" chains the three sides of the triangle, and his measurements are sent to the office and compared with the computed sides; if they do not come within 2 links in 1,000 of the calculated sides, he has to re-measure them until they do, and similarly with all the interior lines which he measures, if they do not fit inside the triangle, when laid down on the plotted plan, they have to be remeasured. The surveyor then finishes the survey in his field-book of all fences, streams, houses, etc., which fall within the triangle.

The field-book is then sent to the office, where the details are all plotted on the plan in pencil by boy or lad "plotters."

When the plan, 3 feet by 2 feet, has all been filled up by the various triangles, it is traced in 6 sections, each one foot square, by other lads called "tracers," fences in black, water in blue, and houses in red.

The six traces are then sent (several months after the chain-surveying) to the "field examiners" who have by this time succeeded the surveyors in the village. They check on the ground every fence, stream, house, etc., collect the names and write them, etch the houses and the water in red and blue, classify the roads and collect from local authorities all interesting information (such as antiquarian) which they can find. The completed tracings are sent to the office, where the "draftsmen" pen in ink all the details shewn on the tracings on to the plotted plan over the pencil plotted lines, and the "stampers" and "typers" stamp all trees, etc., and type all names on the plan, which is then finally examined by the plan examiners.

The "computers" who are also boys or lads, compute the area of each enclosure mechanically by sliding scales, and the areas are stamped in acres and decimals of an acre on the plan of each enclosure.

The Division Officer then takes the finished plan to the ground, and checks all the details in the way he thinks best, making any minor corrections himself, and if he finds any doubtful or wrong work of any extent he sends the Division Sergeant or a special examiner to test it and correct it before punishing the defaulters.

He then signs the plan as correct, and sends it to the Levelling Officer (another special branch) to insert on it the levels. The latter sends the plan to Southampton, where it is again closely examined in every respect as to details, areas, names, etc., and as to whether it is up to the survey standard and orders, and suitable for reproduction.

It is then returned to the Division Officer with the remarks of the Southampton Examiner. The Division Officer returns the map to Southampton with his replies to the remarks, and it is then put in hand for reproduction.

It will be seen that the leading principle of the whole system is division of labour, partly for economy, and partly because the men employed on the various duties act as checks on each other.

26. There is of course no analogy between the minute and laborious accuracy required for the above cadastral work and such work as the topographical maps of the Indian Survey. But there may be some analogy as to the method of expansion, when necessary. When the Home Survey had to be doubled, it was entirely done by training men in the Department itself and filling their places by young recruits who were themselves to be trained. There was no increase or hardly any in the superior staff of officers. Some 12 Royal Engineers, Subalterns or junior Captains, were given by the War Office for the Field Divisions, and a few clerks had to be taken on to deal with the accounts for a much heavier expenditure. In all other respects the administrative staff remained as before.

Revision of large scale maps.

27. All work done in Great Britain on cadastral plans is now "Revision" and not new survey. The method followed is to cut up an impression of the 25-inch or 6-inch map into 6 cards, each about 1 foot square, and correct on the ground in red the altered details, or supply in red the new details. The corrected cards are then traced in the Division Office for zincography. The men who correct the maps in the field are called "revisers," and practically work like the "examiners" above mentioned in the description of cadastral surveys.

28. But sometimes the printed impressions are distorted by the expansion or contraction of the paper so much that they could not be used for the revision. In this case the original manuscript plan is taken, which being on better paper is nearly true to the proper size of the plan, and it is helio-zincographed to the correct scale. Red helio-zincograph impressions are then taken on tracing paper, and are cut to the size of $\frac{1}{6}$th of the plan, as in the case of the cards, but each tracing is provided with a considerable margin. The field "revisers" use these tracings for revising and correcting the work in the field. A blue impression is also taken (dry, like the red tracings, so as to measure correctly) from the helio-zincograph plate, and becomes the revised manuscript plan. When the field revision is complete, the corrections on the red tracings are transferred to the blue manuscript plan, and the whole of the latter is penned in in black suitably for reproduction by photography. The areas, etc., are then dealt with as for the cadastral original maps.

29. Those 6-inch maps which have been originally reduced from the 25-inch maps are revised by reducing the revised 25-inch maps to the 6-inch scale in the usual way by photography.

30. The *revision of the 1-inch map* is done by the reviser taking with him to the ground the latest edition of the 6-inch map and also an impression of the unrevised 1-inch map. He shews on the 6-inch impressions all the alterations or additions since the last survey, but only so far as they affect the detail shewn on the 1-inch map. He also, if necessary, marks new or important names, or names which should be omitted, and marks cuttings, embankments and all others details required to be shewn by symbols on the 1-inch map.

The corrected 6-inch impressions are then passed to the 1-inch draftsmen, who mark on one impression, called the "erasure sheet" all the detail which has to be removed from the copper plate, and on another blue impression all additions or alterations. Meantime a matrix from the original plate has been obtained by electrotyping, and on it all the obsolete detail shewn on the erasure sheet is scraped off. A duplicate is then taken of this matrix, and the new work is engraved on it. From this corrected plate another matrix is made, and from the latter another duplicate which becomes the "printing plate" for the revised map until worn out. The other plates of the revised map are stored.

The revision of *engraved* 6-inch maps is carried out in the same way.

31. In addition to the work above described, the Ordnance Survey has for many years trained and held in readiness for duty a certain number of officers, non-commissioned officers and men of the Royal Engineers, to be available for purely topographical work in any part of the Empire. This work is of the same nature as Indian topographical work. The officers are required to go through a course of a month or two of Astronomical and Trigonometrical work, and a section of men under an officer is sent every year to a hilly district in Wales or Scotland to carry out a small scale topographical survey. These topographical sections have furnished most of the men required for small-scale surveys of Mauritius, St. Helena, Sierra Leone, and in South Africa; and for the Boundary Commissions (under the Colonial Office) near Yola and Lake Chad (Anglo-French); near the Zambesi River (Anglo-Portuguese); near

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Lake Victoria, East Africa (Anglo-German); and the Anglo-Liberian Commission. About 20 non-commissioned officers and men are almost permanently employed on such duties abroad.

Organisation for revision of 1-inch map: Colonel Longe's proposals.

32. As to the organisation of the Indian Survey for carrying out an entire revision of the topographical maps of India, I shall first deal with the proposals which have been made by Colonel Longe. The first of these is contained in a diagram and attached memorandum, dated the 20th instant, in which he suggests that the whole of India should be divided into four Circles, as they are termed here, in each of which he would place a Survey of India Officer who might be called Superintendent, Northern, Western, Southern and Eastern Circle, these Circles being shown on the diagram which accompanies the memorandum. These officers would be immediately under the Surveyor-General. He would have one Surveyor-General, and also one Deputy Surveyor-General who would be the Surveyor-General's Deputy, and act for him in all routine matters and duties, such as Deputies in other Departments carry out. Under each Circle Officer he would place four parties. He then gives his reasons for suggesting his scheme, one being that an officer of high rank on the Survey would be in permanent communication with the local authorities in each Circle; and adds that he would not recommend attaching reproduction offices to the Circle head-quarters, as there would not be sufficient departmental work to occupy them permanently, and he thinks it has been fairly conclusively proved that extra-departmental work is destructive of Survey efficiency. He also adds that in each group or circle he has no doubt that an extra establishment will have to be kept up for special surveys. As regards the United Provinces and Bengal and similar areas in other parts of India, special arrangements for revision would have to be made, because it would be quite unnecessary for the revision of those areas to have large parties, such as he has suggested elsewhere. What is more required there in his opinion, is a number of intelligent surveyors or provincial officers to be placed at the disposal of the Circle Officers for this class of supplementary survey. He also suggests the importance of increasing the number of levels throughout India, and gives what his estimate is of what ought to be done in that respect. And we have, in addition to the above, Colonel Longe's evidence at Calcutta on 7th February.

Objections to Colonel Longe's proposals.

33. I must at once say that my opinion is decidedly against this proposal to divide the country into four big areas, each under an officer of high rank who would be permanently in communication with the local authorities for that area. I think the work which the Committee has to deal with should be treated entirely as one whole, and that it should be carried out directly under the superintendence of the Surveyor-General and the Government of India without the intervention of any intermediate officer of high rank or of the local Governments. The work is a special work of very great extent, and in my opinion, it will require the utmost concentration of the whole of the strength of the Survey Department to carry it out. What I mean by concentration is, that during the next 15 or 20 or 25 years the whole attention of the Surveyor-General and of his office and his staff, should be directed to carrying out this work of revision. Otherwise, in my opinion, there will be difficulties constantly arising. These officers of high rank in the four Circles detailed, will probably, in communication with local authorities, discover what in their opinion is most urgent and necessary local survey work apart from the topographical, and they will bring the whole of their influence to bear upon the Surveyor-General to carry out such special work in those districts. The result would probably be that the whole programme of the revision of the topographical maps of India would be most seriously interfered with. I may perhaps state what was done at home in two cases which bear some resemblance to this work of revision. The first was the acceleration of the cadastral survey between 1880 and 1890, in order to complete the cadastral survey of Great Britain in ten years instead of in 20 years. This involved nearly doubling the strength, and is the case previously mentioned in connection with the work of the Ordnance Survey. The system adopted was to make a careful estimate of the strength and cost required to complete the survey in 10 years: the total area was then divided into the number of areas or blocks for which Field Survey Divisions were available, each of those blocks of approximately equal area (allowing for difficulties) was allotted to each division; and the divisions were then instructed to recruit up to the strength required—in most cases about double their original strength. Each officer and division knew what they were expected to do. At the end of the work there had of course to be small adjustments between the work of the divisions, some being quicker and some slower than the estimates; but as a whole the work was done within the time ordered and within the cost, and as accurately as before the acceleration began. The cost of the work was over a million sterling, and the number of new plans which had to be prepared was probably from 20,000 to 30,000. The second instance was about 1892, when the Ordnance Survey was called upon to undertake the entire revision of the whole of the cadastral maps of Great Britain within 20 years. At that time the same system was adopted. The whole of the country which would have to be surveyed, so as to bring up to date every map within 20 years' interval since the last survey, was divided into a number of areas or blocks corresponding with the number of divisions which were available to carry out the revision. In this latter case I cannot say what the ultimate result will be, because the work will not be completed until 1910; but up to the time when I left the Survey, when about one-third of the work had been completed, the progress had been such as absolutely to ensure its completion, if not interfered with, within the time and cost estimated

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In both of those instances the Government of the country imposed tasks upon the Director-General of the Ordnance Survey, and having granted him the necessary funds, as estimated by himself, they expected those tasks to be carried out. But they had to, and they did, hold him free from all outside local influences, however powerful, whether of towns or counties.

34. I think that for the considerable work of the revision of the topographical maps of the whole of India, the same principle should be followed by the Government of India and its Surveyor-General; and I also think that in carrying out the work there should be no intervention of officers of high rank between the Surveyor-General and the officers of the parties who are to carry out its details, because in that case the concentration, which is absolutely necessary, will probably be thwarted, and delays will arise. There should be no approach to divided responsibility.

Periodical revision.

35. The next point, in which I differ from the Surveyor-General is as to his opinion that periodical revision should not take place. I think it is absolutely essential for the due performance of this work that periodical revision should take place.

[Colonel Longe now explains that, although he differed from the previous Committee in that he did not recommend separate revising parties for different provinces and in that he objected to laying down any hard and fast rule for the periods of revision, and in that he thought revision must follow the opening up of the country such as districts like the Punjab, yet later on in his evidence he stated that he would accept a period of about 15 or 20 years as a period for general revision, while certain areas would possibly have to be revised more frequently.]

36. As to this opinion of Colonel Longe's, my own opinion is that it will lead to great difficulties to depart from the prescribed periods of revision. The interpolation of certain surveys in particular districts, which may have greatly altered, will in the first place mean patchy work all over the country. One district having a survey made within the last year may adjoin a district which may not have been surveyed for 14 or 15 years. It is inevitable that portions of sheets in those two districts should overlap each other, and consequently even in a single sheet of the standard 1-inch map of India, there will be patches of survey made at two entirely different dates. I think this is a highly inconvenient result for any general survey of the country.

37. In addition, it is manifest that the special taking up of such surveys must interfere with the general programme of the whole scheme. The Surveyor-General himself will be placed in difficulties. Before this scheme is undertaken, it is quite clear that it will fall to the Surveyor-General to make a most careful estimate of the strength of his parties and their cost, in view of the fact that he will have to carry out the revision of these surveys within the period that may be defined by the Government of India. If he has to undertake work such as he now proposes, it will clearly throw out the estimates of strength, progress and cost which must be made at the beginning of the work. The result will be that the whole execution will become uncertain. Further, it appears to me that a good deal of the absolute necessity, which, the Surveyor-General seems to think, holds good, for having certain areas surveyed, or re-surveyed, more frequently or earlier than others, is more or less unfounded and imaginary. Special districts have already in India remained often, for much longer periods, without being re-surveyed or the maps being brought up to date. Should the delay cause great inconvenience in any particular areas, it is hardly to be supposed that the local officers will not be able, with the means at their disposal, to amend those maps sufficiently for their immediate purposes, and sufficiently well for these maps to remain useful until the general period of revision comes round.

The periods for revision.

38. As to the periods of revision, the Committee knows that the periods which have been laid down in Great Britain are 20 years for cadastral surveys and 15 for topographical surveys, although I have never heard who first proposed these rather arbitrary spaces of time. Judging from personal experience, I think these periods are for Great Britain unnecessarily short. But I must stipulate that I cannot give, with any confidence, an opinion in the case of India from want of personal knowledge of that country. What I observed at home was that the original cadastral survey of certain agricultural districts in Aberdeenshire, with which I am intimately acquainted, was made about 1867. The revision of that survey took place about 1900 after an interval of 33 years. The revisers of the district had not the slightest difficulty, after those 33 years, in making all the corrections that were necessary, not only as to roads, streams or large and important features, but as to every agricultural fence over the whole district. In fact the original maps were for all practical purposes sufficiently good even after that long interval, and might have remained so for several years longer. Therefore I would suggest, and it is merely a suggestion, that it should be considered whether the period of revision of topographical maps adopted for India might not be lengthened beyond that laid down by the previous Indian Survey Committee of 1904, and certainly up to 20 years or even to 25. One reason for this proposal is that the first revision must inevitably be much heavier and more expensive than any subsequent revision, and it is therefore desirable to relieve the tax-payer by distributing over a longer time the heavy cost which will be required for this first revision.

Revision of special features.

39. With reference to special revisions, the only case I would admit would be that of railways, under the method adopted at home.

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There the Board of Trade notifies to the Ordnance Survey the opening of any new railway or new railway station. The Survey at once sends a reviser to survey it, and when this has been done, it is engraved on the copper plate of the 1-inch map. This is necessary for military considerations. I suppose in India the local Government would make the notification.

As to new canals, personally I would not specially revise them merely for civil purposes because Irrigation officers would have their own plans; but if the Military Department required it, I would specially revise them before the usual revision of the district. This, however, is peculiarly an Indian question, which should be left to the other Members of the Committee to decide. The special revision, either of railways or canals or of riverain areas, would not interfere with the principle of periodical revision.

Proposed organisation for revision.

40. With reference to the above statement, I have prepared two diagrams and memoranda, which, perhaps, will indicate to the Committee the general lines upon which I should propose that the revision of the topographical maps of India should be carried out. The first method proposed is by dividing the country up merely into a number of blocks, corresponding to the number of parties which may be available for the work, the whole of these parties to work directly under the orders of the Surveyor-General. But as it appeared to me that possibly some of the members of the Committee, with their superior knowledge of local conditions in India, might prefer that the parties should be detailed more in accordance with the areas of provinces, in so far as that can be done without seriously affecting the area allotted to each party, I have followed that method in the second diagram and memorandum now submitted. I must premise that under this method as well as the other, no provincial or local interference with the revising officers should be allowed. I must also premise that the only object of these diagrams and memoranda is to indicate to the Committee what my ideas are on the subject. They have no pretensions to the slightest accuracy as to the extent of the areas—these would have to be worked out in detail. My sole object is to indicate to the Committee what general direction the revision might take. And it is probable that when we are informed as to military requirements, the details would have to be modified, especially in the North-West.

Proposed number of parties.

41. The Committee on looking at the diagrams, which have been produced, have at once raised the question how far the Surveyor-General of India could start, within any reasonable time, the revision of the whole of India by 16 parties.

Of course it is understood that the number of parties which I propose, namely 16, may not be the final number decided on; but I must point out that, as far as I can judge, the Surveyor-General of India has at the present time a nucleus, smaller or greater, for providing that number of parties.

For I find that the number of parties enumerated in the disposition list of officers of the Survey for the 1st of January 1905, as at present available, is 20, from which I suppose must be excluded Nos. 4, 5, and 6 employed on the Cadastral Survey of Bengal, No. 7 on Burma Cadastral, and No. 8 on United Provinces Cadastral. The balance would be 15 topographical parties. Further, there is the possibility of dividing the larger parties, if necessary, such for instance as the two which I find employed on the North-West Frontier, namely, Nos. 11 and 15, which together are stated to cost about £20,000 sterling a year, and from which it should be possible to form the nucleus for a sixteenth topographical party. This would make available my proposed 16 parties.

42. It is of course understood that all the parties would not be up to full strength for a year or two, but would have to recruit up to the necessary strength, which I have not attempted to define. But if I am right in estimating, as I do in the memoranda, the average rate of progress of a party of present strength on revision at from 3,300 to 4,000 square miles a season, (and I think the evidence we have heard practically justifies this estimate) then I consider that the 16 parties which I propose would be sufficient.

Recruiting.

43. As to the best method for adding to the strength of the parties, an addition which will no doubt be necessary, I must be equally diffident. But I have already explained the method followed in England, where every division recruited for itself in its own locality, and if that method is practicable in India, then the course which I propose of establishing parties for revision all over India would surely be favourable to it; parties in the North-West would recruit there; those in Burma Burmese; in Madras Madrasees; and so on, and every man would be trained in his own party. Such a proposal as that of the Surveyor-General in his further memorandum on training, received 20th February, namely to establish training schools for several years for from 50 to 130 surveyors in each of his four Circles would never have occurred to any one at home. If, as is quite possible, half of them turned out failures the cost of their instruction would be pure waste. He gives no estimate for this apparently extravagant proposal. We found at home by experience that a large number of town bred youths, whose educational qualifications were excellent, were entirely unsuited for the general work of the Survey. So long as they could be kept in the office, they were suitable, but when sent to field work, many of them were found either physically unfit or unwilling to undergo the hardships of bad weather, frequent moves, and inferior accommodation. These considerations must apply with even greater force in India, and I would suggest to the Committee whether the Surveyor-General should not be asked to consider whether the system of obtaining recruits locally, under conditions which I have pointed out, that is to say, dividing the whole of India up into areas,

where all the parties would be working presumably amongst similar races, and would have to deal with similar languages, could not be followed with greater advantage than organising and maintaining several large schools for surveying, which it must necessarily take a long time to organise, and the pupils at which may possibly turn out less satisfactory than recruits who could be locally obtained from among the country population.

Provincial officers.

44. There is one class of officers employed on the Survey of India which is entirely new to anybody who has not been employed on Indian Surveys, and that is the class of "Provincial officers." Sometimes they are talked about as being necessary for traversing or triangulation work on which a Corporal or a civilian would be employed at home on pay not exceeding 8 shillings a day as personal workmen; on the other hand I find from the "Green book" that many of the seniors get from Rs. 400 to Rs. 650 a month salary, or from £320 to about £520 a year, which would lead to the supposition that they have the status of officers. Either the juniors are much underpaid as officers, or the seniors are much overpaid as personal workmen. Being therefore still ignorant as to what functions they are supposed to discharge, what their qualifications are, and how they perform their duties, I must for the present pass by this branch of the subject.

Two officers for each field party.

45. I agree with Colonel Longe's proposal that there should be two Imperial officers with every field party, it being understood that a substantial increase should be made in the size of a party. Supposing for instance that one officer suffices for the superintendence of a party costing £10,000 per annum, the party commanded by two officers should be required to be increased in number corresponding to an annual expenditure of at least £15,000.

Restrictions as to pay.

46. So far as the office at Calcutta is concerned, I agree with Colonel Longe that he should be relieved from any restrictions on the promotion of subordinate employés up to whatever maximum rates of pay may be fixed by the Government of India. The rule at home is that the Director of the Survey can employ or promote any civil assistant or labourer up to 10 shillings per diem and any engraver up to 15 shillings; above these rates he must go to the Parliamentary head of the Department.

He is of course limited by his fixed annual vote: and he is also strictly limited as to the placing of civil employés on the pensionable list for which he can only recommend when there are vacancies. But he is not cramped, as the Surveyor-General says he is, by vexatious restrictions as to sections, classes, and fixed establishments for men or lads on the lowest rates of pay.

Division of labour.

47. There is one difference between the system of the Ordnance Survey and that of the Indian Survey, in that the former makes it easier to advance recruiting, because as a rule its recruits are required at first to learn only one duty, although, as their service goes on, they are always, if found capable, advanced to higher duties. This point particularly struck me at Bangalore in the case of the eight lads who are now under instruction there. Some of these showed superior capacity for computations, others for delineation of the ground, and so on. It is plain that the instruction of such lads in several duties simultaneously must be more difficult and slow than if they were required to learn only one at a time. I would suggest, as a point for consideration, whether the principle of division of labour could not be extended on the Indian Survey. One question might be whether some of the officers employed in the Trigonometrical Branch could not be employed on carrying out the minor or tertiary triangulation which is now carried out by the field parties themselves; and a similar question may in future arise whether the officer who is in charge only of tidal operations and principal levelling should not be called upon to superintend the minor levelling operations which, all the evidence appears to show, are largely required over most of the area of India.

Scientific work.

48. As to the scientific portion of the Survey of India, it has hitherto been one of its most creditable features; and indeed, practically, until the comparatively recent commencement of geodetic operations at the Cape under Sir David Gill, it was for several years left to India alone to represent the whole of the British Empire in that particular branch.

Employment of natives.

49. With regard to the employment of natives, as compared with Europeans, it is impossible for me to give any decided opinion owing to my ignorance and inexperience of the native character; but I may perhaps say that I have on several occasions been struck by what appeared to me the adaptability and mechanical skill shown by many of those natives who are employed as personal workmen in the field and in the offices. As to their qualifications for superintendence, I can say nothing.

Surveys other than topographical.

50. In accordance with the principles which I am advocating, of concentration and centralisation in carrying out the revision of the topographical maps of India, I should be in favour of authorising the Surveyor-General to withdraw every available topographical surveyor under his command from all duties outside that of revision, and to employ them upon that work alone; but this would not apply to the surveyors employed on the Cadastral Survey of Bengal. Forest surveys, on the other hand, on which I understand some of the best of the topographical surveyors are employed, should certainly not be excepted. These surveys should be carried out as part of the topographical map of India; and the Forest Department, if it considers the continuance of

Forest surveys.

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additional or special survey work urgent and indispensable, should be required to train its own staff for its own immediate purposes.

Municipal surveys. Cantonment surveys.

All municipal surveys should be handed over to the local authorities. All cantonment surveys should be handed over to the military authorities, it being assumed that Commanding Royal Engineers will be provided with the necessary funds for carrying them out. The Surveyor-General should be relieved of all labour and responsibility as to these two classes of survey.

Cadastral surveys.

51. I have always held the opinion that it is correct in principle that the Surveyor-General of India should be in charge, so far as the methods of carrying out the work are concerned, of the cadastral surveys of India. But as the subject is a very wide one, and as there are serious difficulties to be considered, I reserve my opinion on the subject for the present; merely observing that the superintendence of both the topographical and (in a modified way) of the cadastral surveys of India does not seem to me to be a task too heavy for one man to undertake.

One-inch maps.

52. I think the Committee will have to seriously consider the question of the method of production and the scales for the Survey maps of India. I first raised this question conversationally at Madras on 13th January; and at Poona on the 23rd of January I asked the Committee to consider the following alternatives, namely—

(1) Publishing 1″ and ½″ maps by copper-plate engraving.

(2) Publishing maps by photo-zincography.

Up till then I think the Committee, including myself, had generally understood that the present scale, namely 1-inch, and the present mode of reproduction, namely, photo-zincography, should be continued for the topographical maps of India. But on the 27th January in Bombay I read a paper to the Committee to the effect that after a careful inspection of the standard 1-inch maps, partly on board the R.I.M.S. "Bhamo" and partly at Madras, I had come to the conclusion that the 1-inch topographical maps of India are not only out of date and require revision, but are also defective in hill features, in clearness of definition and in the amount of topographical detail which they show; and that the size is inconveniently large. I think the primary defect is the method of reproduction by photo-zincography, that being the method most unsuitable for the reproduction of small scale topographical maps. There were also amongst the old maps many cases of incomplete sheets. Also the presumptive contours representing the hills were often not contours at all, but hachures differing in style in different sheets. There were no symbols of classification of roads, while there were practically no levels. In many of the recent photo-zincographed maps similar defects appear, and in fact it appears from the evidence recently given before the Committee, that, even in the case of surveys of recent dates, incomplete standard sheets containing modern surveys have been completed from surveys 20 or 30 years old, a defect in a topographical map which I consider to be fatal to its usefulness. It seemed, therefore, clear that during the revision, the whole of the existing standard sheets of India, with the possible exception of those of Bombay, would have to be redrawn and that the Committee ought, therefore, to consider the question of reproducing those maps by copper-plate engraving. As to Burma it is admitted that its 1-inch maps, which are the most recent maps of the Survey of India, are a considerable improvement upon those produced at earlier dates. I also at that time raised the question whether the Committee had any objection to publishing maps on the ½-inch scale. Considerable discussion arose upon this point, and some of the members of the Committee were strongly opposed to the ½-inch scale being adopted for *any* of the topographical maps of India. It is only fair to say that no member of the Committee would propose changing the scale of the general topographical maps of India from 1-inch to ½-inch to a mile, except for exceptional areas, sparsely populated, difficult of access, costly to survey, or pestilential as to climate. There is a general agreement among the Committee that for the great bulk of the area of India, the topographical map should be on the scale of 1-inch to the mile. The principal question, therefore, remaining is how these maps are to be reproduced, and it is necessary that the Committee should come to some general decision on this point as soon as possible in order that it may be referred to Colonel Grant for his opinion as to the relative cost of reproduction by photo-zincography and by either engraving on copper, or by the new system of photo-etching which has recently been to a large extent adopted for small scale maps at Southampton.

53. As to the general character of the existing maps, I have only once had an opportunity of taking any of them out on the ground, namely, at Darjeeling on 12th February. I should wish to point out to the Committee, on the map itself, some of the points which occurred to me in that examination. The sheet is No. 270 "Bengal Survey." The date of publication is 1901, but the surveys were made from 1859 to 1883. The style of printing is, therefore, comparatively recent. Apart from the rough, coarse, and badly defined lines inseparable from the defective mode of reproduction, there are two defects of the map which appear to be inexcusable from either the soldier's, the traveller's, or the naturalist's point of view. The lower part of the map shows part of the plains of Bengal, and the upper part shows part of the lower slopes of the Himalayas. The latter are covered by an expanse of dense forest, the former are open except for a few scattered trees. The line between the two on the ground is perfectly

clear and distinct. The map shows the few scattered trees on the plains, but in the dense forest not a single tree; the country might be like the open downs of Sussex. Higher up the slopes the same misrepresentation continues. Large areas have been cleared and planted as tea gardens. The tea gardens and dense forests surrounding them are shown on the maps exactly alike, that is, as all open ground. The other defect is that owing to the fact that in some cases roads are, as is natural, run by the engineer as nearly as he can carry them along contours, it is almost impossible to follow the course of the road except by the very closest and most detailed inspection. The main point, however, is as to the reproduction of the maps. Sir John Farquharson.

54. There have been doubts expressed whether it would be possible to alter the system of reproduction in favour of the method by copper engraving on account of the great difference of cost, and also the great difference in the time of execution, which would be involved if the better method were adopted. I think myself that both difficulties should be faced in preference to leaving India with what is one of the most inferior forms of topographic map in the world. Colonel Grant has estimated that, including the cost of outline-engraving, brush drawing, and the engraving of the hill features, the total cost of an engraved map on the 1-inch scale would amount to not more than about £500,000 for all India, or £20,000 a year for a period of 25 years. The question, therefore, for the Government of India would be whether, for the sake of saving a sum of £20,000 a year for 25 years, they would sacrifice the quality of the whole standard sheets of India not only for those 25 years, but for the whole of the future.

Engraving of the 1-inch maps.

55. The system called photo-etching is now largely used in Southampton in the production of small scale maps, and might possibly reduce the time and cost required for engraving on copper the hill features of the standard sheets. Perhaps Colonel Grant may be able to say whether the adoption of that method would lead not only to saving of both time and cost but also to the production of a satisfactory 1-inch map. He will no doubt state what are in his opinion the advantages or disadvantages of adopting that method.

Photo-etching.

56. I should be inclined to say that the cost of reproducing hills by photo-etching would vary between a half and a quarter of the cost of engraving. The time also that would be necessary would be in the same proportion. My experience leads me to think that photo-etching is more suitable for small scale maps where the hill features are marked in elevation than at a small incline. On the 1-inch scale, specially where the slopes are long and uniform, I do not think the artistic results are quite satisfactory. I have never obtained really satisfactory results from half-toned hills in undulating ground where the features are not well marked. Colonel Grant stated.

57. After Colonel Grant's discouraging reply, probably the Committee will consider that it is unnecessary to prosecute further, at present, the question of the adoption of any other photographic methods of reproducing the 1-inch maps in India than the methods of photozincography or helio-zincography, and the question of photo-etching will have to wait meantime. Sir John Farquharson.

58. As to engraving the 1-inch map, it is practically certain, after Major Bythell's evidence, that at least part, if not all, of the work would have to be carried out in England either by contract or by assistance from the Ordnance Survey. Probably all the Calcutta engravers, or most of them, will be required for the engraved ¼-inch map, and other necessary work.

59. As to the question of a temporary cheap map as a substitute for a copper-plate map, I should be entirely opposed to it. It would be unsatisfactory in itself, and would probably lead to delay in the ultimate completion of a satisfactory map, as well as to useless expense and loss of time. The organisation for carrying out in successive years the publication of the maps, as they are revised, will, however, have to be considered by the Committee.

Temporary cheap maps.

60. With regard to the existing atlas sheets of India, I have carefully examined several of them, as published for different parts of the country. They have in many cases been so well executed, that it is lamentable to have to raise any objection to their continuance as maps of the country. But I am bound to say that, taking them as a whole, including specially the latest maps, I have come to the conclusion, which apparently from what we have previously heard the Surveyor-General had already come to, that, owing to the immense number of erasures required, there would be little, if any, saving of time and cost by revising them, and that the preparation of a new ¼-inch map of India should be undertaken on the general lines which have been adopted in the sheets called degree sheets, some of which we saw in Burma. But I am decidedly opposed to the temporary production of an inferior map by photozincography on this small scale, and I think it should be stopped. My reason is the same as I have stated in the case of temporary 1-inch maps, namely, that the temporary map itself is generally unsatisfactory, and may probably lead to delay in the production of the best kind of map. There ought also to be little difficulty in the Calcutta staff of engravers keeping up the ¼-inch engraved map so as closely to follow the revised standard sheets, if they are not diverted to other work.

The ¼-inch Atlas sheets of India.

Quarter-inch degree sheets.

61. The Committee is aware that, since I first formally brought before it the subject in Poona and Bombay in January last, I have always advocated the adoption by the Committee of the method of copper-plate engraving Simla, 10th April 1905.

Copper-plate engraving.

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as the best method of reproducing both the Indian 1-inch and the Indian ½-inch maps. As to the latter, I think the Committee has practically agreed to that method of reproduction.

Reasons for its adoption.

62. And they also agree, I believe, in thinking, as I suppose most other people think who have studied the subject, that the method of copper-plate engraving for topographical maps is in itself superior to any other method. Yet the other members of the Committee, as I understand, have hitherto been decidedly opposed to recommending the adoption of that method, because they consider that the consequent cost in money and expenditure of time would be excessive. I am myself, on the other hand, of opinion that the Committee should recommend that India should in future be provided with the best kind of 1-inch map, and that is an engraved map, and that if England, France, Germany, Russia, Switzerland, and the United States can afford to expend, as they have expended or are expending, the money and time necessary to provide themselves with the best kind of map, it will be difficult to show that India cannot; that it will be still more difficult to show that the comparatively trifling annual outlay required for this object will be greater in India than in those countries, in proportion to the sums expended in India upon military defence, civil administration, education, public works, in short upon all objects which constitute good government; that nothing has appeared more clearly from the evidence given before us than that for those objects of good government good maps are a practical necessity; and lastly, that, if the present opportunity is lost for substituting in India good maps for bad, no other opportunity is likely to recur.

Conflicting estimates of cost and time.

63. The Committee will remember that in Calcutta in the end of February there was a somewhat sharp discussion between Colonel Grant and myself on this subject of copper-plate engraving. I adhere to the opinion, which I then stated to Colonel Grant himself, that however high his authority is, and it is admittedly high, on the subject of what are called the "process" methods of preparing maps, which mostly depend upon photography, and which form by far the largest proportion of the maps published by the Survey of India, yet his opinion on the copper-plate engraving of maps carries little weight, because he has admittedly never been in responsible charge of any such work, and has never had much experience of it. I may add that during the years 1898-99 the pressure from the public was so great for completing the revision of the 1-inch maps of the whole of Great Britain, that I took direct charge of the Engraving Branch of the Ordnance Survey, numbering some 60 or 70 engravers, and also entered into special arrangements with the outside trade for advancing its progress. I think, therefore, that I can fairly claim more experience in that method of map-making than Colonel Grant can claim. The Committee will also remember that at Calcutta in the end of February, after the discussion which I have just mentioned, it was proposed that Colonel Grant should obtain information on his arrival in England as to the details of the cost of copper-plate engraving. Fortunately I demurred to this proposal, knowing Colonel Grant's decided objection* to copper-plate engraving; and I suggested that the Committee should, instead, themselves refer both to the Director-General of the Ordnance Survey and to Messrs. Malby & Sons, who are a long established firm of commercial engravers, for their estimates of the cost of the work. This was done, and the results have now been received by letter by the English mail received to-day. The same English mail which to-day brings these estimates brings also an estimate from Colonel Grant in a letter addressed to the President. It amounts to £1,382,000. In his original report written at Calcutta in February, his total estimate for the copper-plate engraving of the 1-inch standard sheets of India was 75 lakhs of rupees, or £500,000. In his second revised report received from Aden, his estimate is 69 lakhs of rupees, or £460,000. He now sends this estimate from England, which amounts to £1,382,000.

See paragraphs 29-53 of Colonel Grant's evidence at Calcutta on the 24th and 25th February 1905.

J. F.

* I do not mean by this to throw the slightest reflection on his *bonâ fides*.

J. F.

Colonel Grant's estimates of cost.

This estimate was drawn up after he arrived in England; has been obtained, so far as I have observed, from unnamed sources; and was, so far as my knowledge goes, not asked for by the Indian Survey Committee.

J. F.

Colonel Grant had the President's authority to satisfy himself by enquiries in England regarding the correctness of the estimate he had furnished in India.

C. A. B.

The Ordnance Survey and Messrs. Malby's estimates of cost.

The estimates which we have received from the English authorities to whom I insisted that the question should be referred, are £497,000 from the Ordnance Survey Office and £661,500 from Messrs. Malby & Sons. The Committee will, therefore, have to consider what weight they can place on Colonel Grant's estimates. Owing to the course which the Committee followed, namely, to make references to England for themselves, there are ample means for coming to a conclusion.

64. The Committee will also remember that I questioned at the time the basis upon which Colonel Grant's first estimate was drawn up, namely, his including the whole of the plains of India in estimating for engraving the hills of India. This point will have to be considered when the estimate of cost is considered later on.

See Colonel Grant's evidence at Calcutta on 24th and 25th February, paragraphs 40-42.

J. F.

Sir John Farquharson.

65. I will now turn to the subject as to which I last week asked the Committee to meet to-day; namely, the representation on the 1-inch maps of India of the hill features. I am afraid it will be necessary to give up the idea of representing hill features on those maps by a combined system of contours and vertical hachures, which is the method followed in the 1-inch maps of Great Britain, and in some foreign maps. Colonel Kelly will remember that the object we wished to arrive at was that those using the maps should be able to distinguish on them slight elevations or slight hollows in undulating country, and that this object could not be so easily attained by the use of contours alone, as it could when vertical hachures are used in addition.

Mode of representation of the hill features.

66. But, in the first place, the estimates of cost which were received by telegraph from England about the 23rd of March, considerably exceeded for the hill engraving the cost which had been expected. In the second place, the perusal of Major-General Waterhouse's report of 29th December last on the United States Survey, and an examination of the United States maps, will probably lead to the conclusion that a system of horizontal contours, if well engraved on copper for 1-inch or ½-inch maps, can represent the ground as effectively as is necessary. I have said above "if well engraved on copper," because I do not believe that, by any other method of production, contours at close intervals on steep ground can be clearly and effectively represented; and of this fact the United States maps, engraved on copper, are excellent examples. The third reason is that Colonel Johnston, the Director-General of the Ordnance Survey, in a letter which I have received from him, informs me that his Department will probably be unable to give much assistance to the Survey of India in the matter of engraving, and more especially of hill engraving by vertical hachures. The danger might thus arise of recommending to the Government of India a method of work which could not practically be carried out.

For the above reasons it appears to be necessary that all representation of hill features by vertical hachures should be abandoned; and thus there will at once drop out of the estimates for copper engraving the whole of the cost of the item of brush drawing of the hills amounting to about £60,000.

Horizontal contours.

67. As to cost, both the estimates which we have received from the Ordnance Survey Office and from Messrs. Malby, include the engraving of the hill features by horizontal contours, while the maps of the United States, of which I have here two specimens, will indicate to the Committee the form of engraving hill features which might be attainable for the 1-inch maps of India. I have also at Calcutta, and have sent for them by telegraph, maps of France and Switzerland which have the hills similarly engraved, and which the Committee might wish to see. They will then have available the maps of at least three countries, which they can compare with the existing 1-inch maps of India.

Ordnance Survey estimate adopted.

68. As to the various estimates of cost which have been received, I accept that of the Director-General of the Ordnance Survey. In his letter he indicates, what is well-known, and what is also mentioned by Colonel Grant, that there is a great difference in quality between the engraving done by commercial firms and the engraving done by the Ordnance Survey. The quality turned out by the latter is universally admitted to be the best: and I assume that the estimate of cost furnished by Colonel Johnston applies to that quality.

Two Indian 1-inch sheets, Bombay No. 102, and Burma No. 440, were sent to both the Ordnance Survey and to Messrs. Malby, as specimens on which to base their estimates of the cost of the engraving; the Committee thought that the Bombay sheet was rather under the average closeness of hill features, but that the Burma sheet was considerably over the average for the whole of India. The mean of the two estimates given by the Ordnance Survey for the two maps is, therefore, adopted, so that the estimate should not err in the direction of being an under-estimate. Colonel Johnston's estimate for the complete Bombay sheet is £99, and for the complete Burma sheet it is £184. The mean, therefore, is £142, and £142 multiplied by 3,500, being the number of standard 1″ sheets for the whole of India, gives a total cost of £497,000 as the estimate, or, spread over 25 years, an annual cost of about £20,000.

69. If, on the other hand, my contention is held to be a sound contention that 1,100 sheets amounting to, roughly speaking, 600,000 square miles, forming the mass of the plains of India, ought, as to hill engraving, to be deducted from the total number of sheets, then an amount of £112,200, representing the cost of the hills for those 1,100 sheets, would have to be deducted from the estimate of £497,000, which would leave a total estimate of £384,800, that is to say, spread over 25 years, an annual cost of £15,392. It will, however, be safer, as there may be many contingent expenses to be met, to adhere to the estimate of £497,000 or £20,000 a year for 25 years.

The time required for engraving the sheets.

70. I postpone for the present any statement on the subject of the time required for the engraving of the 1-inch sheets, because I have had no time properly to consider it, but I am quite ready to admit that it is an important subject, and I can even now go so far as to say that it is absurd to suppose that if the Government of India goes to the Ordnance Survey in England, or to one or more private firms of engravers in England, it could not by offering the necessary terms obtain a sufficient number of line engravers to carry out within a

Sir John Farquharson.

reasonable time any quantity of work required, especially as the work is limited to 150 or 160 standard 1-inch sheets a year. The difficulty of obtaining a sufficient number of men who would be able to make artistic brush drawings of hills, and of engravers who would be able to do artistic hill engraving by vertical hachures, is now entirely removed, as I have stated above.

Engraving to be done in England.

71. Probably the whole of the engraving of the 1-inch sheets will have to be done in England, and it is known to the Committee that up to about 1869, that course was followed in the case of the Atlas sheets or ¼-inch maps. It will in any case be necessary that helio-zincographs or photo-zincographs should be prepared in India of the 1-inch sheets.

Printing.

72. After the completion of the engraving of the maps, the printing would be of the simplest description. Printing from the copper-plates themselves is never done. All printing is carried out by transfer to stone; and the only question which might arise in India is whether sufficient store accommodation would be available for the necessary number of lithographic stones, especially if the Committee recommends that colour printing should be adopted.

Electro-typing.

73. It would be necessary that the plates themselves should be kept in India, and that an electro-typing establishment should be provided for the head-quarter office.

Trans-frontier maps.

74. Copper-plate engraving would of course be impossible in the case of Trans-frontier maps. They have, if they are to be of any use, to be produced immediately; they are more or less of a temporary character; and the usually incomplete geographical information which they contain is sure to have to be supplemented later on. Copper-plate engraving is only suitable in the case of the topographical maps prepared from exact surveys within India proper.

The hill engraving on the Atlas sheets of India.

75. There is another very important engraving question which I do not think the Committee have taken up at all, but which they ought to consider. They have decided that an entirely new series of ¼-inch maps, reduced from the revised 1-inch maps, is to be substituted for the present ¼-inch Atlas sheets of India. The latter have the hill features engraved by vertical hachures; so far as the Committee can judge, the work has been well done; it has certainly been done at a great expenditure of time and money; and it would be lamentable if the results should be entirely lost. Moreover, it will have been observed, from what has been said above, that this kind of engraving is the kind for which, under modern conditions, it is most difficult, if not indeed almost impossible, to get competent and artistic engravers. The art, in fact, has almost died out. This question should be referred to the Surveyor-General of India for as early a report as he can furnish, as to whether the engraved hills of the old ¼-inch Atlas sheets can be utilized for the proposed new ¼-inch degree sheets. There is in the last resort the alternative of showing the hills on the latter in the same way as on the 1-inch sheets, namely, by horizontal contours, which would on steep ground, have to be at intervals of at least 250 feet; but as above said, it would be lamentable to have to entirely throw away the old work, and it is to be hoped the Surveyor-General can find some way of utilizing it. Even if the old brush drawings remain, which is improbable, they would not help much towards completing new engraving.

Scales for survey.

76. Another point which the Committee do not seem to have decided is that of scales for survey. I think that in the case of all new topographical surveys in India, the scale of survey should be larger than the scale of publication. This in India principally concerns the question of making surveys on the 2-inch scale for maps to be published on the 1-inch scale, and making surveys on the 1-inch scale for maps to be published on the ½-inch scale. I know no country in the world which produces its maps on any other principle. The first thing to decide is what the scale of publication is to be, and then a larger scale should be adopted for the survey. But this rule would only apply to future surveys in India; existing maps must remain. The reasons for the rule are two: firstly, errors of survey are reduced on the smaller scale of publication; and secondly, photographic reductions to the smaller scale make better maps than direct reproduction on the same scale.

Half-inch maps.

77. As to ½-inch maps, I remain of the opinion which I expressed in February at Calcutta, namely, that the 1-inch map must be the general topographical map of India, and that that scale should not be departed from in the case of any small area; but that the Committee should recommend that if there are anywhere large areas, sparsely peopled, unlikely to be settled, or of a character approaching to a desert, or pestilential or malarious as to climate, or so difficult of access as to make a survey on a large scale too expensive, then the scale of publication should be ½-inch and the scale of survey 1 inch to the mile. There is no law of the Medes and Persians which requires the adoption of any particular scale for a map, and there must be many districts in India where the details to be shown, whether natural or artificial, are so few as to be capable of being shown on the ½-inch scale, which involves from a quarter to half only of the cost of the 1-inch and carrying of only a quarter of the quantity of maps by either the soldier or the traveller who has to find his way across such districts. The whole question turns upon whether, with the scale fixed upon, the size of the sheet of the paper upon which the map is drawn is large enough to contain the details which should appear on it. I believe that on this subject of scale of maps there is a good deal of prejudice. Men generally stand up for the scale to which

they have been accustomed. I would add that our kinsmen across the Atlantic, who are not generally supposed to be fools as to the practical carrying out of their objects, including maps, have adopted for the "general maps" of the United States the scale of ½-inch to the mile, supplemented for the more densely populated districts by maps on the scale of 1-inch to the mile.

Transfers of establishment.

78. There is another subject which, I think, should be considered early by the Committee. It is in connection with the question which has been referred to them whether there should be a transfer of the headquarters of the Indian Survey from Calcutta to Dehra Dun. This involves the question of moving the reproducing offices, and raises the question of how far any disturbance of the existing conditions of reproduction might affect the rapid carrying out of the revision of the 1-inch topographical surveys. The move may be in itself entirely desirable, but it appears to be possible, if not probable, that if the existing arrangements for reproduction were upset in the near future, much delay might be incurred in carrying out the proposed topographical revision of the maps of India; and it may, therefore, be desirable to postpone any such move until that revision has been carried out.

Symbols.

79. As to the subject of symbols for the 1-inch and ½-inch maps of India, I should be sorry, with my imperfect knowledge of the conditions of the different Provinces of India, to lay down any fixed rules. I think it ought to be practically dealt with by the two Indian Service Members of the Committee, namely, the Surveyor-General and Colonel Kelly. I have, however, two very strong opinions on the subject. The first is that, when there is any doubt, the decision should lie with the military authorities. The second is as to lines of communication, which are, for the maps of India as for those of every other country, probably the most important feature to be indicated. If India is to have a coloured topographical map, the roads should be coloured. I mention this matter, because it has been suggested that there should be only three colours, namely, black for the detail, brown for the hills, and blue for the water. The printing of an additional colour for roads is a trifling matter. If there is to be an *engraved* 1-inch map, the different classes of roads could be easily enough distinguished by different widths and thicknesses of the dividing lines, and in that case all lines of communication could be coloured; but with the use of photo-zincography or helio-zincography, the lines probably cannot be made fine enough to carry out that distinction, and colour should probably be confined to metalled roads. The same difficulty as to fine lines will arise in the case of any symbols (except those of the roughest kind) for railways; and in fact it applies more or less to nearly all symbols; all of which points to the necessity for having engraved topographical maps.

Cadastral surveys.

80. With reference to cadastral surveys, I have hitherto avoided giving any definite opinion, beyond the opinion that they should be generally carried out under the Surveyor-General of India. But the evidence we have recently heard has brought me to the conclusion that the requirements of the Surveyor-General of India should be strictly confined to connecting those cadastral Surveys with the general system of triangulation carried out all over India; I see no reason for his interfering beyond that one point. In every other respect, I think, it is practicable and desirable that the cadastral surveys should be decentralized, that is, should be directed and controlled by the Provincial Governments of India. I understand from what we have heard that nearly every Local Government in India either has already carried out or desires to carry out this principle of connecting cadastral surveys with trigonometrical stations, and I am now told that the views of the Imperial Government are entirely in favour of that being done. There is certainly one exception, as to which we received evidence comparatively lately, and that is the case of the Local Government of the Punjab. The opinions we heard at Lahore on this subject appear to me to be somewhat untenable, not to say eccentric. We were told that it might or would be desirable that a Deputy Surveyor-General should be specially appointed by the Government of India to either the Punjab province alone, or to a small group in its immediate proximity, but without any control over their survey work. They persisted in the opinion that their own Punjab system, which I may call the rule of thumb system of surveying, is entirely suitable, and would be strongly insisted upon by that Local Government. It would follow from this that, if they get their Deputy Surveyor-General, they must entirely disregard the opinion which, from his professional standing, he is bound to hold upon systems of surveying. It appears to me to be a parallel case to their requesting the Government of India to appoint a medical officer of the highest skill, and possessed of the most recent scientific information on all medical subjects, to take charge of their local hospital, and to their then strictly tying this officer down to prescribing only Holloway's pills and ointments. The reason they gave for maintaining their own system of survey is that it is sufficient for their own administrative purposes; but I hardly think that reason is sufficient. Some centuries ago the Pope excommunicated Galileo for saying that the earth moves round the sun. I am not aware that the Pope encountered any administrative difficulty on account of his maintaining that the sun goes round the earth. He received no doubt his Peter's pence just the same before and after Galileo's excommunication, It would appear that the Government of India would be perfectly justified in requiring the Local Government of the Punjab to carry out the same principles as to connecting the cadastral with the topographical surveys, as the other Local Governments of India have generally done. And it would appear also from the limitation which has been laid down as to the scope of interference of the Surveyor-General in the case of cadastral surveys, that his duties in that respect would be extremely limited and that, therefore, the charge of what is usually

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called the scientific part of these surveys, would turn out to be a comparatively easy task.

(*President*).—The survey of a village in the Punjab is preceded by a traverse which connects it with the points of the scientific survey; do you think there is any objection to the use of the Punjab square system in filling up the details?

A.—The only question that would arise in that case would be the question of accuracy within very small limits; and the evidence shows that for all topographical purposes within those limits the square system when well carried out, is sufficiently accurate.

Maintenance of fixed points by Local Governments.

81. I would even suggest an extension of the above principle, namely, that every Local Government in India should be required by the Imperial Government to maintain in the Province a small staff consisting of, say, two experienced Provincial officers, who would be required to maintain throughout that Province the necessary connection between the cadastral and the topographical surveys in the Province. In cases where triangulation is easy, as in hilly districts, they should, at such times as might be convenient for the Local Government, add the necessary amount of minor triangulation. In the more level districts, where triangulation is difficult and expensive, they should similarly be required to provide at such times as desired by the Local Government, as for instance in advance of a new settlement, such traverses or such triangulations as might be necessary. They would only be under the control of the Surveyor-General as to their *methods* of carrying out this work. In every other respect they would be under the control of the Local Government. It is hardly necessary to say that, if some such system were adopted, one of the first essentials, if not the first essential, would be that all Local Governments should be strictly held responsible that every permanent mark thus established, whether of triangulation or of traverse, should be erected and maintained by the Local Government of the Province. I understand that in this important respect there has been considerable deficiency, not only in the maintenance of these subordinate points, but even in the maintenance of the much more important stations of the Trigonometrical Survey of India. I am now speaking only of cadastral or settled districts, in every 4 or 5 miles square of which there should be at least one fixed survey point maintained in connection with the triangulation of India. The object is plain; namely, that in every case of development or of great change in the face of the country, the revision of the maps can be carried out with the smallest possible waste of time and money. If more points can be maintained, that object will be more effectively reached; and the advantages will be the more marked, if periodical revisions are decided on.

In answer to a question from Colonel Longe.

82. I think it is perfectly reasonable to expect that the Surveyor General of India —I do not mean upon any special occasion, such as the present, when he has to look forward to a large increase of staff, but under the ordinary circumstances of carrying out the survey—should have comparatively little difficulty in training a number of officers, which would not probably exceed from 15 to 20, in order to replace the more skilled officers whom he would have to detach for the special duty of doing traverses or triangulation for Local Governments. It is clear that if he cannot train within a reasonable period that limited number of officers, he must be unable to fill vacancies caused by ordinary casualties and retirements.

In answer to President.

83. As to the cost involved, I am distinctly of opinion that the whole of it should be borne by the Local Governments, and I am also of opinion that the cost of the completion of the maps of India, which will be required for local purposes down even to the scale of 1-inch to the mile, should also be borne by the Local Government. The smaller scale maps, such as the ½-inch or ¼-inch, and so on, should be provided for them by the Imperial Government. It appears to me that some definite rule of this kind might possibly lead to the abolition of the frequent haggling and disputes which seem to have occurred as to whether the Imperial or the Local Government should bear the cost of different branches of the Survey of India; and provided that the Imperial Government gives the Local Government those smaller scale maps which, according to the evidence we have received, are required for local purposes, it seems perfectly fair that they, on the other hand, should bear the cost of the production of all the maps on the larger scale down to the 1-inch. Those 1-inch maps which the Local Governments require cannot be strictly called topographical maps, because the local authorities whom we have consulted invariably require that they should include such details as village boundaries, which are not in the least required, and are in fact objectionable, in a topographical map. It therefore follows, and I am not sure that the Committee has yet sufficiently considered the point, that two kinds of 1-inch maps will be required.

One-inch maps for local purposes.

84. I have spent a good deal of time this morning in insisting that the topographical maps proper of India should be engraved on copper, but it is different in the case of the 1-inch reduced maps which we have now under consideration. It seems desirable, certainly for the present, that they should be prepared in the same manner as the present topographical 1-inch maps of India, and as it appears from an examination of the latter that during the revision a considerable amount of labour will have to be expended upon supplying local details as to village boundaries, etc., which are at present omitted upon them, it should be understood that the whole of this expenditure should not be estimated for in our estimates of the revision of the topographical maps of India, because the cost of supplying them should be borne by the Local Government. The principle would be that the Local Governments should be responsible up

to the stage of providing the 1-inch maps reduced from cadastral surveys with what is necessary for their own local objects. The cost of converting that 1-inch map into what is more strictly a topographical map should fall upon the Imperial Government. Sir John Farquharson.

85. As to the question how the actual execution of the work necessary for connecting the cadastral with the topographical surveys should be checked, I am afraid I shall have to raise an entirely new question, and that is the question of the Trigonometrical Branch of the Survey of India.

Trigonometrical Branch of the Indian Survey.

That question is whether the Trigonometrical Branch of the Survey, highly distinguished as it is, does not now devote its attention to some subjects which are not either strictly geodetic or geographical, or suitable for advancing the now urgently necessary work of the topographical surveys of India.

I would not reduce its strength (it might rather be necessary to increase it), but would suggest that those officers and men who are solely employed on what may be called the more academic scientific objects, should be diverted to the advancement of the strictly geodetic and topographical work; and one advantage of this might be that in the case of the procedure which I have proposed as to the establishment of fixed trigonometrical points or traverse points, that branch of the work, as carried out by the Provincial officers who have been mentioned, might be placed immediately under the charge of the officer who is in charge of the Trigonometrical Branch of the Survey of India.

86. On the 10th April the Committee asked me for this estimate during my remarks on the advantages of engraving the Indian 1-inch maps. At that time I had not gone into the details of this question, but I have now done so. Addendum, 19th April 1905.

Estimate of time required for engraving on copper the 1-inch standard sheets of India.

87. Colonel Grant brought out from England, and I received from him before he left Calcutta, two English engraved 1-inch sheets of the Ordnance Survey, Nos. 135 and 136 of England and Wales. Each has recorded on the margin the number of days which the engraver took to finish the work, distinguishing the time taken on the various branches of it, as outline, writing, contours and ornament. The quality of the engraving is supposed to be up to the highest standard, taking the longest time. The amount of detail, other than contour, is closer than would be the case on an average Indian 1-inch sheet, but the number of contours is considerably under the Indian average; those two points may be taken to counterbalance each other, and the average closeness all over of the two sheets may be taken as about the same as that of the Indian sheets. The two English sheets cover a mountainous district of North Wales, and the area they contain is 216 square miles each; the area contained in the Indian sheets is about 540 square miles, so that the proportion of the amount of work on the English and the Indian sheets is as 216 to 540, or as 2 to 5.

The time taken on the English sheet No. 135 was 111 days: so that the proportional time for the Indian sheet would be $2 : 5 :: 111 : \frac{5\,5\,5}{2}$ or 278 days, which at 23 working days to the month is exactly 12 months.

The time taken on sheet No. 136 was 103 days; and $2 : 5 :: 103 : \frac{5\,1\,5}{2}$, or 258 days, or $11\frac{1}{4}$ months for the Indian sheet.

88. The above estimates can be checked in another way, as follows:—

The Ordnance Survey estimate for engraving an average sheet of the Indian 1-inch survey is £142. About 20 per cent., or £28, has to be deducted for superintendence, contingencies, etc., leaving £114 as the net pay of the engraver. His average pay would be from 7*s*. 6*d*. to 10*s*. 6*d*. a day or from 45*s*. to 63*s*. a week, say an average of 9*s*. a day, or 54*s*. a week. If £114 is divided by 9*s*., it gives 253 days, or 11 months, as the time taken by the engraver.

Messrs. Malby's estimate for engraving an average standard 1-inch sheet of India is £163. Worked out in the same way as the last case, this would give probably about 13 months as the time taken by the engraver.

We have thus 12 months, $11\frac{1}{4}$ months, 11 months and 13 months as the time taken for each Indian sheet, or say 1 year.

89. The number of 1-inch standard sheets for all India is generally taken at 3,500. If they were all to be engraved in 25 years, the number annually would be 140, and as each would take a year, 140 engravers would be required. But 1,100 of the 3,500 consist of the plains of India, where there are no hills to be engraved at all, and where the estimate of time is quite different. The Ordnance Survey estimates that these sheets without hills can be engraved for £42; deducting 20 per cent., the engraver's net pay amounts to only £34, and dividing this by his pay of 9s. a day the time taken is found to be 75 days, or $3\frac{1}{4}$ months. Messrs. Malby estimate the cost of each of these sheets without hills at £27; deducting 20 per cent. it would be £22, which divided by 8s. a day (the trade probably pays less than the Ordnance Survey) would give 55 days, or $2\frac{1}{2}$ months, as the time taken. So that in the case of these 1,100 sheets without hills, an engraver would engrave four sheets a year, or 100 sheets in 25 years, and 11 engravers would be required instead of 44. Thus 33 engravers have to be deducted from the 140, estimated as necessary if all the sheets had hills to be engraved, and the total number required would be for all India 107. This compares with Colonel Grant's estimate of 500 engravers, see para. 29 of his evidence of 24th and 25th February at Calcutta.

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90. But another point might be considered. A large part of Burma has been recently surveyed, and the photo-zincographed maps produced by the Survey of India on the 1-inch scale for that area, are by far the best which they have produced. That area will not probably be revised for nearly 25 years, and, therefore, for the whole of that time the present photo-zincographed maps must remain in use. There seems, therefore, to be no inconsistency, considering their quality, in completing the 1-inch maps of the whole Province on the same system, and postponing engraving them until the second revision beigns 25 years later. If this were done, the engraving of about 450 sheets, which is the number for the Province, would be withdrawn from the present estimate ; this amounts to 18 sheets annually for the 25 years, and 18 engravers can be deducted from the total of 107 for all India, leaving 89, as the necessary number.

91. This reduction of the total number of engravers to 89 has led me to modify my opinion as to the necessity of having the whole of the 1-inch engraving of the revised maps done in England. I see no reason why a large part of it should not be done in India, natives being trained. I do not think more than about three years is required for training a line engraver. The difficulty and time required for training artistic engravers for hill engraving by vertical hachures have now been entirely removed from the problem, and 25 years are available, or at least a great part of it, for the necessary training. At first no doubt it all would have to be done in England ; but as the training of natives progressed, it could be gradually withdrawn and a large part of it done in India. Line and writing engraving appears to me to be an art which is well within the capacity of a native of India, and I would not readily accept any estimates of time and cost framed on the work of the present 30 copper-plate engravers at Calcutta. The work there seemed to me to be mainly patchy and fragmentary, taken up one month and laid aside the next, and no strict standards of progress and cost can under those conditions be laid down or enforced.

ORDNANCE SURVEY OFFICE.

Specimen of progress report. 1-inch revision, 190 .

TENTH DIVISION.

NAMES.	No. of days.	SHEET. No.	SHEET. Area. Sq. m.	Done during the month.	Done previously.	Total.	REMARKS.
Revised—							
Total during month .	...	...	...				
Finally Revised—							
Total during month .	...	...	...				
Drawn—							
Total during month .	...	...	...				
Forwarded to D. O. 12—							
Total forwarded during month	...	...	...				

Revised, but not drawn . . . . . .

Drawn, but not forwarded . . . . . .

NOTE.—The Divisions now do the Field Revision of the 1-inch and draw the plans on the 1-inch scale; O. E. examines and passes the drawing to the engravers. The work is actually done in the field on 6-inch plots, *i.e.*, ¼ a quarter sheet as printed.

J. F.

Specimen form of Abstract from the Quarterly progress and Cost Statements.

$\frac{1}{2,500}$ SCALE. GREAT BRITAIN.

Revision on Cards and Tracings.

Division.	COST PER ACRE, NOT REDUCED (INCLUDING REGIMENTAL PAY). Surveying and Plotting Revised.	Detail Revised.	Examined in Office.	Areas Revised.	Traced for Zincography or Photo-zincography or Drawn.	Total.
3rd . . . —						
4th . . . A						
5th . . . A						
8th . . . B						
9th . . . —						
10th . . . —						
Average .						

$\frac{1}{2,500}$ SCALE. IRELAND.

Division.	COST PER ACRE, REDUCED TO MEDIUM (INCLUDING REGIMENTAL PAY). Surveyed.	Plotted.	Traced for Examination.	Examined on the ground.	Drawn.	Areas Computed.	Total.	Cost per acre not reduced. Chargeable to Ordnance Survey Vote. Not including Regimental Pay.
1st . . B								
2nd . . B								
7th . . A								
11th . . A								
Average .								

Methods of classing adopted:—

A—In accordance with Circular of 29th January 1881.

B— „ „ „ method suggested in Circular of 8th January 1885.

Sir John Farquharson.

Estimates of cost of engraving the standard sheets of India alluded to in Sir John Farquharson's statement.

No. $\frac{2}{3}$805, dated Southampton, 23rd March 1905.

From—Colonel D. A. Johnston, Director-General of the Ordnance Surveys,

To—The Secretary, Indian Survey Committee.

In reply to your letter of the 1st instant, asking for estimates of the cost of engraving on copper two sheets of the Survey of India, I give below the estimated cost:—

Sheet 102, Bombay.

			£
Engraving outline and writing, including scoring, laying down on copper, and other preliminary work, also the cost of the copper plate			49
Ditto	ditto	hills on a separate plate	53
Ditto	ditto	outline and hills, complete on one plate	99

Sheet 440, Burma.

Engraving outline and writing, including scoring, laying down on copper, and other preliminary work, also cost of copper plate			35
Ditto	ditto	hills on a separate plate	152
Ditto	ditto	outline and hills, complete on one plate	184

The above does not include the cost of electrotyping, which would amount to £2 5*s.* 0*d.* for each matrix, and to £6 for each duplicate.

The estimate is made on the assumption that the engraving is in the style of sheet 39 S. W. of the Indian Atlas, except that horizontal hachures are allowed for instead of vertical. We have on the Ordnance Survey no experience of engraving horizontal hachures, but have assumed that they can be engraved somewhat more rapidly than vertical hachures.

The quality of engraving estimated for is that of the Ordnance Survey. The point is a material one, as the quality of engraving affects the cost very largely.

With regard to outline and writing engraving, the trade use very largely a different and shallower class of engraving than that used by the Ordnance Survey. This engraving is used by firms like * * * * * and others, and as far as I know, the work engraved is never printed direct from the copper, but is transferred to and printed from stone. This class of engraving is cheap, and costs much the same as drawing on stone, and consequently far less than deep engraving like that of the Ordnance Survey. In quality I should put such engraving little, if at all, ahead of photo-etching.

I should add that the estimated cost given above includes provision for superintendence, and a proportion of leave, sick pay, etc., etc.

With reference to paragraph 2 of your letter, if the present sheets were issued in sheets, of half the size, the estimate given above would have to be somewhat increased, because two copper plates would be needed instead of one rather large one, and the marginal writing would have to be done twice instead of once. If the plates are electrotyped, the cost of doing so will be increased probably about 50 per cent. The extra cost above the estimate already given, but excluding electro-typing, is estimated at about £9 for two half sheets.

I may perhaps add that the issue of these half sheets would make it much easier to double-print from copper, should it be decided to engrave the hills on a separate plate from the outline. While sheets of the size of the existing Indian 1-inch sheets can be double-printed from copper, it is not very easy to do so, and it is possible that double-printing may be more difficult in the climate of India than here.

A telegram giving the cost of engraving sheets 102 Bombay, and 440 Burma was sent you to-day.

Dated London, March 24th, 1905.

From—Messrs. Malby & Sons,

To—The Secretary, Indian Survey Committee.

In reply to your letter dated March 1st, 1905, we beg to inform you that, in giving estimates for the two plates, Burma Survey Sheet 440 and Bombay Survey Sheet 102, these estimates must not be taken in the nature of a contract to execute the work at these exact prices, as the instructions given are not sufficiently clear to enable us to form a distinct idea as to the amount of work that will be required to be put on the plates, but if you should decide to place the work in our hands, we shall endeavour to carry it out to the best of our ability, both with regard to quality of work and price.

Your instructions with regard to hill work on the specimen sheet of the Indian Atlas not being quite clear to us as to whether you require the hills on the new plates to be in horizontal or vertical hachures, we give estimates for both horizontal and vertical.

Estimates of cost.

Bombay Survey Sheet 102—

		£
1.	Outline and writing	30
2.	Hills horizontal	75
	„ vertical, as on specimen sheet of Indian Atlas	90
3.	Complete Map, including copper plate with horizontal hills	112
	Complete Map, including copper plate with vertical hills	127

Burma Survey Sheet 440—

1.	Outline and writing	24
2.	Hills horizontal	184
	„ vertical	220
3.	Complete Map, including copper plate with vertical hills	251
	Complete Map, including copper plate with horizontal hills	215

The difference in cost for dividing each plate into two plates would be about £5 more for each of the four plates.

Should it be decided that these plates are to be engraved by us, we would suggest that the character of each name should be marked on the originals by a symbol with a reference, and also that the hill work should be washed in on each original, showing amount of space to be covered by hachures, as on the originals at present the amount of contouring is vague and unequal with regard to shading.

Trusting the above estimates will meet with the approval of the Committee.

Col. F. H. Kelly.

II.—Memorandum by Colonel F. H. Kelly, Assistant Adjutant General, Military Member of the Committee, regarding Topographical Surveys and Maps.

[*Calcutta, 27th February 1905.*]

1. From a very careful examination of the existing maps it becomes evident that, from a military point of a view, topography in India is in a dangerously backward state. Except of certain areas in Bombay, Baluchistan, Sind, and Burma, up-to-date topographical maps are non-existent. Few even of the maps of the above mentioned areas are complete in *all* essential topographical details.

2. Of other parts of India topographical maps either do not exist at all—are hopelessly out of date and inaccurate as regards hill features—or have been prepared by reduction from cadastral or revenue surveys without revision in the field, and are consequently wanting in many topographical details, besides being crowded up by village and other revenue boundaries which confuse the reader and obscure the already scanty topographical features. It appears then to all intents and purposes "in case of war on the frontier or of internal disturbances," the Surveyor General is not "prepared to place in the hands of the military really accurate maps," and it becomes necessary:—

(1) to lay down the areas, the mapping of which on military grounds is of primary importance;

(2) to settle the scales of publication;

(3) to lay down what should be depicted on the maps;

(4) to formulate recommendations regarding the style and method of reproduction;

(5) to submit certain other recommendations which appear desirable from a military point of view.

3. *Areas which should be considered of primary importance from a military point of view.*—For military, as indeed for all other purposes, a correct topographical map of the whole of India on a fairly large scale is most desirable and essential. Owing, however, to the enormous area to be dealt with and the magnitude of the cost involved, the completion of such a work must be a question of at least 15 to 20 years. His Excellency the Commander-in-Chief, therefore, thinks that the whole of the energy of the Survey Department should, for the present, be concentrated on the North-West Frontier, and that work should be carried down to a line roughly indicated by the Karachi-Hyderabad-Sukkur-Bhatinda-Delhi Railway. The parts nearest the frontier should be worked at first. Next, but far behind in importance, would come the Dir-Chitral-Kashmir country. The rest of the frontier and internal India can, as far as military considerations go, wait their turn. I am to hope that the Committee will strongly support this recommendation that the early completion of up-to-date topographical maps of the areas suggested be arranged for. The necessity for revision should not be lost sight of.

4. *Scales of publication.*—There is little doubt that military opinion in the country is practically unanimous that the smallest scale of any use for tactical purposes in India is the 1-inch-to-the-mile, and in this view His Excellency the Commander-in-Chief fully concurs. It is impossible on any smaller scale to work out tactical problems in peace or war. I am, therefore, to strongly recommend, on military grounds, the publication of a 1-inch up-to-date topographical map of the whole of India and Burma. On the North-West Frontier there is generally so much intricate physical topographical detail, that it has been found necessary—that being the area in which active operations are most likely, and on having good tactical maps of which the fate of India might easily depend—to map the country on the 2-inch-to-the-mile scale. These maps should be extended to the whole of the Trans-Indus area, north of the line Attock-Dera Ismail Khan-Loralai-Kalat along latitude 29° as far as Chagai, and should be in addition to the standard 1-inch maps mentioned above.

In the case of Afghanistan we have at present to be content with the $\frac{1}{2}$″ maps which are the largest scale ones which exist.

In addition to those on the 1″ or 2″ scales, maps on the $\frac{1}{16}$″ scale are required for strategic purposes. These will of course be obtained by reduction from the larger scale.

5. *Information to be depicted on the 1-inch or 2-inch maps*—

(*a*) Marshes—large extents of rice cultivation—areas liable to be flooded during the rains.

(*b*) Large areas of cultivation distinguishing that irrigated from that watered by rain.

(*c*) In countries where trees are few and far between, those forming prominent landmarks should be shown.

(*d*) The depth from bank to bottom of main nullahs, streams, rivers, and canals should be shown at every mile or two, as well as at every crossing.

(*e*) Perennial water should be shown in blue—dry nullahs or river beds in black. Care must be taken that blue is only used where the streams have never been known to run dry.

(*f*) All ferries, fords, bridges, level crossings or other means by which the traffic on all roads and paths crosses rivers, streams, nullahs, canals, railways, etc., should be

depicted. In the case of railway bridges the existence of a roadway for ordinary traffic should be also depicted.

(*g*) Where karezes are shown, the depths of the vertical shafts should be given at intervals – the figures being in blue where water exists.

(*h*) Embankments, cuttings and tunnels, both on roads and railways, should be shown.

(*i*) Railway lines should be classed as single or double, and the gauge should be given.

(*j*) Isolated telegraph lines should be shown.

(*k*) Roads should be classified and depicted as follows :—

Metalled road	═══════
Unmetalled road or cart track . .	─ ─ ─ ─ ─
Camel road	.....
Mule or bridle road . . .	———
Footpath	.....

Milestones should always be shown.

(*l*) Whenever communications cut the margin of the sheet, the distance and name of the next important place off the map should be given.

(*m*) In settled districts the ordinary camping grounds for troops should be indicated.

(*n*) Post and telegraph offices, also markets or bazaars should be distinguished.

(*o*) Heights above mean sea-level should be much more frequently marked along the crests of hills, on the saddles, and in more or less corresponding places in the valleys, and also at intervals along main nullahs, streams, railways, canals, road and communications generally. This is especially imperative at any great change of slope.

(*p*) All triangulation and trigonometrical points with their heights should be depicted as well as all bench marks.

(*q*) Different type for different sized towns and villages should be used.

(*r*) The following information, as far as the Survey Officer can collect it, should be given in footnotes :—

(i) Amount in inches of the average annual rainfall of the locality, as given by the Meteorological Department.

(ii) Month or months of harvest.

(iii) Translation of any vernacular names which may be denoted by letters or otherwise on the map, *e.g.*,—

N. (Naddi) = river.

Ch. (Chyoung) = stream.

(iv) In the case of great forests or jungles it should be noted whether they are generally impenetrable, passable by infantry, or if the growth is widely scattered.

6. I am very strongly to urge that no boundaries of any administrative subdivision lower than a tahsil or its equivalent, be shown on the ordinary topographical maps.

7. The conventional signs used should be the same all over India and Burma, and should, as far as possible, agree with the ordinary military signs. I submit that all the above information is useful to the ordinary traveller, the district officers, and especially to all classes of engineers as well as to the soldier. Some of it is already given in Survey of India maps, and orders have, I understand, been issued by the Surveyor General, which will ensure much of the remainder being given. Part of it, however, we cannot expect the survey parties to supply. It has accordingly been arranged that officers in charge of survey parties should be directed to apply to the General Officer Commanding concerned for any information they require. The General Officer Commanding will, further, on receipt of a request to that effect from officers in charge of survey parties, depute selected officers to go into the matter, if necessary, in the field—with the survey officer.

8. *Style and method of reproduction.*—For the ordinary individual who has not been brought up, as it were, to translate maps, there is no doubt that some system of relief hill shading with plenty of figured heights, is the easiest to read. It is true that in mountainous countries contouring makes things clear enough, but when we come to more flat undulating countries and countries of moderate elevation, it is harder to pick up quickly the nature of the ground from contoured maps. The soldier is, however, becoming every year more accustomed to map reading, and combining this with the fact that contouring makes a map more useful to all classes of engineers, military and civil, I am to recommend, at all events for the present, the retention of contours. These contours should be in brown, black hill shading or contouring being a fertile source of obscuring important names and details, and of making maps more or

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less illegible. A map like Burma Standard Sheet No. 384 with all the information asked for above depicted on it, and possibly somewhat more clearly reproduced, may be taken as most satisfactory for military purposes.

9. This brings us to the colours in which the maps should be printed. From a military point of view the more colours the better, but bearing in mind that each colour means the preparation of a separate plate and an additional printing, it is necessary to moderate demands in order to keep the expense within reasonable limits. After much enquiry, therefore, and careful examination of maps prepared in the United Kingdom as well as in foreign countries, I am to suggest that, *as a rule*, 3 colours should be used, *i.e.*, blue for perennial water, brown for showing the hills, and black for the remainder. In the case, however, of extensive forests or jungles on hills a green wash may be necessary, as in such cases the conventional signs for trees, etc., shown in black, would make the contouring very difficult to read. Though very desirable to have metalled roads coloured, it has not been considered advisable to ask for it. There are not many in India, so that those existing can easily be coloured by hand in the military offices.

10. As regards the method of reproduction, owing to the immense number of maps on the large scale required, engraving in their case is out of the question both on the score of slowness and expense. Some process of photographic reproduction must, therefore, still continue to be used. With care, very good work of this kind is now being turned out, and no doubt this will be still further improved. It was hoped that printing on pegamoid, a tough waterproof substance, would be a success, but home experience has proved that it not only discolours, but from the smoothness of the texture the ink does not get a proper hold of it, and the map loses its legibility after a time. It is further expensive and, in fact, I am informed that so little did it succeed at home that its use for mapping purposes is certainly not increasing. Before definitely abandoning this substance, however, a reference will be made home. For the present I am advised, therefore, to recommend that maps be printed on stout paper, partially mounted on linen, and folded like the specimen produced by Colonel Grant.

11. Turning to the $\frac{1}{1\,0}$″ maps—they should always be engraved—clearness of definition being essential. In order, however, that there shall be no delay in the issue of up-to-date $\frac{1}{1\,0}$″ maps for military purposes, they should be prepared by reduction from the standard sheets as soon as the latter are available and be produced by photographic means. With regard to the reproduction of maps for manœuvres and other military purposes in peace time, steps will be taken to ensure that, when these are asked for by the military authorities from the Survey of India, the drawings or tracings are sent up in such a form that copies can be taken off at once by the Vandyke or some similar process, no compilation or redrawing being required.

12. *Other recommendations considered desirable from a military point of view.*—It appears a matter for consideration whether it would not be desirable to establish a committee, as is done in France. This might consist of the Quarter-Master General—the Surveyor General—Assistant Quarter-Master General for Intelligence—a representative from each of the following: the Home Department, the Foreign Office, Military Department, Public Works Department, Railways, Postal Department, Telegraph Department and any others deemed desirable. The Survey would thus be in close touch with all branches of the service. The President might be the Quarter-Master General on account of the paramount importance of topographic maps for military purposes. The Committee could meet during the summer in Simla, arrange a programme for new surveys and revision, discuss the latest methods of reproduction, and generally ensure that the zeal, energy and high scientific attainments of the Survey of India are so directed as to produce the most useful work possible for the Empire in general and for India in particular.

13. I am to press the advisability of publishing all standard sheets complete to margin, and to suggest that they be numbered in one series throughout India, instead of by provinces as at present. Index maps should be coloured to show exactly the area that will be found mapped on the standard sheets, and both they and the catalogues should be so prepared as to be more easily "understanded by the common people."

14. Attention is invited to the importance of a closer connection between the topographical parties of the Survey of India and the military authorities. Provision has been made for this at the end of paragraph 7 above. This connection is the more necessary in the case of the Intelligence Branch and the Frontier parties. The moving of the Frontier Drawing Office to Simla should be carried out at once, and all parties employed on the North-West Frontier should recess there.

15. I am further most strongly to urge the formation of a small special party to be in still more intimate connection with the Intelligence Branch at Army Head-Quarters. Its primary duty will be to find men for survey work for expeditions, special explorations, or boundaries, without trenching on the *personnel* of regular parties. When not wanted for special work, the officers and men can be used for ordinary survey, care being taken that they are get-at-able.

16. It seems worthy of consideration whether one of the officers of this party should not be responsible for making any maps which the Intelligence Branch have to compile from information they have received from various sources. That branch cannot be considered a map-making department, and such an arrangement would leave them more free for collecting information regarding routes and supplies, etc., and compiling military reports generally.

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The actual surveyors of this special party should be soldiers who, under the new scheme, have been permanently taken on by the Survey. These men should be put through a very brief course of shooting and military training each year.

17. In this connection the employment of the Survey parties on active service requires notice. Officers of the Intelligence Branch and Survey officers should work in the closest consultation on service. There will then be no danger of work being done twice over. Remembering, however, that the survey are the map-makers and that the Intelligence Branch are not, the programme of what the Survey party should (as far as the exigencies of active service permit) do, and the scale on which it should be done, must be arranged by the Quarter-Master General in India, the Surveyor General, and the Foreign Department. It does not seem advisable for the General Officer Commanding on the spot to be in a position to use the Survey party for any species of reconnaissance work, or for isolated sketches of any particular bit of ground. That is the work of the Intelligence Branch who will also have with them soldier surveyors who have been trained by the Survey of India. Still it must be remembered that both the Survey and the Intelligence Branch are under the orders of the General Officer Commanding, and must do what is wanted on the spot. What has been said above regarding laying down a programme applies to surveyors with civil missions.

18. Arrangements should be made without waiting for indents as soon as a sheet (on any scale) is published, that a copy is sent to the General Officer Commanding the Division, as well as to the General or other Officer Commanding the Brigade in which the area of the country mapped falls.

19. I trust that the Committee will feel themselves in a position to support all the above recommendations and suggestions. In making them I may say that I have been placed in full possession of His Excellency the Commander-in-Chief's views. I submit that I have not unduly pressed the military side of the question. The necessity for a good topographical map is Imperial. I cannot emphasize this more clearly than by quoting from the book on the Origin, Development, Organization and Operations of the United States Survey—a quotation which will fitly close this note.

"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 division into counties and townships. They serve the Military Departments of the Government in locating encampment grounds, in planning practices, 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 for classifying the woodlands, 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."

Additional note on Organization by Colonel F. H. Kelly.

[*Lucknow, 3rd March 1905.*]

I would suggest 10 Royal Engineer officers being always temporarily employed in the topographical parties of the Survey of India—ordinarily for five years, but never for more than seven. No officer should be appointed who has not five full years to run before promotion to Major. This would ensure no one of higher rank than Captain being employed. I consider that after six months' training with a party in the field these officers should at all events be able to act as second officers of a party, and if necessary after another year to have charge of a party. The mixture of new blood would be a very good thing for the Survey, while the training undergone by the officers would be no bad one for war—certainly better than in the Military or Public Works Services. No officer should be taken who has not passed the Higher Standard, and had two years in India.

As regards pay, I would suggest that in order to make sure of getting plenty of volunteers, they should get more pay than when in the Military Works Service (which is their normal employment).

The following seems a fair scale of topographical or survey pay:—

		Rs.
Lieutenant	under 7 years' service	250
„	over 7 „ „	350
Captain	under 15 „ „	400
„	over 15 „ „	450

This would give total pay of—

Lieutenant	under 7 years' service	Rs. 515-12-0	as compared with Rs.	415-12-0 in Military Works.
„	over 7 „ „	„ 615-12-0	„ „ „	515-12-0 „ „
Captain	under 15 „ „	„ 833-10-0	„ „ „	733-10-0 „ „
„	over 15 „ „	„ 883-10-0	„ „ „	783-10-0 „ „

At the end of their time they would go back to Military Works, and fresh officers would take their place.

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The Royal Engineer Survey Officers of the above ranks get at present about—

Rs. 570 to Rs.	670	Assistant Superintendent,	2nd grade.
Rs. 670 to Rs.	740	„ „	1st „
Rs. 740 to Rs.	990	Deputy Superintendent,	2nd grade.
Rs. 990 to Rs.	1,140	„ „	1st „

I see no reason why officers other than Royal Engineers, exceptionally qualified, should not be employed with topographical parties, but they would have to be exceptionally qualified. They could be seconded in their regiments.

III.—Colonel S. C. N. Grant, C.M.G., R.E., attached to the Committee to advise on methods of reproduction.

[*Calcutta, 24th and 25th February 1905.*]

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Examined by Sir John Farquharson regarding the method to be adopted in revising the maps of India.

1. *Q.*—We may take as an example standard sheet No. 51 of the Central Provinces published in 1870. This does not show the ground by contours approximately determined by the clinometer, but by a system of rough horizontal hachures which merely gives an approximate idea of the relative heights. The result is that the Committee has hitherto assumed that the whole of the original survey of that sheet would during revision have to be redrawn, if the Committee decides that the hill features of the revised map should be shown by clinometer contours. Is that so?

A.—I am of opinion that the whole of the new revision should be made on a new manuscript plan of the whole of the standard sheet. I make no exception to this.

2. *Q.*—For reproduction purposes how would you propose that the new maps should be prepared? Would you recommend that they should be revised on the original survey scale of two inches to a mile, where such original survey exists, or would you revise them on the existing one-inch scale as published?

A.—Where the two-inch original survey exists, I should certainly revise the maps on the two-inch scale in the field.

3. *Q.*—By what method would you prepare the sheets of the original survey for actual revision in the field, with reference to the cancelling of the details which have disappeared and the insertion of alterations?

Q.—I should take the original manuscript drawing where it exists. If that drawing is not so distorted, but that a sufficiently distinct photographic reproduction can be obtained, I should photograph it by helio-zincography. I should then print impressions in red on tracing paper which would be revised in the field. I should further print a blue impression on hand-made paper which would form the basis for the new drawing. Where the original manuscript is so distorted that it cannot be reproduced by photography to scale, I should make a tracing to scale equating the errors and photograph that tracing. If no original manuscript exists at all, I should be forced to take an impression.

4. *Q.*—Does it follow from what you have said now that in the case of an inferior original manuscript map great expense would necessarily have to be incurred in tracing by hand a map like the specimen produced (No. 51 Central Provinces)? Supposing that expense became practically prohibitive, would you forbid in any case the printing of an impression for revision in the field from the actually existing printed map?

A.—That must depend entirely on the degree of accuracy aimed at by the Survey Department in its new work.

5. *Q.*—Would you consider that the loss of accuracy would be so great in such a case as that mentioned, as to destroy the value of the new map as a topographical map?

A.—Not in this particular piece of country.

6. *Q.*—So that in the last resort you would allow the actually printed map on the one-inch scale to be issued for the purpose of revision in the field?

A.—Yes, for certain areas of the country where there is little detail, or where exact accuracy of detail is not on the face of it very essential, I should agree to that being done, that is to say, I should agree to the printed map being photographed, and treated as an original manuscript.

7. *Q.*—What size of tracing or card would you recommend for issue to the revising officer?

A.—I should cut the sheet in two, so as to cover the whole of a plane table, because this size is well suited to the plane tables in use in the Survey of India, and gives space for a sufficient number of trigonometrical points for the reviser to work on.

8. *Q.*—Next as to the transfer of the alterations on to the new plan, how would you propose to carry that out?

A.—I would recommend a red tracing for working in the field, to simplify the labour of transferring the work to the new manuscript plans printed in blue.

9. *Q.*—Is there any particular form in which you would prepare the two-inch revised map? After the blue map has been completed, how would you prepare it for reproduction on the one-inch scale?

A.—I would have the manuscript drawn for reduction to the one-inch scale.

10. *Q.*—In cases where the one-inch print-map has been used how would you prepare it?

A.—The manuscript map would be prepared for reproduction on the same scale. In certain localities it might, however, be considered advisable to enlarge the one-inch map for revision in the field and for reduction again.

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11. *Q.*—Can you give the committee any idea as to what would be the cost of these preliminary operations for preparing the map, so far as it applies merely to the production of the necessary copies and plates for printing, that is to say, exclusive of the cost of the field revision and exclusive of the cost of the drawing of the map?

A.—I think £4 per sheet of standard size would be sufficient to prepare the red and blue prints and the helio-zincographic plate before revision. Wherever the two-inch scale obtains, the cost would be four times as great for each one-inch standard sheet.

12. *Q.* (*Colonel Longe.*)—I should like to know whether Colonel Grant has any experience of surveying on the one or two-inch scale in this style from trigonometrical points.

A.—I have surveyed the country from the Zambesi to the Limpopo in East Africa, covering an area of perhaps 12,000 square miles. I have surveyed the country in Natal to the north of Ladysmith, covering an area of 3,000 square miles, on the one-inch scale. I have surveyed the country between Sierra Leone and the French Territories in West Africa. I have done many other surveys of similar nature. I was also employed on the survey of Cyprus on the one-inch scale. My survey experience commenced in 1880, and extends up to date.

13. *Q.* (*Colonel Longe.*)—That is to say, you have had experience of surveying on the one-inch scale from trigonometrical points exactly as we have to do in this country?

A.—I do not know of any other way of doing surveys of such large areas.

14. *Q.* (*Colonel Longe.*)—Do you think that a map printed on tracing paper sent into the field for correction and practically for re-survey, which would cover an area of about 225 square miles, will bear the wear and tear in the field, necessitated by the drawing of the hills shown on sheet No. 51 before you? And do you think that the trigonometrical points on a printed map would have to be carefully plotted and examined before they could be used for plane-tabling purposes?

A.—If the existing work is as correct as I have always thought the work of the Survey of India is, there should be no difficulty in getting a tracing plan that would last the time required by the slight revision which, I should think, would be necessary. If, as I am now given to understand, a complete re-survey will be necessary, I agree that the tracing paper will have to be replaced by strong hand-made paper, and in such a case the trigonometrical points will have to be replotted.

15. *Q.* (*Colonel Longe.*)—Also in the case of revision of half-sized standard sheets, would it be necessary to plot a considerable number of trigonometrical points beyond the margin of the area to be surveyed in order to enable the Surveyor to fix his position with sufficient accuracy?

A.—It would be very desirable to do so.

16. *Q.* (*Colonel Longe.*)—Therefore a mere blue print sent into the field on tracing or any other paper would not be sufficient?

A.—It would not be impossible to add on the red tracing any extra trigonometrical points that may be required.

17. *Q.* (*Colonel Longe.*)—As you say that you would redraw the whole of the sheet for reduction or reproduction, I should like you to explain what is the object of having a blue print for the preparation of the new sheet. Would it not be better to replot the sheets to ensure their being corrected critically, as you will have to transfer every item from the new field sheets to the new manuscript plans?

A.—My suggestion was made under the impression that nine-tenths of the work of the survey was good, and that the corrections would form a small proportion of the work. Therefore the blue print, where there are few corrections necessary, would immensely facilitate and cheapen the work of drawing. Such arrangements will of necessity require modification, where the work is so wrong that it requires not a revision but a re-survey.

18. *Q.* (*Colonel Longe.*)—The present system of revision in the Survey of India consists in sending out blue prints, or maps drawn in blue, on plane table sections. The revising officer shows in black everything that is to be given in the new map, so that there can be no doubt as to whether items in blue should be shown or not. The map comes back as a new map in black. Do you not think that this system is better than possibly leaving the matter in doubt as to whether rivers or roads, etc., should be copied or not? Would you not make the revising officer responsible for everything?

A.—If the corrections are small in comparison with the revising work, I do not see the necessity of the reviser's inking up the whole of the tracing, the assumption being that where no correction is made, the old work holds good. If on the other hand the corrections extend to nearly all the details in the sheet, it might be necessary to make a modification to meet such cases. I should not object at all to Colonel Longe's suggestion, if he finds it more suited to his class of revision. It does not, however, alter the principle of the method that I propose to recommend.

19. *Q.* (*Sir John Farquharson.*)—Possibly it might be as well to take, as nearly as we can, a concrete case. My own opinion from what I have seen of the previous work of the Survey of India, is that on the whole it has been remarkably accurate, as for instance in the case of the triangulation, and of the details shown on the maps, such as roads, rivers, and so on. But in the case of some of the maps those would only form part of the work that would have to be revised and corrected. Taking now the map which we have in front of us, I should think it probable that the greater part of the revising and correcting which would have to be done, would

not be with reference to the trigonometrical stations or to the correctness of the roads, rivers and other details shown on the map, but would be the revision of the approximately corrected clinometer contours. Assuming that would be the case, and that the reviser would have to redraw practically the whole of the hill representation on the sheet which we have before us, would you consider that would mean a greater amount of revision than can be satisfactorily carried out by the reviser on your proposed method?

A.—This is an extreme case, and under the circumstances stated by Sir John Farquharson, I should in the first place prepare my red tracing of the details only and omit the hills. I think it extremely improbable that the tracing would stand the wear and tear required during revision, but the reviser can be supplied with a dozen or any number of red tracings, so that when one begins to get worn, he can take up work on another. However, in extreme cases like this, red prints on thick paper can be substituted for the tracing paper.

20. *Q.*—How in that case would you propose to transfer the details from the red tracing on to the new manuscript plan in the office?

A.—It would involve tracing on to thick paper.

21. *Q.* (*Colonel Longe.*)—You say that in an extreme case of that sort you would transfer the details only and omit the hills. By what process would you do that?

A.—By merely duffing out the hills on the original before making the helio-zincographic plate.

22. *Q.* (*Colonel Longe.*)—Surely it would be a matter of very great labour and trouble, and would be unnecessary, if you used the blue print in the field on which you could conveniently draw by hand all the details to appear on the new map?

A.—It would not be a matter of very great difficulty and expense. But if blue is better than red, with or without hills, it does not seem to me to make very much difference. I have no particular reason to recommend one colour more than another. I have, however, had some experience in this matter, and have tried every colour for the revision of maps in England, and, in the end, I found that the most convenient method of revision was to use tracings printed in red and corrected in black.

23. *Q.* (*Colonel Longe.*)—But this revision in England referred only to the 25-inch scale, and the area covered by each card was small, and were not the revisers dealing with maps which were practically known to be absolutely correct in themselves, and to hardly require more than a few slight alterations or additions?

A.—No. In the vicinity of large towns the alterations and corrections were excessively numerous and close.

24. *Q.* (*Colonel Longe.*)—But would not making these blue and red prints throw a large amount of work on the reproducing offices?

A.—It would practically double the departmental work of the Photographic Office. This Department has already enough strength to cope with this work, and the effect on the Printing Department would not be very considerable.

25. *Q.* (*Sir John Farquharson.*)—I have an impression that some of the members of the Committee look with considerable alarm on the question of reproducing maps in different colours owing to the large number of separate prints which would be required. Could you give us any information as to whether, either as regards labour or cost, you consider the reproduction of maps in colour objectionable? For instance, there is one point which the Committee may have to consider, namely, the preparation of two different kinds of standard sheets,—one for the use of local officials and administrative officers, which it would be advantageous to print in colours, so as to show civil boundaries; the other would be the topographical map, which the Committee may also consider it necessary to propose the preparation of to some extent in colours. Have you found in your large experience at Southampton, that the constant addition to the work of the Printing Department caused by colour printing is so formidable that you would hesitate to recommend its adoption? Before 1894 the one-inch maps of Great Britain were published only in black; in 1894 the Treasury and Board of Agriculture authorized me to publish an edition in other colours besides black, namely, burnt sienna for roads, blue for water, red for contours, brown for hills. That is to say, there are at present four colours in addition to the original black. Can you give us an idea to what extent the addition of these colours has increased the labour and cost of producing a map, and the time required for producing a large number of maps, in case of necessity, at short notice?

Colour printing.

A.—The cost for a standard sheet for preparing a road plate, a water plate, and a contour plate, in addition to the black plate and the brown hill plate, would be very roughly at English prices £12, and the amount of work in printing is proportional to the number of colours employed.

26. *Q.*—Can you give us an idea what the additional cost of printing in an additional colour one map of standard sheet size, or 100 copies, or 1,000 copies, would be in addition to the cost of printing the map in black and brown?

A.—For a single sheet the cost would be a fraction of a penny, but for a thousand sheets £2 additional at English rates.

27. *Q.*—So that for the production of 50,000 copies of a coloured map the additional cost would only amount to £100?

A.—Quite so.

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28. *Q.* (*President.*)—Would you recommend us to go in for colour printing?

A.—Yes; in moderation—in blue, black and brown.

29. *Q.* (*Sir John Farquharson.*)—Do you think from what you have seen, that the engraving of the one-inch standard sheets would be a formidable task for the Survey of India?

Engraving.

A.—I quite agree with the opinion expressed by Sir John Farquharson, that an engraved map is vastly superior to one produced by any other method. But assuming that the number of standard sheets in India and Burma is 3,500; that, in order that these 3,500 sheets may be revised and engraved in 25 years, it would be necessary to do roughly 140 sheets a year, and that each sheet will take from 2 to 3 years to engrave, I think that the Survey Department would require something like 500 engravers to do the work in the specified time. This is on the supposition that all the work is done in India. Unless a large proportion of the work is sent to England, I do not think it would be possible to arrange so to increase the Engraving Department in India as to face such a large amount of work.

30. *Q.*—Can you give us an estimate of the time which you would require to engrave one of these standard sheets?

A.—The sheets vary so much that it is very difficult to say. I think that an outline sheet without hills could possibly be done in six months. The hill sheet ought not to take more than three years. The average time for completing both outline and hills on a sheet would be perhaps three years.

31. *Q.*—Could Southampton take over a large portion of the work to be done here or would the Surveyor-General have to go to private firms?

A.—I cannot say anything definite with reference to Southampton, but I believe that they could conveniently undertake some work for the Government of India.

32. *Q.*—I may take it that the Survey of India would probably have to go to private firms for a certain amount of work?

A.—Possibly.

33. *Q.*—Supposing that the Committee are of opinion that the engraving of the standard sheets is too formidable a task to recommend, do you think it might be possible to produce satisfactory results by any other method?

A.—I think the process of helio-zincography as employed in England can produce results which might be satisfactory, but not as it is carried out in Calcutta.

34. *Q.*—Do you think that the inferiority of the process, as carried out at Calcutta, is due to removable causes or not?

A.—I think so. But the reason for its failure is stated to be the hot season in Calcutta. Of this I have no experience.

35. *Q.*—In what respect do you think the causes are removable?

A.—I do not think that the process, as employed in India, is capable of producing better results than it does at present.

36. *Q.*—Is the process itself wrong?

A.—The process is different from that employed in Southampton. The inferiority is due to the material used and also to the method in using the process.

37. *Q.*—Have you seen any reason to suppose the inferiority is due to want of skill and supervision?

A.—I cannot say that, until I eliminate the amount of inferiority that is due to the process employed.

38. *Q.*—At present you do not see any hope of the Calcutta Office turning out maps which might be considered satisfactory?

A.—I do not see any immediate prospect of its turning out maps any better than those which have been shown to the Committee as samples of the work they are doing at present.

39. *Q.*—You do not think that improvements in the materials, such as better paper and general cleanliness of the office, etc., would affect the quality of the map?

A.—Yes; I think better paper, greater cleanliness of the office and every improvement in that way would result in a better quality of work being turned out.

40. *Q.*—I presume there is a marked difference between the quality and style of copper engraving done at Southampton, and the work done in the trade. Is your estimate of the number of engravers which would be required based upon the Southampton experience or the trade experience?

A.—My opinion is based on the progress of the engravers at Calcutta.

My estimate does not include the Degree sheets, of which the number would be about 600, and which will probably require to be engraved on copper plates.

The estimate given in my report of £250 for engraving a copper plate is made up as follows:—

	£
2 copper plates	10
Outline	65
150 miles heavy shading	100
150 miles light shading	60
Contingencies	15
	£250

The estimate of £150 for a locally engraved plate is made up of :—

	£
Brush drawing	15
2 copper plates	10
Detail	35
150 miles heavy hill shading	50
150 miles light hill shading	30
Contingencies	10
	£150

This estimate takes account of the expense of personal labour only, and is based on the cost of the engraving of the quarter-inch map in the Calcutta Office by native engravers. As stated in my report, the question of obtaining from the work on the quarter-inch a rate for the one-inch map, seeing that no previous work has been done on that scale, is a very difficult one, and allowance for error must be made. But my estimate fulfils the condition of allowing engravers drawing a salary of Rs. 70 a month three years to engrave one standard plate. Of course many plates will take only one or two years, whilst others will take four or five years. The estimate then appears to me to be a reasonable one. In the President's instructions relative to this estimate, nothing whatever was said about any limited time, and naturally no allowance was made for executing the work otherwise than under the normal working conditions of the department, as it exists at present. A slight increase to the strength of the department would be immaterial, but my estimate cannot reasonably be applied to a new set of conditions, in which the existing department would have to train engravers, so as to increase the strength suddenly to something exceeding 20 times its present numbers.

The impossibility of executing this work locally is I think apparent. My estimate for cost, if all this work were sent to Europe for engraving by contract there, is £250, exclusive of £30 for hill brush drawing, making for 25 years an annual expenditure of £40,000.

I did not take into account the fact that one-third of the area of India will not require any hill engraving at all. My estimate is, however, based upon standard sheets, including the sheets in which there will be no hill engraving. I take an average sheet of India, and I assume that it contains an average number of outlines. I then assume that one-third of the sheet is covered with light hill shading of medium density, one-third is blank as regards hills, and one-third is covered with heavy hill shading. This is what I call a normal sheet on which to base an estimate for the 1,800,000 square miles of India. I think this method of making the estimate will give the same result as an alternative method proposed, *viz.*, excluding entirely the area of India for which there are no hills, and then taking the average character of those sheets of India which have hills more or less.

41. *Q.*—Supposing the general character of the area in those parts of India only which have hill features, answers to the description which you have given of the average sheets, namely, that one-third of the sheet would be blank as regards hills, one-third would have light hills and one-third would have heavy hills, do you not think your estimate, which presupposes this description for the whole of India, is incorrect ?

A.— I was told to obtain an approximate estimate, and I think the way in which I have done it will produce an approximately correct result.

42. *Q.*—Even supposing that the estimate which you make for the whole of India would be correct only for two-thirds of India ?

A.—My estimate is framed on the supposition that taking the whole of India, 600,000 square miles would require heavy hill shading, 600,000 square miles light hill shading and 600,000 square miles will have no hills at all. In my estimates I have confined myself to the sole question of engraving the sheets on copper in every respect. I have not taken into account or considered in any way the possibility or advisability of modifying the requirements of that estimate. That is to say, I have not considered the question as to whether the maps of India would be improved by the copper-plate engraving of the outlines without incurring the expense of the copper-plate engraving of the hills. That question was not put to me. But as a matter of fact, I have distinguished between hills and outlines in my estimate. I consider it might be an improvement to have the outline only engraved on copper, excluding entirely for the present the engraving of hills. I have already said that no doubt copper engraving would be the best method of reproducing a map, irrespective of the question of cost and time. It is in my opinion desirable in the first place that the existing maps should be improved. I think they can be, and should be improved, and I think that the best way of improving them, so far as the style is concerned, is by engraving the outline on copper.

Sir John Farquharson stated that the difference between his estimate and Colonel Grant's estimate was that Colonel Grant estimated the average standard sheet of India generally, as having one-third no hills, one-third medium hills and one-third close hills. He included therefore in the whole of the area the 600,000 square miles, in which as a whole there are no hills at all. Sir John Farquharson's argument on the other hand was that India is a country of vast plains, covering an area of perhaps 600,000 square miles, which should be entirely excluded from consideration in any estimate of the cost of hill engraving ; that Colonel Grant's description of one-third heavy hill shading, one-third light hill shading, and one-third blank area, would be strictly correct for an average one-inch sheet of the rest of India, that is, for perhaps only 1,200,000 square miles instead of 1,800,000 ; and that, to the extent therefore of perhaps one-third, the data of Colonel Grant's estimate are wrong.

Col. S. C. N. Grant.

43. *Q.*—I think we have heard already that you do not recommend any other method of improving them as to style, for instance by such a process as photo-etching ?

A.—I am aware that we have adopted photo-etching at Southampton, but I am not prepared to say that the results justify the hope that it would be worth while undergoing the increased cost of photo-etching over that of good helio-zincography for outline only. The net additional cost of photo-etching in one colour, as compared with good helio-zincography for outline, would be about £10 per sheet.

44. *Q.*—You consider that the helio-zincographed maps at Calcutta are unsatisfactory, but at the same time it is not in your opinion worth while incurring the extra cost involved in photo-etching. Does it not appear to you that you practically give the Committee no practicable method of improving the present existing standard sheets of the Survey of India ?

A.—No ; I do not think so.

45. *Q.*—Then seeing that according to the evidence which we have received, you condemn engraving on copper, you condemn the Indian helio-zincography and you condemn photo-etching, would you be so good as to state distinctly for the consideration of the Committee how you would propose to improve the existing standard sheets of the Survey of India ?

A.—I should produce them by helio-zincography in a style approaching that of the six-inch maps of England.

46. *Q.*—Then have you given in your evidence and report, or in either, any practical details which you would recommend to be adopted at Calcutta with the object of improving the Indian maps ?

A.—The report is in the hands of the Committee. I think all through there are suggestions for improvement.

47. *Q.*—I ask the question because I have a strong impression that you have been asked the definite question whether you could say that the maps of India could be definitely improved by the adoption of practical details, and my impression is that you declined to commit yourself to any such details, partly on account of the difference of climate, and partly on account of other considerations. Will you say whether my impression is right or wrong ?

A.—I said, I believe, they could be improved, subject to qualifications about the question of climate, on which I am not capable of forming an opinion.

48. *Q.*—There are no other considerations ?

A.—Yes ; there are. A change in the method of working helio-zincography, including materials.

49. *Q.*—That is to say, you have not stated in your report with any approach to certainty of conclusion that the existing standard sheets of India can be improved by the method of helio-zincography ?

A.—I have given my opinion and cannot add to it. I think the climatic difficulties, the difficulties connected with Indian labour and the use of inferior materials would apply equally well to photo-etching as to helio-zincography.

50. *Q.*—You have given your estimate for contract expenditure for engraving the whole of the standard sheets. Do you derive your estimate partially or wholly from what the Southampton rates of progress and cost are ?

A.—Not entirely. My estimate is partly derived from Southampton rates and partly from trade rates. I have never been in charge of the Engraving Department at Southampton. I have never been responsible for either the rate of progress or the cost of the engraving at Southampton. I have never been in charge of any contract engraving work done for the Ordnance Survey in London or elsewhere. I have therefore had no close opportunity of comparing the rates of progress and cost of the two kinds of work, that is to say, the Southampton work and the trade work. But in order that these replies may not give the Committee a wrong impression, I wish to add that, although I have never been in charge of the Engraving Department at Southampton, otherwise than temporarily for short periods, I have during 20 odd years of Survey experience had other opportunities of making myself acquainted with the cost and methods of copper engraving.

51. *Q.* (*President.*)—In what way ?

A.—I have been directly or indirectly connected with arranging for the copper engraving of three maps outside the Ordnance Survey. And my present duties on the Ordnance Survey are such that the return showing the cost of engraving on copper plates is passed through my office.

52. *Q.* (*Sir John Farquharson.*)—Have you ever been responsible in any way for the quality of the work, or the rate of progress of the engravers at Southampton ?

A.—Yes. I was on a Committee, with the Executive Officer and the Officer in charge of the Engraving Department, which for many days sat in the Executive Officers' office for the express purpose of reporting on the progress and the work done by the engravers about that time.

53. *Q.*—But I presume that your answer does not imply that you have ever been personally in charge of, or responsible for, the work of the Engraving Branch at Southampton.

A.—No, except temporarily as *locum tenens* for short periods.

54. *Q.* (*Sir John Farquharson.*)—I produce a specimen map on the scale of two miles to the inch (No. 87 of England) which is part of a series lately ordered by the Government to be prepared for the whole of Great Britain. This specimen has been produced by photo-etching. I also produce a specimen, which I consider rather a favourable specimen, of the execution of the standard sheets of India, namely, No. 385 of the Burma Survey. I would ask the Committee to compare the two maps, and I would ask Colonel Grant to say what his own opinion is as to the relative clearness of outline and general method of indicating the topographical details on small scale maps.

A.—I do not think that the work of the Burma sheet is so fine as that on the English map.

55. *Q.*—You do not consider that the difference in quality between the two maps would justify any departure from your previous answer as to the relative cost of photo-etching, absolutely irrespective of the question of colours?

A.—I adhere to my previous opinion, provided that both the maps prepared by the two processes are prepared in the same style by similar workmen and under similar conditions. That is to say, if the heliozincographed map and the photo-etched map were prepared at Southampton, I do not think that the difference in quality between the two would justify the additional cost of £10 required by the photo-etched map. (I am referring throughout to the one-inch standard map.) Similarily, if the heliozincographed map and the photo-etched map were produced or could be produced at Calcutta, I would assume that the same considerations would practically apply.

Draftsmen.

56. *Q.* (*Colonel Longe.*)—Do you think that our manuscript plans are as good as they ought to be, or do you think we ought to employ a better class of draftsmen on them?

A.—No doubt a better class of draftsmen would produce better drawings, and I should try to get a better class of draftsmen. But the drawings, as done at present, are some of them not bad.

57. *Q.* (*Colonel Longe.*)—The present system in the Calcutta Office is to have the pay for every post fixed by Government both in the Drawing and Photographic-Lithographic Offices. If you had to take charge of these offices, would you adhere to that system or would you not endeavour to get it modified and get more power in your own hands to promote good men, and get rid of bad men?

A.—I should distinctly desire to have it modified, and get more power to reward good work and punish bad work. I should under these circumstances consider that I would be able to get more and better work done; if I were given a large sum to distribute amongst as many men as I required, that is to say, a sum limited in amount, but which I could spend as I thought advisable. I consider the Drawing and Photographic-Lithographic Offices would produce better results, than are at present got, if run more or less on trade principles as regards pay. I should pay the men in accordance with the quality and out-turn of their work, regardless of the length of service, though of course length of service must be considered to a certain extent.

58. *Q.* (*Colonel Longe.*)—Our present system of recruitment in the Calcutta Drawing Offices is to recruit apprentices. There are now about 18 boys on roughly Rs. 6 a month which is less than the pay of a chaprassi in the office. Do you consider that such a system is conducive to cleanliness and good work in drawing?

A.—I think it is a question that requires more local knowledge than I have. At Southampton we do not take apprentices, but a boy begins on 6*d.* a day, but is soon raised to a shilling. At 18 he gets two shillings and six pence.

From my visit to the Drawing Office I do not consider that if I were in charge of the office myself I would be satisfied with the draftsmen I saw. I think I should strive to get a better class of men in the Photographic and Lithographic Offices also, and this, even if they were paid more.

Improvement of the Photographic-Lithographic Department.

59. *Q.* (*President.*)—You think the present arrangements in the Photographic and Lithographic Offices are far from satisfactory? In your report you say that the inferior work of the office is due to want of cleanliness and order, to failure to use labour properly, and to using an unsuitable process with inferior material. Can you say from the present state of your knowledge what special steps you would take, if you were yourself in charge to improve the working of that Branch?

A.—I should first ask for a young officer as an Assistant, and this would be advantageous not only in the immediate present, but I think it desirable that a second officer should always be in training in that Department to take over the duties of the officer in charge, when he is absent. I should then suggest, if I took over that section of the Drawing Office which executes the drawings for reproduction by photography, that steps should be taken to have a thorough cleaning out of the whole of the workrooms and workshops, and I should take measures to ensure that they are kept clean in the future. I should then see about putting in the fittings and making the alterations referred to in my report. I should then put all the workmen on piece work, and I think this would result in a large reduction of the lower class of labourers. I would not include the foremen in piece work. I should then be in a position to advise definitely about the transfer of the Photogravure Section to the Central Press as well as a portion

Col. S. C. N. Grant.

of the Letter Press Printing Department. I should then try to improve the quality of the work done, by asking for increased power over the pay of the men and possibly increase the same generally. I should then take up the question of the European and Eurasian Assistants. At present there are 22, drawing salaries varying from Rs. 15 to Rs. 550. My object would be to largely reduce the number of these men, but to improve very much the position and pay of the remainder who would be retained, or of those who would be obtained from the Continent to replace the existing staff. My idea is to have a few Superintendents, who would be good workmen with capacity for hard work, rather than a large number of workmen who might be inferior.

60. *Q.*—Have you anything to say about the hours of labour in the Photographic and Lithographic Offices? Do you consider the present hours—10 to 4—reasonable hours of labour for printing work?

A.—In England it would not be considered reasonable.

61. *Q.*—Is there any reason why a reproducing department like the one here should not work as long hours as at Southampton?

A.—For draftsmen's work and work of that nature the hours of work must be restricted, but there is no reason why printers on letter press machines and hand presses should not be able to work 8 hours a day.

62. *Q.*—Some complaints have been made of the impossibility of turning out good work in the Calcutta climate. Do you think, apart from any general question of ability, as far as the quality of the work is concerned, it would be advisable to await the results of the improvements you suggest, before considering it necessary to transfer the whole of the reproducing office to a better climate?

A.—I think the removal might await the trial of improvements in other directions.

63. *Q.* (*Colonel Longe.*)—In paragraph 36 of your report you say "the quality of the supervision is much more important than the quantity." Does not this depend on the capabilities of the individual workmen, that is to say, with better workmen the supervision would be less?

A.—I have already said that I should prefer to run the Photographic and Lithographic Offices with fewer, but better men.

Letter dated Ordnance Survey Office, Southampton, 23rd March 1905.

From—Colonel S. C. N. Grant, C.M.G., R.E.,

To—The President, Survey Committee, India.

Since my arrival in England, on the 20th instant, I have been able to make enquiries relative to the estimated cost of engraving in this country. I find that, as stated by me to the Committee, the cost can vary as much as almost 100 per cent., it being dependent upon the quality of the work. The depth of cut and the consequent life of the plate would not be discernible from a printed proof copy.

Sheet 81 of the Bengal Survey has been assumed by me as a typical average sheet, as regards outline, of the whole of India and Burma.

The price of engraving the outline and writing of this sheet may vary from £75 to £45. As regards hills, assuming that in each sheet there is an average of 170 square miles of light hill shading and the same area of heavy shading, the estimated cost of this shading will vary from £320 to £240, so that we have the average cost per sheet, outline and hills, varying from £395 for superior work to £285 for work of a lower grade. It appears then that the estimate, given by me to the Committee, of £250 per sheet or £875,000 for the whole of India and Burma will, if work similar to that of the copper plates of the one-inch maps of England be desired, have to be raised to £395 per sheet or £1,382,500 for the whole map. Tenders could doubtless be obtained for engraving at a cheaper rate, but the experience of the Ordnance Survey is that, irrespective of the apparent quality of the work, the life of such plates (represented by the number of impressions which can be pulled from them) is far inferior to that of plates better, and consequently more expensively, engraved.

The above estimates are for engraving the hills by vertical hachures similar to those of the one-inch maps of the United Kingdom.

The cost of an electro-typing plant, assuming electricity to be available, sufficient for duplicating 100 standard plates per annum would cost, in England, about £2,500.

There are four processes by which, or by a combination of which, the maps of India may, on revision of the survey, be reproduced:

(1). *Heliozincography of the original manuscript drawings made by the field parties.*—This would be the cheapest and quickest. The cost of reproduction in one or two colours should not exceed £2 or £3 a sheet. Specimens* (A) and (B) herewith have been prepared by this method, and I see no reason why the work in India, with improved training of workmen and methods of reproduction, should not approximate in quality to that of these two samples.

* Not printed.

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(2). *Heliozincography—the work being specially drawn.*—As a sample, I attach that marked C, * and assume that the drawing done in the field sections would not be sufficiently good for this class of work; and that consequently special drawings would have to be made by specially trained draughtsmen. This would make the cost exceed that of (1) by the cost of these drawings which would probably amount, for outline and hills, to possibly £70,000 for the whole of India and Burma.

* Not printed.

If either processes (1) or (2) be adopted, all negatives should be stored, and this would provide the cheapest, quickest and most simple means of carrying out future corrections and alterations.

(3). *Photo-etching.*—If the work be close and fine, and the number of impressions to be obtained renders it preferable to print from stone rather than from zinc, then this process has advantages over that of heliozincography. The one-inch maps of India are not close, nor are the number of impressions printed great. The cost of first preparation may be taken for any class of work, as being about £10,000 for the whole of India above that of heliozincography. Any corrections in the future will be expensive relative to those made in processes (1) and (2). For these reasons I do not recommend its adoption for the standard sheets of India.

(4). *Copper engraving.*—This process gives an impression clearer and sharper than any of the others; it is, however, expensive, both in original engraving and future correcting.

The work on the greater portion of the standard sheets of India is so open and the demand for many of the sheets so very small that, in my opinion, the additional cost of this method is not justified.

There is no reason, however, why some sheets exceptionally close, for which the demand is great, should not be engraved, even if some system of heliozincography be selected for adoption generally.

Col. S. C. N. Grant. *Estimates for producing standard sheets in colour* (i.e., *outline and names in black, hills in brown, water in blue and roads in another colour*) *by heliozincography and by photo-etching.*

HELIOZINCOGRAPHY—*See attached notes.*

In the following estimates it is assumed that the manuscript plans are drawn ready for photography, the detail and water on one plan, and the hills on another.

	Col. 1. Colonel Grant's estimate.	Col. 2. As per current Photographic Lithographic Office rates.	Col. 3. For standard sheets half their present size.
Detail and water plates.	Rs. A.	Rs. A.	Rs. A.
Two large negatives about 36″ × 24″ at Rs. 10	20 0		
Duffing one negative for detail plate	7 0	40 0	17 0
„ other „ water „	7 0		
Making and proofing two helio. plates at Rs. 5	10 0		
Examining proofs and correcting at Rs. 3	6 0	12 0	18 0
Hill plate.			
One large negative at Rs. 10	10 0		
Retouching	10 0	20 0	8 8
Making helio. and proving	5 0		
Examining and correcting at Rs. 5	5 0	6 0	9 0
Road plate.			
One set off from detail plate	2 0		
Inking up roads	5 0		
Making helio. and proving	5 0	10 0	9 0
Examining and correcting	1 0		
TOTAL	93 0	88 0	61 8

Photo-etching.

The same assumption being made as in previous case.

	Col. 1. Colonel Grant's estimate.	Col. 2. As per current Photographic Lithographic Office rates.
	Rs. A.	Rs. A.
Detail and water plates.		
Two large negatives	20 0	
Duffing same	14 0	40 0
Two transparencies	20 0	
Two sheets of copper ·04 burnished	75 0	
Printing two copper plates, burning and etching, European	20 0	
Touching by engraver	70 0	
Hill plate if in line drawing.		
Negative	10 0	
Retouching same	10 0	
Transparency	10 0	
Copper—sheet of	40 0	
Printing and etching	10 0	
Touching by engraver	140 0	
1 Road plate.		
Same as for heliozincography	13 0	
TOTAL	452 0	

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If the hill plate be done from a brush drawing in screen work, the estimated cost of the zinc plate will be—

	Rs.
Negative—Screen	20
Duffing same	30
Transparency. (I do not think a transparency of a screening could be obtained readily except by contract printing, and a gelatine plate 36″ × 24″ would be a somewhat exceptional size, cost, say Rs. 20.)	30
Copper plate	40
Printing and etching same	10
Fine etching (4 months at Rs. 70 at the least)	280
Proving, etc.	10
TOTAL	420

and of the map in four colours.

	Rs.
Detail and water plate	219
Hill plate	420
Road plate	13
TOTAL	652

NOTES.—1. It is difficult for me to put down a value for each stage, as so much depends upon whether the work would be done by European or native labour. Possibly I have gone betwixt and between, and recommend that these estimates be sent to Mr. Pope, who will be able to modify them where he thinks necessary. I have purposely left a column on the right hand of each sheet to enable him to do so.

In some respects I have been guided by the charges for work done at Roorkee College. It will be noted that nothing has been added for contingencies: at least 10 per cent. should, I think, be allowed for these.

S. C. N. GRANT,
Colonel,—28-2-05.

2. I return these notes and estimates checked, as far as I am able to do so.

At our rates, the cost of reproducing a standard sheet in black and three colours by heliozincography works out at Rs. 88 per sheet, or Rs. 5 less than Colonel Grant's estimate. Our figures also include all contingent charges, so there is no need to add 10 per cent. to them as he suggests.

I find I cannot criticise his estimate for doing the same work by photo-etching, as we have no experience here in the reproduction of maps on a large scale by this method. But I am inclined to think his figures are approximately correct.

I suppose the Committee are aware that Colonel Grant's estimates only carry the work as far as the preparation of the plates and proving. He does not go into the cost of printing and paper.

T. A. POPE,—8-3-05.

3. I have appended to the estimates another column showing the cost of each stage in the process of reproducing a standard sheet in black and three colours, if the size were reduced to exactly half the present size. The figures are based on the assumption that *new* originals would be supplied of the proper size. If we had to deal with the old originals of the present size, the work would cost a good deal more, and would be extremely difficult to estimate for. So that it must be understood that these figures can only apply to future work, unless it were intended to re-draw all the old sheets to half their present size, complete with border lines, etc.

There is not a very great difference in the cost of reproducing sheets half the size, the labour and materials being much the same, whatever the size of the sheet may be. But there would be a big difference in the cost of paper for each sheet.

T. A. POPE,—29-4-05.

4. For the 3,500 standard sheets of India Colonel Grant's estimate for printing in three colours by heliozincography amounts to Rs. 3,25,500, and Mr. Pope's to Rs. 3,08,000. Colonel Grant's estimate for producing these sheets by photo-etching is Rs. 15,82,000, if line drawing be used for the hills, and Rs. 22,82,000, if brush drawing in screen work be used. For heliozincographing 7,000 half sized sheets in the same number of colours, Mr. Pope's estimate is Rs. 4,30,500.

C. A. BARRON,—1-5-05.

SECTION III.

SELECTED EVIDENCE.—SURVEY OF INDIA OFFICERS.

Colonel J. R. Hobday, I.A., Officiating Surveyor-General of India.

[*Calcutta, 14th December 1904.*]

Col. J. R. Hobday.

1. Before 1865 the Survey Department was under the Military Department. In that year it was transferred to the Home Department, and remained so till the Revenue and Agricultural Department was formed, *i.e.*, in 1871. Orders relating to these changes are to be found in Financial Department Resolution No. 3996 of 22nd December 1864, and Home Department No. 1421 of 15th February 1865.

Questioned as to the organisation of the Department.

2. Before 1878 the work of the three branches, *viz.*, the Trigonometrical, Topographical and Revenue, was distinct, though all were under the Surveyor-General with a Superintendent of Trigonometrical Surveys. Before 1877 there were two Deputy Surveyor-Generals in charge of Revenue Surveys; since then there has been only one. The officers of the Revenue and Topographical Branches were borne on one roster, whilst those of the Trigonometrical Branch were on a separate list. The whole Department was amalgamated in 1878. Financial questions had a good deal to do with the amalgamation, besides which there were a number of officers in the Trigonometrical Branch for whom there was no employment owing to the completion of the triangulation of India. A number of the Trigonometrical Branch officers were then being employed on topographical surveys whilst the topographical and revenue officers were also indiscriminately employed on revenue and topographical surveys. Financial pressure first began to operate about 1875-1878; when the complement of Imperial officers fell from 69 to 50 and of Provincial officers from 168 to 135. In 1875 orders were received for a reduction of four lakhs in the budget to be effected in three years, and the expenditure on surveys was reduced to a maximum of 20 lakhs. (Letter No. 712 of 30th September 1875 from Secretary, Revenue and Agricultural Department, to Surveyor-General.) The sum of 20 lakhs was intended to cover all classes of expenditure. The limit of 20 lakhs has not been enforced in recent years. In 1878 cadastral surveys were being conducted in the United Provinces and Bengal.

I belonged to the Topographical Branch and joined prior to the amalgamation. After me no Imperial officer was appointed for six years, during which time about 20 steps were absorbed with a view to reduction of establishment.

3. The present administrative staff of the Department consists of (1) a Surveyor-General, (2) a Deputy Surveyor-General, (3) a Superintendent of Trigonometrical Surveys, (4) a Superintendent of Forest Surveys. These officers divide up the work so as best to administer the Department. The Surveyor-General administers the North-West Frontier and Punjab parties, and makes arrangements for all special trans-frontier detachments accompanying military expeditions and political missions out of India. The Deputy-Surveyor General has all revenue and cadastral parties under him, as well as four topographical parties. The Superintendent, Trigonometrical Surveys, administers all scientific parties, one topographical party, and the Dehra offices. The Superintendent of Forest Surveys administers all forest survey parties.

4. At the Calcutta office there are three Assistant Surveyor-Generals in charge of (1) Surveyor-General's Office and Mathematical Instrument Office, (2) Drawing and Map Issue Offices, (3) Photographic and Lithographic Offices.

5. There is an Imperial and a Provincial staff. Prior to 1895 they were known as the Senior and the Junior Branches. The Senior Branch was composed of military officers and civilians promoted from the Junior Branch for special good services. Before the reorganisation, there were 60 in the Senior Branch and 163 in the Junior Branch; the reorganisation diminished the number of posts open to officers of the Army, and added them to the Previncial Service. At present the strength of Imperial officers is 40. In the Provincial Service the grades of Extra Deputy Superintendents and 1st grade of Extra Assistant Superintendents are filled by selection, and Provincial officers filling these appointments are considered fit to be placed in executive charge of parties. Provincial officers who joined prior to 1888 can rise to Rs. 800 and a personal allowance of Rs. 200; officers joining after that date can only rise to Rs. 800; the total strength of Provincial officers is now 142.

6. The recruitment of the Imperial Service is kept up by appointing officers of the Royal Engineers and Indian Army who apply for service in the Department. There is no rule as to the proportion of Royal Engineers and Indian Army officers but, generally speaking, one Indian Army officer is appointed to three Royal Engineers. The maximum pay of a Royal Engineer officer is Rs. 1,600 as Superintendent, 1st grade. The salaries are consolidated. An officer enters the Department as Assistant Superintendent on Rs. 500. A Royal Engineer officer draws in addition the pay of his military rank, but no officer can draw more than Rs. 1,600, unless he holds an administrative post.

Recruitment of Imperial officers.

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Q.—If the Committee found it necessary to increase the number of Imperial officers, have you any suggestions to make as to how they should obtain them, and what steps it would be necessary for Government to take?

A.—Reference would have to be made to the Military Department as to whether the extra demand for Royal Engineers and Indian Army officers could be met.

7. As regards training, an Imperial officer first undergoes a course of instruction for a year at Dehra Dun, after which he is appointed to a survey party as an assistant. He should remain there for at least two years to complete his education before he is given an executive charge, but of late years owing to the paucity of officers several Royal Engineer officers have been given executive charge of parties after, and even before, the completion of their year's training at Dehra Dun. Officers should not, I consider, be placed in executive charge of parties under three years' service in the Department. This remark applies equally to Royal Engineer and Indian Army officers. There is one senior officer in charge of a party; he is generally an Imperial officer, but may be one of the 10 senior officers of the Provincial Service. With reference to the question as to how far the present establishment is in excess or defect, I consider that, for the sake of efficiency, there should be two Imperial officers with each party. At present there is only one, and some of them have had insufficient training.

8. I put in a statement, showing the designation of survey parties and the administrative officers under whom they are placed, as it stood on 14th November 1904. The last two columns of the statement show the number of Imperial officers now attached to the parties, and the number which, I think, should be attached to secure efficiency. The figure 41 in the last column is irrespective of officers required for trans-frontier and other expeditions out of India. Of these 41, five may ultimately be Provincial. At present only three Provincial officers are holding executive charges; these three have served over 34 years, and are employed as follows:—

(1) Mr. McHatton, Cantonment Surveys.
(2) Mr. Shaw, Superintendent, Provincial Surveys, Assam.
(3) Mr. A. W. Smart, in charge No. 6 Party (Bengal).

Name of Parties, Drawing offices, etc.	Locality.	Nature of operations.	Administrative officers.	Imperial Officers.	
				Now.	Should be.
No. 11 Party . . .	N. W. Frontier .	Topographical .	Surveyor-General .	1	2
„ 14 „ . . .	United Provinces	Ditto .	Ditto . .	1	2
„ 15 „ . . .	N. W. Frontier .	Ditto .	Ditto . .	1	3
„ 18 „ . . .	Punjab . .	Ditto .	Ditto . .	1	2
N. W. Frontier Drawing Office.	Mussooree .	...	Ditto . .	0	1
Simla Drawing Office .	Simla . .	...	Ditto . .	0	0
No. 1 Party . . .	Central Provinces	Topographical .	Deputy Surveyor-General	1	2
„ 2 „ . . .	Berar . .	Ditto .	Ditto . .	1	1
„ 3 „ . . .	Lower Burma .	Ditto .	Ditto . .	1	2
„ 4 „ . . .	Bihar . .	Cadastral .	Ditto . .	1	2
„ 5 „ . . .	Chota Nagpur .	Ditto .	Ditto . .	1	2
„ 6 „ . . .	Eastern Bengal .	Ditto .	Ditto . .	1	2
„ 7 „ . . .	Burma . .	Ditto .	Ditto . .	1	2
„ 8 „ . . .	United Provinces	Ditto .	Ditto . .	1	1
„ 10 „ . . .	Upper Burma .	Topographical .	Ditto . .	1	2
Assam Detachment . .	Assam . .	Traverse . .	Ditto . .		
Bangalore Drawing Office .	Bangalore .	...	Ditto . .		
Bengal „ „ .	Calcutta . .	...	Ditto . .		
United Provinces Drawing Office.	Naini Tal .	...	Ditto . .		
Assam Drawing Office .	Shillong . .	...	Ditto . .		
Carried over .	...	...	...	13	26

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Name of Parties, Drawing offices, etc.	Locality.	Nature of operations.	Administrative officers.	Imperial Officers.	
				Now.	Should be.
Brought forward .	...	...	...	13	26
Bangalore Training School .	Bangalore .	...	Ditto . .		
No. 12 Party . .	Sind . .	Topographical .	Superintendent, Trigonometrical Surveys.	1	2
No. 22 Party . . .	India . .	Astronomical .	Superintendent, Trigonometrical Surveys.	1	1
„ 23 „ . . .	Do. . .	Pendulum .	Ditto . .	1	1
„ 24 „ . . .	Do. . .	Triangulation .	Ditto . .	1	2
„ 25 „ . . .	Do. . .	Tidal and Levelling.	Ditto . .	1	1
„ 26 „ . . .	Do. . .	Magnetic .	Ditto . .	2	2
Dehra Training School .	Dehra Dun .	...	Ditto . .		
No. 9 Party . . .	India .	Topographical (Forests).	Superintendent, Forest Surveys.	0	1
„ 17 „ . . .	Bombay Presidency.	Ditto .	Ditto . .	1	1
„ 19 „ . . .	Madras . .	Ditto .	Ditto . .	1	2
„ 20 „ . . .	Burma . .	Ditto .	Ditto . .	1	2
			Total .	23	41

9. Several Royal Engineer officers are now in charge of parties who have not had sufficient training. Lieutenant Browne, R.E., who joined the Department in 1903, has been recently placed in charge of a party working on the North-West Frontier. It was preferable to employ a very junior officer of the Imperial Service to a senior Provincial officer for this party as Lieutenant Browne had seen service on the Frontier and won a D.S.O. there, and it was desirable to employ him, though he had not had sufficient training in the Department.

10. *Q.*—Do you consider that senior Provincial officers are fit or will be fit to take charge of parties, and from your experience have such officers been a success?

A.—I think officers of this class fit to be put in charge of parties have been the exception rather than the rule. Army officers owing to their military training naturally possess a better sense of discipline than a Provincial officer, who would in such a case be working with his own kith and kin; and whose orders would therefore be more liable to disregard and dispute. I would certainly prefer to place junior Imperial officers in charge of parties to appointing senior Extra Deputy Superintendents or Extra Assistant Superintendents, because the latter cannot maintain the same discipline with their subordinates. The Provincial officers who can enforce discipline are rare and difficult to find.

In the Provincial Service there were no men who could have been promoted out of turn in order to relieve the pressure on the Imperial Service, and so set free officers with insufficient training.

Recruitment of Provincial Service officers.

11. The Provincial Service is recruited by Europeans and Eurasians being statutory natives, and natives of India who have to pass a qualifying examination. The qualification for a European or Eurasian is that he should have passed the High School examination. A European or Eurasian must be between 18 and 22, whilst the limit of age for a native is 24. Candidates must be statutory natives of India. A native must have passed the F.A. examination. It was formerly the B.A. but the standard was reduced, as Bengalis only came forward, and it was desirable to secure up-country men. If the Provincial Service were increased, there would be no difficulty in getting an additional number of candidates of the same class without lowering the standard. (The number of men who have presented themselves for examination each year can be obtained in the office, also the number who passed, and for whom there were no vacancies.) Every fourth vacancy must be filled up by a native of India; they go through the same examinations as the Europeans and Eurasians. I consider that natives should not be allowed to appear at the annual examinations for the Provincial Service. They should be promoted from the Subordinate Service of the Survey Department. Occasional promotions in this way are allowed by the existing rules for exceptional good service. If the type of men employed in the subordinate grades were improved, it would be possible to fill the appointments of natives from this service alone.

12. I consider that the natives in the Subordinate Service should not be required to pass a qualifying examination, but the system should be that of pure selection for good service. No native should rise above the Sub-Assistant Superintendent grade or at most the grade of Extra Assistant Superintendent, 6th grade, on Rs. 300. By taking men from the subordinate grades they would probably never rise beyond the grade of Sub-Assistant Superintendent. The Native Provincial officers now in the Department can rise to any position in the Provincial Service, but are unfitted for the higher grades. Time will prove the truth of this statement. At present the natives that have been admitted have not yet risen above the grade of Extra Assistant Superintendent, 6th grade.

The President pointed out that in other Departments of the Government Service, natives rose to a position in which they could be put in charge of districts; they could become District Superintendents of Police and Judges.

Q.—How do the natives in the Provincial Branch of the Survey of India compare with other Provincial officers?

A.—It depends on what part of India the men come from. The most successful candidates are Bengalis, owing to their superior educational qualifications, but education alone does not make a desirable survey officer, and Bengalis are better fitted for sedentary pursuits.

13. I am unable to answer the enquiry put by Sir J. Farquharson as to the social position of the natives who join the different services of Government.

The effect of the reduction of the educational standard from B.A. to F.A. cannot yet be gauged, as it has not had time to work; probably there would be no difference in the educational qualifications needed for the survey profession, as distinct from other branches of the Government service. I do not think there is much difference between the social position of those who are promoted from the subordinate grades and those who enter the Provincial Service by competition. By the rules, as they stand, the Surveyor-General is practically compelled to promote an inferior Provincial officer, if there is no glaring report of inefficiency against his name, otherwise he would have a grievance. If natives were not promoted to grades above that of Extra Assistant Superintendent, 6th grade, they would also consider they had a grievance.

14. *Iman Sharif Khan*, the senior native in the Provincial Service, was promoted from the Subordinate Service, after 20 years in that service; he had done some excellent work on the frontier. I can give no particulars as to his abilities. I do not know him personally. He is a north-country man.

Examined as to the native officers at present serving in the Provincial Service.

Aulad Hussain, joined as a computer at Dehra Dun, and entered the Provincial Service by competition: he was in several parties. He is a high class mathematician, but of no use for out-door work; is not a B.A.; he is a north-country man, and is now back again in the Dehra office.

Rahmat Ullah joined as a computer, and entered by competition; he has never worked under me.

Nilmoni Chatterjee, a Bengali, entered by examination. He was placed in charge of the Godavari Detachment. So long as he had only three or four traversers to supervise, he conducted the work satisfactorily, but as soon as the *amins* arrived to take up the detailed survey, he went sick. He has been recently transferred from the Godavari to the United Provinces.

Amar Singh entered the Department by examination. He is a north-country man; he has done very well, and is a better class of man than a Bengali, and is now in charge of a Forest Survey Camp. I have asked the officers in charge of parties to report on the Native Provincial officers working under them. Their replies will be put at the disposal of the Committee.

15. I do not think that natives compare unfavourably with the Provincial Europeans and Eurasians. It is very difficult to find out how a native entering by examination is going to turn out, even after the usual period of probation. Some natives have been rejected before the completion of the probationary period. The length of probation is one year at Dehra Dun, and one year in a field party.

Transferring natives from one part of India to another does not affect them, since they are liable by the rules for service anywhere, though naturally they would prefer to work in their own country.

16. The strength of the Subordinate Service is not fixed; the numbers vary according to requirements. Sub-surveyors are first enlisted as probationers on the temporary establishment, and they are only brought on the permanent list, if they have worked well, whilst in temporary employ. Their service counts towards pension from the beginning of their temporary service, if they are subsequently made permanent. The officer in charge of a party sends his recommendations annually to the Surveyor-General regarding the pay and promotion of surveyors and sub-surveyors. There is no hard-and-fast rule, but an increase of salary is generally given after every third year of approved service. The sub-surveyors are picked up wherever they can be found and trained by us; they are frequently relations of other sub-surveyors. They are started on salaries of from Rs. 12 to Rs. 15. After five or six years they may get to Rs. 20 or Rs. 25. Then if they have worked well, they are recommended for transfer to the permanent

Examined regarding the Subordinate Service.

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establishment, and receive from Rs. 25 to Rs. 100. There are no fixed grades. The surveyors and sub-surveyors on the permanent list now number about 200, and those on the temporary list about 300. If educational qualifications were insisted on, and a hope held out of subsequently entering the Provincial Service, a better class of men might be recruited both as sub-surveyors and draftsmen. Educational centres have been tried, but without success, for the native students find they can get better pay elsewhere in other departments. Unless the Survey Department offers higher pay, it will be difficult to get educated men. In order to get natives who have passed the school final examination, it would be necessary to offer Rs. 25 to Rs. 120. At present the rates of pay are left at the option of the Surveyor-General.

Colonel Longe explained that in this matter the Surveyor-General had the powers of a Local Government, but it has been customary to consider that the maximum to be given is Rs. 100.

17. I would prefer, even if higher pay were offered, to keep the men as probationers on the temporary list for 5 or 6 years, to see how they shaped, whether they had energy and aptitude for their work. The natives we recruit as sub-surveyors and draftsmen are not as good as they should be. The right class of men cannot be got without offering higher pay. Our budgets are cut down, and in order to turn out work cheaply, we are compelled to employ natives on low rates of pay, though the best plan would be to try colleges with a view to getting educated natives, and offer better openings in the Department. I would promise them permanent employment, if they proved satisfactory after a probationary period.

It was pointed out to witness that Major Crichton had said the number of candidates was eight times the number that could be employed.

Q.—Would you offer permanent employment without a period of probation?

A.—No. I do not like that.

Q.—But you must offer something. You must give them certain definite prospects, if you want a better class of men.

Colonel Longe said that if advertisements were put in the Gazette offering such and such rates of pay, no doubt there would be hundreds of applications.

A.—The colleges should be asked to devote some time to teaching natives map drawing as well as plan drawing. It is important that sub-surveyors and even draftsmen should know English; at present the majority do not.

18. Draftsmen are paid too little. A student leaving a college often gets Rs. 40 to Rs. 60 in the Public Works Department as a draftsman. The Survey Department rates have lately been raised; men now get Rs. 10 or Rs. 12, and directly they can draw fair maps, their pay is raised to Rs. 25 or Rs. 30. The fixed establishment at the Calcutta and Dehra offices start on a salary of Rs. 6 which is a ridiculous salary to offer a draftsman. In the Calcutta and Dehra offices the junior section of draftsmen get from Rs. 6 to 15, and the senior from Rs. 25 to Rs. 120, *i.e.*, natives. Europeans get Rs. 50 to Rs. 300. At present the native draftsman gets less than in other Departments, such as the Public Works Department. We cannot induce students to remain with us owing to the low salaries offered.

Colonel Longe explained that there is no such thing as a draftsman in the country; he has to be trained.

19. Map drawing as well as plan drawing should be part of the curriculum of our colleges, where the Government of India should encourage instruction in the art of map drawing and so educate students as draftsmen. At present plan drawers get Rs. 60 to Rs. 70 in the Public Works Department and other Departments straight away. Since they are generally taken on temporarily, their chances of getting permanent employment are less. The Department has been trying to get these students from colleges with offers of higher pay, but as we do not offer sufficient pay at starting, they cannot be induced to come or else they leave us soon after joining; besides they are not map drawers and have to be trained. The draftsmen on a pay of Rs. 300 are not very superior to native draftsmen; they are simply European or Eurasian draftsmen and not in the position of superintendents: they might well be abolished. Sub-surveyors in topographical parties are generally required to draw their own fair maps during the recess. On this account they seldom get any leave.

20. There are very few parties with soldier surveyors except on the Frontier. Soldier surveyors are generally too thick-fisted as draftsmen. Soldiers get two years' training at Roorkee which enables them to carry on a route survey with a compass or plane-table. They would probably be more efficient as surveyors with longer training in the Survey Department (five years perhaps).

Questioned as to soldier surveyors.

21. *Q.*—If it were decided to suddenly increase the Provincial establishment, how would you grade the men brought in so as to minimise the difficulties that would arise as regards stagnation of promotion?

General.

A.—It would be quite possible to give them certain rates of pay after a certain number of years' service, but I would not recommend it.

Q.—Could you not take men for an ordinary term of years as a commercial firm does? Say that there would be no pension, but that there would be a higher rate of pay,—would they come in that way, if you are taking on men for a special programme?

A.—No. There are no surveyors or draftsmen capable of making maps in the field and then fair drawing them, in the open market in India. We have to train all our own men. Europeans from home would not do at all, because they would be very expensive, and would know nothing of the customs and languages of the country; besides our methods of work are somewhat different from those in vogue in Europe.

Questioned by Colonel Kelly regarding officers and surveyors accompanying armies on active service.

22. On active service the placing of surveyors under the immediate orders of the General commanding the troops is a mistake. I think the Intelligence Branch should have nothing to do with mapping.

The senior survey officer with an army in the field would, of course, be under the orders of the military commander, and should be nominated as a member of his staff, but all survey officers and subordinates accompanying brigades or detachments of an army should receive their orders from the senior survey officer. What I mean to imply is that whilst survey officers and subordinates would carry out surveys, whenever and wherever required for military requirements, military staff officers should not be allowed to interfere with the methods, and principles on which surveys are usually conducted by survey officers on field service. Our surveyors should not be told off to undertake route surveys, which is the work of the Intelligence Branch. The duties of a survey officer with an army in the field are mainly confined to the making of geographical maps of the theatre of operations. Route surveys undoubtedly assist in the compilation of such maps, but owing to the want of training in geographical work at our military colleges, route surveys conducted by officers in the Army are difficult to locate with any degree of accuracy on a geographical map, unless they are supervised by professional survey officers in the field.

As an instance of the difficulties which arise, I may mention that during the annexation of Upper Burma, when I was senior survey officer, a surveyor was sent out by the military staff to do route surveys contrary to my instructions. I complained and asked that the surveyors should be directed to do only such work as could be correctly located on a map. At the conclusion of the military operations this surveyor was compelled to go over the whole ground again before his work could be utilized. This would have been avoided, if the staff officers had not interfered.

Examined regarding the Survey of India maps.

23. Our standard maps are published on the scale of 1 inch=1 mile. They are drawn in the offices of survey parties, and submitted for approval before publication to the administrative officers who decide whether they satisfy the standard of quality. No particular outturn is called for; it varies according to the strength of a survey party, and the nature of the country to be surveyed. The officer in charge of a party knows the country and what the men can turn out, and makes out an approximate programme annually which is generally carried out. There is a weekly return of what each surveyor is doing. These are submitted to camp officers who send in reports to the officer in charge, who again sends in a monthly progress report to his administrative officer. I produce specimen forms* of these reports. I think the estimate made last year by the Departmental Committee of the cost of an average survey party is fair. I would prefer to answer questions on this point after receiving the answers to certain questions I am circulating as to averages for the past five years.

* Note.—Specimens are attached to the evidence.

24. *Q.*—Do you think it affects the estimate that the survey should be on the 2-inch scale?

A.—No.

Q.—Would you recommend the 2-inch scale everywhere for topographical survey, whether hills or plains? Do you think the cost would be any greater than on the 1-inch scale?

A.—No. I do not think it would make any material difference in the cost, and a man can work just as fast on the 2-inch scale as he can on the 1-inch. For field work the 2-inch scale of survey is preferable in every sense to the 1-inch scale which should be abolished. I speak from considerable experience in work conducted on both scales of survey. Our standard maps should continue to be published on the 1-inch scale, but the scale for field work should be 2 inches=1 mile.

Examined regarding cadastral surveys in the various Provinces.

25. In Madras and Bombay the Imperial Survey Department has taken no part in cadastral surveys which have been undertaken by local establishments.

26. In the Punjab, cadastral surveys were conducted by the Survey Department up to 1889. Since then they have been carried out by local agency on primitive methods known as the "square system." The local agency village maps are being utilized by reduction in the compilation of topographical maps, but their work has to be checked and supplemented by us in the field. Some sheets have thus been completed in the Punjab, but there are large arrears of work remaining. Many districts have been cadastrally surveyed, but the maps await reduction and supplementary survey before topographical maps can be compiled. There is only one survey party in the Punjab. Until another party commences work in the Province, it is impossible to bring out topographical maps of these districts at a reasonable date.

27. In the United Provinces there is a Superintendent of Provincial Surveys, or in other words, of cadastral surveys, who belongs to the Imperial Department. He is assisted by six or seven Provincial officers. Original cadastral surveys in these districts are drawing to a close, and the work is now mostly restricted to the revision of cadastral maps in Hamirpur and Banda, which is, strictly speaking, not work for the Survey Department but for the Land Records Department. The Superintendent is subordinate to the Director of Land Records. All cadastral surveys are paid for from local revenues, but traversing is an Imperial charge at the rate of Rs. 30 per square mile traversed. A drawing office is compiling maps from

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these cadastral surveys, but the work is much in arrears due to insufficient establishment. All these maps should be tested and supplemented in the field, but there is no establishment for taking up this work.

28. In Bengal, there is also an Imperial Superintendent of Provincial Surveys who is not subordinate to the Director. He works under the Board of Revenue. No monthly returns of work are received by me from Bengal. The Survey Department exercises no control over the programmes of, or the expenditure on, cadastral surveys in the United Provinces or Bengal; the Deputy Surveyor-General only sees that they are conducted on professional lines. The expenditure in Bengal does appear in the Survey of India Budget.

29. In the Central Provinces two Provincial officers have been employed for some years past by the Land Records Department, and one is still so employed. The Survey of India had no concern with them. These officers were seconded.

30. The officers employed on cadastral surveys in Bengal, the United Provinces and Assam are not seconded; the Department cannot employ other officers in their places. If Local Governments extended their cadastral operations very much, this would hamper the topographical work of the Survey Department. There is a fixed establishment, and if Local Governments take more of our men, there are necessarily fewer left for other work of the Department. The only Provincial officers seconded are eight in Burma in the Land Records Department, and one officer in the Central Provinces. There are no disadvantages in seconding, for the officers seldom return to the Department, and other men take their places. It would be preferable to get rid of the men employed by Local Governments from our rosters. They are only employed on cadastral work, and should they ever return to us, they are bound to have lost a good deal of their professional knowledge, and contracted slack habits.

31. In Burma cadastral surveys are conducted entirely under the supervision and control of the Imperial Survey Department, but no record writing is done by us. The maps are then printed and made over to the settlement officers. All original cadastral surveys in Burma are done by the Survey of India, and charged to the Government of Burma. The Land Records Department undertakes extension surveys, where fresh cultivation is started.

32. Undoubtedly in all alluvial tracts, devoid of hills and undulating country, there must be a gain in utilizing cadastral surveys, especially those that have been conducted by professional agency, but every map so compiled should be looked upon as a preliminary issue, and requires checking in the field and supplementary survey in a greater or less degree, before it can be accepted as a final standard map, embracing military and general requirements. The saving effected by utilizing cadastral material in the compilation of topographical maps, as contrasted with the cost of a resurvey of any area is a moot point and not easy to get at. Undoubtedly it depends on the character of the country—in Bengal there must be a gain in utilizing such material, also in the Ganges Valley, the United Provinces and the Doabs of the Punjab.

Questioned regarding the utilization of cadastral material for topographical maps.

Q.—Would it be possible to lay down any criterion as to where economy ends and extra expenditure begins, and is there any gain in accuracy?

A.—In the Central Provinces the Department endeavoured to use some village maps done by local agency which were found to be totally deficient in topographical detail, and which were of no use whatever, except for laying down village boundaries. I am collecting some data from executive officers in charge of parties on these points to lay before the Committee.

33. Topographical maps are generally published during the year after survey, but a great deal depends upon the block in an office owing to the existence of arrears, and the strength of establishment to deal with them.

Examined regarding the publication of maps.

Q.—Major Crichton says his standard maps compiled from cadastral surveys should be got out in two years after survey, but he hopes to reduce the figures by six months. Do you accept that?

A.—Yes, now that he has got together the drawing establishment needed to deal with the work.

Cadastral work does not at all delay the publication of topographical maps in Burma. I do not think there are older districts in the United Provinces than Meerut. In the United Provinces, the delay in bringing out standard maps was due to the fact that no Drawing office was established for the compilation of such maps till five years after the cadastral surveys had commenced. The Department has hardly ever done traversing for purely topographical work. All traversing has been done for future cadastral surveys over cultivated areas.

34. *Q.*—Traversing in the United Provinces costs Rs. 30 a square mile, while the cost of a topographical survey may be as low as Rs. 25?

A.—We only resort to traversing in topograpical surveying where triangulation is impossible, and that is seldom the case.

Q.—If you are simply doing topographical survey, would you dispense with the whole of that Rs. 30 for traverse work, or would there be any traversing work to be done?

A.—Where no previous traverses have been carried out, we should in the plains have to run a certain number of traverses to supply fixed points for the plane-tablers, but the cost of these traverses would be far less than those necessary for cadastral surveys.

35. *Q.*—Should cadastral surveys always be preceded by traversing?

A.—According to modern ideas of cadastral surveys, I think they should undoubtedly be based on traversing.

36. *Q.*—Do you think there would be any advantage in trying to get cadastral work that is still shown in the estimates as chargeable to the Survey of India, and is then transferred, taken out of the budget?

A.—I think it would be a distinct advantage to distinguish fiscal surveys from other survey and scientific work. This would tend to minimise mistaken ideas as to survey expenditure.

Examined regarding the proposed decentralisation of the Department under three Deputy Surveyors-General.

37. The scheme recorded in Colonel Longe's notes for the Survey Committee as Colonel Gore's scheme was really drafted by myself. I advocated it six or seven years ago, when I first came to the Calcutta office. I have frequently brought to notice the necessity for increasing the administrative staff and for decentralising the Drawing and Map Issue offices. I think Mr. Fuller's suggestion regarding an annual conference to fix the survey programme in a province a very good one, but practically administrative officers have hitherto always consulted Local Governments as to survey programmes. If three Deputy Surveyor-Generals are appointed, it would be quite possible and an advantage for them to take over the control of forest surveys in their respective Circles.

Transfer of offices from Calcutta to Dehra.

38. I think the objections to the transfer of the offices from Calcutta to Dehra Dun insuperable on the score of expense, and nothing would be gained thereby. The climate of Dehra is not much better than Calcutta, and fever is very prevalent. The surroundings are unsuited for the training of junior officers and subordinates. The climate of Calcutta is bad no doubt for map reproduction, but I do not consider it affects the efficiency of the engravers. What is wanted for a Photographic-Lithographic office is a dry climate like Poona, or Bangalore.

Extra-departmental work.

39. There is no doubt maps would be published much quicker, if there was no extra-departmental work. It cannot be altogether excluded, as for instance, irrigation, military, and railway maps. The Department should have nothing to do with the illustrating of books reproducing Gurmukhi manuscripts, and work of a similar description. It might be possible to get such work done at Poona, and also a certain amount in England. I cannot say if refusal by the Department to do such work would lead to private enterprise coming forward. Extra-departmental work should not be allowed to interfere with the work of the Department. If a separate office were started for extra-departmental work, it should not be in Calcutta. I cannot say if this would lead to a large initial outlay. The Drawing office is also inflicted with all kinds of extra-departmental work which is often the most troublesome.

40. There is no objection to a Local Government bringing out ½-inch district maps. No rule has ever been laid down that the Department should produce maps of only certain scales previously fixed. We are asked to supply maps on all conceivable scales.

Sir J. Farquharson explained to the Committee the methods employed in England.

41. Maps in connection with military manœuvres must also be done by this Department. Nobody complains of the size of the sheets, $31\frac{1}{2}'' \times 27''$. I consider that an early effort should be made to publish standard sheets in a completed form, *i.e.*, full up to graticule limits. At present there are many sheets in a fragmentary state, and these give endless trouble in the Map Issue office. These fragmentary surveys have only to be put together to make the standard sheets complete, but at present there is no establishment available to undertake this work.

Employment of officers by Local Governments.

42. I wish to add a few remarks which, though they do not apply to the subject of topographical maps, do affect the organisation of the Department. I refer to the depletion of officers due to their employment by Local Governments on Land Records and other Provincial work. At present the following officers are so employed:—

	Imperial officers.	Provincial officers.
United Provinces	1	7
Assam	...	2
Burma	...	8
Central Provinces	...	1
TOTAL	1	18

The eight Provincial officers in Burma, and one in the Central Provinces are seconded, and others have been recruited to take their places, but their names are still borne on the departmental rosters.

The one Imperial and nine Provincial officers in the United Provinces and Assam are not seconded, and the departmental establishment is consequently deficient to this extent.

The officers in the United Provinces are now principally engaged in the revision of cadastral maps, an employment which has hitherto been considered as essentially the work of the

Col. J. R. Hobday.

Land Records Department; while one Provincial officer is engaged on road surveys for the Public Works Department and on municipal surveys.

In Assam the two Provincial officers have been almost exclusively employed on Land Records work.

43. In 1897, my predecessor Colonel Sandeman urged the necessity for creating establishments in all Provincial Land Records Departments for the up-keep of cadastral maps and records, and pointed out that without such maintenance, a resurvey will be inevitable at the next settlement of every district. Since then I have on several occasions brought this subject to the notice of Local Governments; but with the exception of Burma, no Province, to my knowledge, possesses a Land Records staff capable of carrying out this important measure with any pretence to efficiency, and the question has generally been shelved.

I wish, therefore, to urge the desirability of instituting an enquiry on the organisation and working of the Land Records Departments in every Province with a view to settling the following questions once for all :—

(1) Whether it is practicable or desirable on the plea of economy to organise establishments and establish survey schools, and thus strengthen the Land Records staff for the efficient maintenance of cadastral maps, as recommended by Colonel Sandeman.

(2) Whether it is not possible to put an end to this demand by Local Governments for the services of our officers for Land Records work.

As regards (2), I propose that Revenue officers who are intended for future employment in Land Records Departments should, at the commencement of their service, be attached to our cadastral survey parties for a three years' course of training in cadastral surveying and record writing, and be paid for by Local Governments, while under such tuition.

Necessity for professional control in cadastral surveys.

44. Another matter which I wish to impress on the Committee is the harm that has been done in the past in handing over survey work to amateurs; and starving the Survey Department. It is only of late years that it has been possible to examine and form an opinion on such work, and show that it has proved to be a false economy. In the Punjab, for years past, we have been called on by that Government to endeavour to patch up, and reconcile discrepancies due to the primitive methods of survey by local agency that are in vogue in that Province, and we are still sinking money in this futile attempt. Compare the cadastral maps of Madras and Bombay or of the Central Provinces under the control of the Local Government with those that have been executed by the Survey of India. To vindicate my statement I would mention that the Bengal Government commenced to undertake surveys under amateur supervision, but soon found that they could be done cheaper and better by professionals, and have now wisely decided that all cadastral surveys are to be carried out by the Imperial Survey Department.

Necessity for a history of the Department.

45. There is also a great need in the Department for a full and clear chronological history of topographical, and of revenue surveys, including Land Records surveys, province by province. The only extant works we have on the subject are the editions of "Indian Surveys" by Markham and Black, but they are mere outlines, and only deal with the subject in a general and perfunctory way, and are of very little practical use departmentally or as books of reference, whilst they are deficient in information of vital importance. I venture to think that had such a history been available, the labours of the present Committee would have been considerably facilitated.

O.$\frac{45.}{47.}$

SURVEY OF INDIA.

Col. J. R. Hobday.

*Progress Report of*_____*for the month of*_____*190* .

Plane Table No.

Sq. miles.

Area previously surveyed on this table. Blue wash or

Area surveyed on this table during the month under report. Red wash or

Total area surveyed on this table

N.B.—A sketch map should be drawn above showing names and positions of the more important towns, rivers and roads. The position of the Surveyor's camp at the time of the submission of the Report should also be indicated. The area surveyed should be coloured or shaded as directed above, and the area expected to be done during the following month by a yellow wash or

Return of Work.

	Dates.		Days.					Work during the month.				
	From	To	Work.	Sick.	Sunday and holiday.	Marching.	Total days.	△ n No. of Stations.	Traverse No. of Stations.	Detail " Sq. M.	Detail " Sq. M.	Testing Linear Miles.
Already reported												
During the month												
Total up to date .												

I hereby certify that the above is a true statement of the work done by me; that on working days I have worked for at least 8 hours each day; that I have inked up my plane table section regularly; that I have entered all names in my village list in ink daily; that I have been in correspondence with the adjoining plane tablers; and that I have generally carried out all orders to the best of my ability.

Read carefully before signature.

*Camp*_____

*Dated*_____*190* .

Survey.

Note.—This return is sent by the Surveyor to the Camp Office.

SURVEY OF INDIA.

Col. J. R. Hobday.

Journal No. *Party* ( ), *from* *to*

Month and Date.	Where encamped.	No. of hours at work in the field.	No. of Traverse stations observed at.	Distance traversed in chains.	Number of P. T. stations.	How occupied.
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

N.B.—Entries to be made daily.

Dated 190 . } *No.* *Party* ( ).

SURVEY OF INDIA.

Report Progress of No. *Party (* *), for the month of* 190 *, dated* 190 .

Executive Establishment. Names and Grades.	Dates.		Days.					Work in Miles during the month.					Total Work in miles up to date.					Employment during the month.	Proposed Employment during following month.	General Remarks.
	From	To	Work.	Sick.	Sunday and holiday.	Marching.	Total Days	Δn	Traverse.	Detail "	Detail "	Testing.	Δn	Traverse.	Detail "	Detail "	Testing.			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Superintendent in Charge.																				
Programme of season's work.								Area completed up to date.										Area remaining to complete.		

Testing.—Examination by check line or *in situ*, if regularly done.

Superintendent,
In charge No. *Party (*).

Note.—This return is submitted by the Camp Office to the Executive Officer. A similar return is submitted by the Executive Officer to his Administrative Officer.

O. 71.

SURVEY OF INDIA.

Return of Mapping performed by No._____ Party (_____) during the month of_____ 190 .

STANDARD MAPS.

Scale "=1 Mile.

Sheet Numbers.		Projected and plotted.	Traced.	Typed.	Outline inked.	Hills inked.	Borders, headings, and footnotes.	Examined.	Date of submission for publication.
Sheet .	During month								
	Present state								
Sheet .	During month								
	Present state								
Sheet .	During month								
	Present state								
Sheet .	During month								
	Present state								
Sheet .	During month								
	Present state								
Sheet .	During month								
	Present state								

Original P.T.Sections.

Finishing.	Date of sending to Head Quarters.

TRIANGULATION OR TRAVERSE CHARTS.

Scale "=1 Mille.

Sheet Numbers.		Projected and plotted.	Printed or typed.	Rays inked.	Borders, headings, and footnotes.	Examined.	Date of submission for publication.
Sheets .	During month						
	Present state						
Sheets .	During month						
	Present state						
Sheets .	During month						
	Present state						
Sheets .	During month						
	Present state						
Sheets .	During month						
	Present state						
Sheets .	During month						
	Present state						

DISTRICT OR DEGREE SHEET MAPS.

Name of District or Degree Sheet Numbers.	Scale "=1 M.	Projected and plotted.	Traced.	Typed.	Outline inked.	Hills inked.	Borders, headings, and foot notes.	Examined.	Date of submission for publication.
	During month								
	Present state								
	During month								
	Present state								
	During month								
	Present state								
	During month								
	Present state								
	During month								
	Present state								
	During month								
	Present state								

N.B —If any maps are returned from Head-quarters for correction, the date of their receipt in your office and the nature of the corrections to be carried out should be reported here below, and the progress of such corrections is to be reported every succeeding month until the maps are resubmitted for publication.

Any arrears of mapping or computations are also to be reported.

_____ 190 .

Superintendent,

In charge No._____ Party (_____)

NOTE.—This return is sent by the Executive Officer to his Administrative Officer.

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SURVEY OF INDIA.

Col. J. R. Hobday.

*Examination Report of Sheet No.*_____

Stage ( ) of P. 73.

*Scale*_____ *Season*_____

	1	2	3	4	5	6
A						
B						
C						

Section Number and Letter.	Remarks and signature of Examiner.	Orders and signature of Officer in charge of Section or Executive Officer.	Corrector's initials and date.

NOTE.—This form is used in the recess offices of field parties for each *stage* in the examination of a fair map.

Col. J. R. Hobday. P. 73.

SURVEY OF INDIA.

*Examination Register of Sheet No.*_____

Stages in the preparation of maps.	Signature of draftsman or typer and date.	Signature of Examiner and date.	Signature of Officer in charge of section and date.
(1) Projection of Graticule and rectangular Co-ordinates.			
(2) Plotting of trigonometrical and traverse points.			
(3) Inking in trigonometrical points, and village trijunctions.			
(4) Tracing or transferring details in pencil.			
(5) Adjustment of edges with adjoining sheets.			
(6) Inking in town, and village sites.			
(7) Typing district, pargana, forest reserve names, etc.			
(8) Typing town, and village names, and heights, bench marks, &c.			
(9) Inking in roads, rivers, railways, water courses, edges of cultivation, boundaries, etc.			
(10) Typing, and drawing minor symbols, river and stream names.			
*(11) Hill shading, or contouring and broken ground.			
(12) Finishing borders, headings, footnotes, references, scale, area statement, index to adjoining sheets, etc.			
(13) Final examination.			

* When maps are drawn in two colours, the hill sheet which is drawn separately, may be commenced after (9), the rivers and streams being traced from the outline sheet, and inked in very faint blue lines; spaces to be marked in pencil, where the village names and heights fall. The same quality of paper to be used, as for the outline sheet.

*Date*_____

*Map passed by*_____

Officer in charge of $\frac{\textit{Party}\ (\quad)}{\textit{Drawing Office.}}$

NOTE.—This form is finally pasted on the back of every fair map as a record to show who it was drawn by

Lieutenant-Colonel F.B. Longe, R.E., Surveyor General of India, and Member, Indian Survey Committee.

Lieut.-Col. F. B. Longe.

[Calcutta, 8th February 1905.]

Scales of maps issued by the Survey of India.

1. The Surveyor General has absolute discretion to accept or refuse demands by Government officials for maps on any scale, provided in case of acceptance, the work requires no special establishment to carry it out, and he has the material for preparing the map in his office. To my knowledge no orders have been issued as to the scales on which the Survey Department should publish its maps. I believe the matter has hitherto been left to the discretion of the Surveyor General. The quarter-inch map or Atlas of India dates back to the beginning of the last century. No doubt the matter of scale was decided in consultation with the proper authorities at the time the Atlas was commenced. As regards standard sheets on the 1-inch scale, when a survey is decided on, the scale of the map is discussed with Government. There has never been any systematic survey for the preparation of a map of India on any one scale. The whole system has been patch-work. As regards the Sind map on the half-inch scale, the question of scale was discussed with Government. Such points would come up when submitting the yearly programme of work to Government for sanction. As regards general maps of India, I have never heard of any special orders from Government as to whether the scale should be $\frac{1}{4\frac{1}{8}}$" or $\frac{1}{6\frac{1}{4}}$", etc.

2. The $\frac{1}{1,000,000}$ map was discussed at the Seventh International Geographical Congress in 1899. It is a portion of the map of the world which has, I believe, been undertaken by every European nation within its territorial limits. The commencement of this map was certainly mentioned to Government.

3. The various general maps are prepared in accordance with the requirements of the country. In Upper Burma maps were prepared on the $\frac{1}{8}$" scale, because there was not sufficient material to prepare maps on the $\frac{1}{4}$" or any larger scale. This is the case also with regard to parts of Persia. The general maps of India are prepared from existing maps on larger scales. Some have been prepared by photo-zincography and some are engraved. I shall submit a list of all the small scale maps which are prepared.

4. If it is decided to make a general topographical map of India, I would recommend a scale of 1" = 1 mile. My reason is that a map on a smaller scale is of little practical value, while the cost of a larger scale map of the whole area would be prohibitive. In Burma the topographical surveys are being carried out on the 1" scale for publication on the same scale. The Department has never surveyed for topographical maps on a smaller scale than 1" = 1 mile, though in the deserts of Rajputana and in Baluchistan and on the Frontiers generally surveys or reconnaissances have in part been made, and maps have been published on the $\frac{1}{2}$" or $\frac{1}{4}$" scales. There are other places which have been surveyed on the 2" scale, and the resulting maps have been published on the 1" scale. In Baluchistan triangulation was regularly done in advance. The Military authorities are, I believe, considering the question of resurveying the whole of Baluchistan and the Frontier on the 1" scale. I object to this on the grounds that such a scale would give very little more information than is already shown on the $\frac{1}{2}$" maps, and it would be a waste of money to do it. If it were done at all, the survey should be on the 2" scale. The Department does not publish $\frac{1}{2}$" maps from 1" surveys. Ordinary topographical parties survey on the 1" for publication on 1". This is the usual rule, but there are several exceptions in which 2" surveys have been carried out, specially in the Bombay Presidency and in Allahabad. In the case of Allahabad the villages were so small that the boundaries could not be shown on the 1," and so the maps had to be published on the 2" scale.

Scale of survey.

5. If it is decided to publish a topographical map on the 1" scale as a general rule, I would strongly urge the survey of the mass of the country on the 2" scale for reduction. But there are large areas in the hills and in quite unopened country where this would be too expensive, and also where no more information could be got on the 2" than on the 1" scale, besides which there are difficulties in getting about such country. In the Lushai hills and in many parts of Burma and Assam the jungle is impenetrable. These remarks would not apply to Chota Nagpur, which is thickly populated. My chief reason for mentioning these tracts is that they are sparsely populated, there is no trade, and the roads are few and far between. I am referring to the surveys of the present time. Such areas should be surveyed on the 1" scale and published on that scale, even though the maps may have to be supplemented in future by a larger scale survey as the country becomes opened up.

6. Where the survey is done on the 2" scale, I would agree to recommend that an arrangement should be made for making maps available on that scale, if there is a special demand for them, but I would not publish regularly on the 2" scale, as I would almost always draw such maps for reduction to the 1" scale. The reproduction would be carried out by the process most suitable and economical at the time.

7. I do not agree with Colonel Hobday that the 2" survey is not more expensive than the 1". I consider a 2" survey is considerably more expensive than a 1" one; but it depends very much on the nature of the country. In the case of certain countries, especially flat countries, where traversing forms the basis of mapping, there would be very little difference in the expense, but the moment work begins in hilly or intricate country, where the work has to be done by

Lieut.-Col. F. B. Longe.

plane table intersections from trigonometrical points, the expense would be considerably greater. This is a matter I should like to explain to the Committee in more detail a little later.

Cost rates of topographical survey.

8. I produce figures showing the difficulty of arriving at any exact conclusion as to the cost of a topographical survey in different classes of country. The cost of triangulation in Sind for the 2″ scale works out to Rs. 5-6-0 per square mile for 7,656 square miles; the cost of traversing in Sind on the 2″ scale works out to Rs. 11-5-0 per square mile for 19,880 square miles; the actual topographical survey on the 2″ scale works out to Rs. 14-7-0 per square mile for an area of 17,485 square miles. The smallness of the area triangulated is due to the fact that in some countries, such as parts of Sind, triangulation is not suitable as a basis for topographical survey, and traversing has to be resorted to. The approximate cost of a topographical survey on the 2″ scale in Sind is Rs. 27 a square mile, omitting triangulation. No. 15 Party working in Sind on the 1″ scale surveyed chiefly in the hills approximately 10,000 square miles at Rs. 17-2-0 per square mile all told.

The total cost of the 1″ survey of Mysore was Rs. 9,07,626, which comes to a mileage rate of Rs. 29-5-4 for the whole area surveyed. That includes drawing the maps. The Mysore figures include 84 square miles on the 4″ and 57 square miles on the 12″ scale. The average mileage rate was enhanced by the slow progress of survey during the first three years, owing, I believe, to famine, and to the men being not fully trained. The Mysore map was surveyed and published on the 1″ scale. The actual plane-tabling was carried out mainly by Provincial service officers on comparatively high pay, yet the cost rate is not high, and tends to show that cost is not necessarily proportionate to the pay of the surveyor, and that it is advisable to search for a better class of man rather than to increase the number. I have more to say on this subject later.

The cost of topographical work in the Shan States varied from Rs. 11-8-0 to Rs. 40-7-0 per square mile.

9. Rupees 30 per square mile would be a fair rate for the whole of India for topographical work including triangulation, and traversing on the 1″ scale. This includes drawing. The corresponding figure for the 2″ scale would vary enormously; in easy ground it would probably be Rs. 45; in difficult ground it might be as much as Rs. 90. Survey on a 2″ scale is impracticable in large areas of India owing to impenetrable jungle where the outlay would be prohibitive, owing to physical difficulties. I do not think there would be much difference in the amount of detail shown on the maps of such areas in Burma, whether the survey were made on the 2″ or 1″ to the mile scale.

Contours.

10. I think the new 1″ maps should be regularly contoured. Better resultant maps should thus be obtained than even those of the present Burma series. Contours should in the plains and in minor hills be at 50 feet intervals. It would not be possible to show 50 feet contours on the 1″ scale in the steeper hills, and an interval of 100, 150, or 200 feet in accordance with the ground would have to be selected, with some footnote on the maps explaining the fact. I would not recommend changes in contouring at definite heights above sea-level. The ground levels of large areas of India are very variable, and no one rule could well be made applicable to the whole country. For instance, if we said that above 3,000 feet contours should be at 100 feet intervals, we should have practically no 50 feet contours in the undulating ground in parts of Mysore, or in the Quetta plains, or in the Shan States. I suggest that the matter should be held over for discussion at a later stage. As the country varies so much, it would be better not to lay down a hard-and-fast rule.

Hill shading.

11. As regards hill shading and the difficulty of reading maps, I would adhere to the shading of hills in brown. I would gradually redraw the whole of the maps, even the 1″ maps which have the contouring practically correctly shown but in black. This should be done when the time for revision comes round. As a matter of fact, there has been an enormous variety in the style in which the maps have been drawn and even surveyed. Formerly all names were hand-printed, as in the Mysore maps. Now the names are typed. I would strive to get a uniform style for the whole series of 1″ maps of India. I accept the Burma pattern generally. My plan would involve redrawing every 1″ map prepared before the Burma pattern was adopted, but, as the maps will mostly require heavy revision, this would generally be necessary in any case. I consider there should be a vastly greater number of levels through the country. Good photographs cannot be obtained of the older maps, which have got dirty and stained.

Method of reproduction.

12. As to the question whether I should propose to continue the publication of the 1″ standard sheets when redrawn by photo-zincography, I have never thought of anything else but photo or helio-zincography for maps on this scale, but I should prefer to have the final maps engraved. I would publish the revised maps at once in any case by photo-zincography or helio-zincography. I infinitely prefer an engraved map to any other, but the question of cost and time is very important.

Levels.

13. It is not possible for me to come to an immediate conclusion as to the number of spirit levels which should be shown on a standard sheet. Levels should depend to a great extent on the roads, and on the extent to which the country is, or is likely to be, opened up. At the present time it would be useless to attempt to run levels through a great number of sheets in Assam and Burma where there are no roads.

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I should like levelling parties to go one or two years ahead of the survey party.

Note.—I have since modified this idea.

F. B. L.

The main levels in India have never yet been assimilated; there has never been time to adjust the differences finally. There is practically no levelling establishment at present. I am of opinion that the matter should be taken in hand as soon as possible. I do not think it is possible to attempt such accuracy all over India as in the Great Trigonometrical levelling, which is taken to two places of decimals, but some limit of error should be fixed. I admit that this matter of running levels is an essential part of the scheme, but as to the cost, I must point out that in the Punjab, which is a comparatively flat country, where levels are required very much for canals, the levelling would have to be very accurate. I have not yet considered the cost of levelling, but will note it for consideration.

Symbols.

14. As to symbols, if it is desired to treat India by provinces, it would be possible to show the whole of the symbols without difficulty in the margin of a map; but it would be impracticable to so show the whole of the symbols required for the whole of India on each map. I agree that certain symbols should be selected which would always appear on the margin of all the maps of a particular province. It would be possible to show such symbols uniformly upon the maps of each province; but I would not show symbols such as those for railways on maps of countries where railways do not exist. The officers responsible for the preparation of a map could quite well see that every symbol required is on the map. Different classes of symbols and abbreviations are required for different provinces owing to the languages being different.

Boundaries.

15. I am of opinion that, in order to define boundaries on maps, the system of dots along streams and roads is preferable to bars. I am not aware that the point is treated entirely differently by every other map making country.

Village boundaries.

16. I am strongly opposed to showing village boundaries on topographical maps at all, but I recognize that some form of map is required for local civil purposes showing such boundaries. This opens up a very large question. In countries which have cadastral surveys, there would be no difficulty in preparing a skeleton showing these boundaries, because they have all been traversed, and such a map can be compiled. Where areas have not been surveyed on special traverse lines, it would be necessary to carry out a traverse, or to fix certain points on each boundary by plane table, to allow of the compilation of such a map. Where no cadastral survey exists, it would be necessary to actually survey the boundaries in the field. I agree that no further work as regarded boundaries is needed in the case of Bengal, where village boundaries have been shown on the preliminary edition of the latest maps, these maps being sufficiently good for local civil purposes.

Q.—In countries like Burma where you have to prepare two plates, one for the hills and one for the outline and names, would it be any advantage to show village boundaries on the outline sheet?

A.—If we are not going to show them on the final topographical map, we must have a special skeleton map drawn, showing the village boundaries only.

Q.—Having prepared the outline sheet, would it not be better for civil purposes to leave out the hills, and print the village boundaries on the outline sheet only?

A.—I cannot understand any civil officer preferring a map showing village boundaries, but without any distinction between hills or plains, to a map showing boundaries as well as topographical features. I think the matter should be left open. It would be a saving to us to show this information on the outline map only.

Size of sheets.

17. Personally, I should prefer sheets half the present size. They would be approximately square, and would form a neat and more portable atlas.

Printing paper.

18. The paper on which our maps are printed is of varying quality, and is generally inferior to papers used for such purposes in other countries. The surface is not good. The paper is obtained from the Director General of Stores at the India Office. The 1″ map would look a vastly better production, if printed on better paper. I have no technical information, however, on the point. A number of 1″ maps have been printed on linen. I have recommended pegamoid for mobilization maps. This substance is vastly superior to cloth; the clearness of the map and the quality of the printing are better. I am doubtful, however, whether pegamoid may not get discoloured with age and exposure.

Printing in colours.

19. I do not consider the Burma maps are sufficiently good, if the question of printing in colours is gone into properly. I would strive for a better map. The map is capable of further improvement, more specially in the direction of using colours. The survey is of a somewhat rough description, because it is almost entirely in heavy jungle tracts where the forest is impenetrable for thousands of square miles and the survey is more of the nature of a good sketch survey. The Burma maps cannot therefore be taken as a standard. Rivers should be in blue; roads should be shown by colour, but this would be putting a great amount of extra work on the printing office and the roads might be coloured by hand.

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Q.—Do you agree with Colonel Kelly's proposal that, where hills are covered with jungle, there should be a green wash, or would you prefer waiting a little, so as to examine more closely the actual specimens of coloured maps of England and Continental countries, before giving a decided opinion upon the subject?

A.—I should prefer to wait. Generally I consider perennial streams and wet cultivation should be coloured blue, and dry cultivation yellow. This is an important question; the passage of troops is sometimes rendered impossible by the flooding of irrigated lands. Roads in India can hardly be divided up as in England; metalled roads should have a distinct colour, but this might be done by hand. Blue colour should only be shown where water is perennial, not in ravines. The main object is to show where water exists. I would adhere to the present method as regards contours. I would advocate the colouring of woods in green in countries where they were few and far between, but not in such countries as Burma and Assam, where at times whole maps would practically be green if all forests were to be coloured.

Delineation of hills.

20. *Q.*—As to the hill shading, do you consider the system of horizontal contours sufficient to indicate the hill features without any addition of vertical hachuring?

A.—I think vertical hachuring in place of horizontal contours necessary when the slope gets beyond a certain steepness, that is where it becomes precipitous. I would use vertical hachuring where there is a big slope and where it runs into a cliff. The natural features of the country are easier to read in India than in England, there being far fewer artificial ones, and the surface of the country not having been, as it were, levelled down.

Colouring boundaries.

21. To show local boundaries by colour on the standard sheets for civil purposes would, I consider, be an unnecessary expense and trouble. This could be done by hand by the civil officials themselves. Besides, boundaries are constantly changing. The Government of India has laid down certain colours which have to be used; each province has a special colour.

Revision survey.

22. I do not agree with the previous Committee in recommending that there should be any definite period within which there should be a revision. I think the revision must follow the opening up of the country, *e.g.*, the Punjab, where enormous irrigation works are in progress, and new villages and population are being put down, will require early revision, and should be taken up in preference to places where there has been little or no change. The country should be divided up into areas, and a survey officer should be put in charge of each of those areas. He would be closely connected with the local authorities, and would know everything that was going on within the limits of his area. This would necessarily mean the permanent stationing of such an officer in a particular area. His office would have all the records appertaining thereto. It would be the duty of this officer to find out all about the changes in the area for which he is responsible. There should be a systematic method of obtaining information of all changes in connection with railways, canals, and roads. The present orders * on the subject are not in all cases carried out. The administrative civil officers should supply such information connected with boundaries, etc.; the military authorities should supply all information as to changes relating to their commands; the Public Works Department in regard to roads, canals, and railways, and the Civil Department as to district or tahsil head-quarters, dâk bungalows, etc. This is a question that will require to be gone into very closely. The district officials could inform the Survey party of any great and unusual changes in rivers. As soon as a great number of changes occurred in a district, there should be a revision of the maps affected. When maps get out of date, a detachment should be sent to bring them up to date, entirely irrespective of the age of the map, *e.g.*, some of the new cantonments may entirely alter the whole characteristics of the places at which they are located, and the map should be early revised.

* Contained in Government of India P. W. D. Resolutions Nos. 148-G., dated 16th January 1892, and 1417-G., dated 29th May 1893.

23. *Q.*—You would not lay down any period at all when the maps of the whole country should be revised?

A.—That is hardly a point for the Surveyor-General. I should like to think over the matter: it is one of the questions I should like to answer last. I have not formed any definite conclusion. Personally I think we cannot lay down a hard-and-fast rule. My opinion is that such maps as require revision should be revised as soon as possible. I would not reprint until the changes called for it; not necessarily on account of a new railway. I cannot mention any period when revision should be undertaken. The reprinting of such maps in the course of a year would be a very minor matter; it could not possibly affect the office here. I am not likely to alter that opinion.

As to whether any particular date should be laid down after which all the maps should be revised as a matter of course, I think 15 to 20 years an outside limit. Every map should be examined at least every 15 to 20 years.

24. *Q.*—Do you think the Survey Department should examine and revise the maps, independently of the information derived from the other Departments mentioned?

A.—Yes. The information is merely an office record as a guide to the survey officer.

25. The whole principle of the future of the Survey Department is involved in the arrangements to be made for special revision. My idea is to depend entirely on what is decided as to whether the country should be divided up into big areas, putting officers in

charge of those areas under the Surveyor General, or whether there should be parties directly under the Surveyor General with no intermediate officers. If the country is divided into large areas, I would have an officer in charge of the survey of each of these areas. This officer would have a number of parties under him, and these parties would have a certain definite programme. A special revision establishment might be required. Some parties would be stronger than others. This is a question of detail, and would have to be worked out. The revision could be done without seriously interfering with any general programme. As soon as I know what principle the Committee is going to recommend, the matter will be worked out. In addition to the revision detachments, the Department would require a certain nucleus of men to be always available for special surveys, explorations, trans-frontier work, etc.

I would not detail separate revising parties for different provinces as the last Committee suggested. If there are to be only two areas—(1) India, (2) Burma and Assam—then revision parties will be at once necessary in every province. If India is divided into several groups, it will not be necessary to have revision parties. Each province or group of provinces would have a programme and a certain number of suitable parties to carry it out. As regards this, I should prefer to make the best use of the parties in the area for which they were told off.

Local Governments and the Government of India might be consulted as to areas, etc., to be covered by each party. The importance of the different tracts varies enormously. I would perhaps have a special establishment capable of doing some special work, whether revision or special survey. I would not necessarily tie any party down to revision work.

In regard to this question of future working, I have not been considering to a great extent the Bengal maps, which all require revision in the field, or the need for spreading a party all over this province. I have in view the Punjab, which is in more urgent need of revision than other parts. I consider the difference between revision and new survey, in many cases, merely nominal. I would, if necessary, move parties from one officer's command into another group which might be held to be more urgently requiring survey or revision, but would prefer not to.

Q.—If you are working on one programme for all India, would that affect your proposals?

Sir John Farquharson explained that his proposal was not to start work in one corner of India and then continue all through the country. That was shown by his questions regarding the advisability of men of different races and classes carrying on surveys in parts of India to which they did not belong. His proposal was that every survey should locally recruit the men who would carry out the local survey so far as might be possible. There was no intention in his mind that the survey of India should be continued from one part of India only.

A.—Yes, if the programme is to be that work is to start from one end of India only, because that would mean that there would be no work in the extreme south for 30 years. Until I have the programme, I should prefer not to give any opinion as to how the revising parties should work.

26. *Q.*—Will the system of reproduction be altered by your proposal of revising at indefinite periods?

A.—The "system" would not be affected. It would entail the reproduction possibly of a few more maps.

27. As to the new information the revised maps would show, I would allow nothing to be put on the plates which has not been actually surveyed. I would not correct my fair maps or my zinc or other plates from information supplied by other departments, as is sometimes done at present. There has hitherto been no establishment for the purpose of revising or putting new information on existing maps by surveys in the field. If such revision takes place on account of numerous changes, the maps should be reprinted with the alterations shown, and would come out as a new edition. The opening of a new railway running through a sheet would not necessarily necessitate a second edition being prepared. Such a correction would, if surveyed, be put on individual copies by hand, or be surprinted in another colour. Supposing a new canal system fell into a new sheet and a little bit of the system extended into other sheets, I would not necessarily issue a new edition of that other sheet.

Q.—Then these alterations would be incomplete?

A.—Such corrections could be put on by hand if specially required, and the fact would be recorded in the office. But if the matter was important, I would issue a new edition showing the canal system. We do not keep large stocks of maps, and there should be no difficulty in making small but important corrections when required.

28. Every standard sheet, as revised, should be sent to the Drawing Office, as it should be used in the compilation of the smaller scale maps.

Preparation of ¼" Atlas sheets.

Q.—Can you form any idea as to whether it would be possible to correct the old engraved plates as they exist at present or will new plates be required?

A.—I cannot answer that off-hand. Each Atlas sheet covers a considerable number of standard sheets.

29. With regard to the delay inseparable from the engraving of maps, I consider it absolutely necessary to publish some form of small scale maps more promptly, and I would

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extend the system of preparation and publication of degree sheets, as is now done for Burma. These sheets exactly cover 8 standard sheets.

Q.—You would have the $\frac{1}{4}$″ map of India on the degree system?

A.—Yes, helio-zincographed degree sheets should precede the engraved map.

30. *Q.*—These would be in addition to the engraved $\frac{1}{4}$″ Atlas sheets?

A.—This is a question I wish to bring up, as to whether the engraved Atlas sheets should not be gradually superseded by engraved degree sheets I should like to see each map an integral part of another, but that cannot be done until the old Atlas sheets are superseded. I wish to raise the question whether in preference to trying to correct or revise the old Atlas sheets of India, it would not be better to start an entirely new quarter-inch map of India, on some system such as we have begun with a few degree sheets in Burma, embodying all new surveys and revision or supplementary surveys; an important reason being that by this latter arrangement every standard sheet would be an integral part of the new Atlas of India. The Atlas sheets of India are practically complete with the exception of the North-West Frontier, part of Rajputana and the whole of Burma, but are mostly quite out of date.

31. I think it would be a very good thing for the Committee to lay down the maps and scales of maps that should appear in the Catalogue of the general maps of India.

32. *Q.*—In the case of areas of country that have greatly altered, for which you propose to issue new editions of the standard sheets, would you also recommend that these revisions and alterations should be carried out on the smaller scale maps?

A.—Not on the engraved map until the whole map can be revised. It would not be worth while, because the information would be available on the larger scale map. As regards photo and helio-zincographed maps, which it would not be difficult to correct, I should try to keep them up to date as regards new railways, roads and canals, if important.

Supply of maps.

33. The rules regarding the issue of new standard sheets are that 30 copies of the map are supplied to the India Office, and a certain number to the Secretariat offices of the Government of India. As regards distribution to others, copies are sent out of courtesy to people interested. There is a scheme of distribution before Government, but no orders have yet issued. General maps are not sent out, except on indent to any one but the India Office and perhaps the Government of India. I believe index maps go to every Government, but do not reach district officers. After the Provincial catalogues are published, all new maps are notified in the *Gazette of India* and in local *Gazettes*.

Cadastral surveys.

34. I approve of the principle that the cost of cadastral surveys should be borne by Local Governments. In cases where there are cadastral surveys everything cadastral should be charged to Local Governments, inclusive of the preparation of 1″ reductions showing village boundaries, as these are required for the local officers only.

ORGANISATION.

Pay and promotion of subordinates.

35. The Surveyor General decides all important questions. Questions of detail are disposed of by the Surveyor General, the Deputy Surveyor General, the Superintendent, Trigonometrical Surveys, or other administrative officer concerned. There is no defined system of dealing with rates of pay of subordinate officers. On the 1st of July of every year the officer in charge of each party sends up to his administrative head, who is either the Surveyor General, Deputy Surveyor General, Superintendent, Trigonometrical Surveys, or Superintendent, Forest Surveys, qualification reports of his men, with recommendations of those who should be promoted, reduced, employed permanently, etc.,—in fact sends up all information and recommendations regarding them.

36. A sub-surveyor becomes surveyor when he draws over ₹50 per mensem. A surveyor or sub-surveyor may be on the temporary establishment. There is no particular period after which a temporary man becomes permanent. A man is never made permanent until his executive officer is satisfied that he is going to be a good man. This involves the question of pension. As long as a man is temporary, he can be dismissed, but not after he is made permanent. Temporary men are sometimes paid at a higher rate than permanent men. No man can be brought on to the permanent establishment without the Surveyor General's sanction. No man's pay is raised without the Surveyor General's sanction; but the Surveyor General seldom interferes with the administrative officers so long as his hands are not forced with regard to the budget. The administrative officer considers each case on its merits; he considers the service of the man with others of the same standing in other parties, and he keeps in view the idiosyncrasies of the officer in charge. The matter requires careful selection. The administrative officer corrects the lists sent to him in accordance with what he considers right; he declines some of the recommendations and accepts others; he has not the power to finally sanction. He deals with the list generally before submitting it to the Surveyor General.

No Surveyor can draw more than ₹100 a month. The Surveyor General has the powers of a local Government in this respect.

37. There is no fixed establishment for anything except Head-quarter offices and the Provincial Service. The Surveyor General has absolute power over the subordinate staff; he could put any such man on the permanent list; khalassis could, by a stroke of the pen, be placed on the pensionable list.

Head-quarters offices.

38. The officers in charge of the Drawing Office, Engraving Department and Photo-zincographic office send in returns of the state of the work monthly to the Surveyor General. This shows the entire amount of work done and that in hand. The pay of the subordinate staff is fixed; the system obtaining in the office is to have fixed rates of pay for each post. If the Department gets an urgent demand for maps, the ordinary work has to be stopped temporarily. There is no power given to take men on temporarily. The Government of India have lists of the men employed in the Survey of India offices with their rates of pay.

Pay of draftsmen.

39. There is no doubt the pay of the draftsmen in the offices is, at any rate to start with, far too small to attract good men. I think no post on the fixed establishment should be allotted less than 20 rupees. There should be a grant for temporary establishment from which men might be selected for the fixed establishment, but the spending of this grant should not be interfered with by Government. The Surveyor General should have power to pay such men as he pleases, and in accordance with their value as draftsmen, and the number employed should be left to his discretion, provided he keeps within his budget allotment. All low paid posts should be cut out of the fixed establishment. I could get better men if the initial pay were higher, and if I had money to spend on temporary or contingent establishments. I think the Committee should recommend better men being got, and this would entail higher pay, but would probably result in better and cheaper work.

Pay of surveyors, etc.

40. The Surveyor General is trying to improve the recruitment by getting in soldier surveyors. I hope a nucleus of soldier surveyors will attract their relatives. They will be a better class of men than is got from the civil population generally. I do not think I shall ask the Committee to put forward any recommendations regarding higher pay for this class of men. The question is one absolutely within the powers of the Surveyor General. The Committee should perhaps recommend a better class of men being enlisted. I strongly object to an educational test, pure and simple. I do not think the introduction of men on an improved rate of pay would lead to complications with the existing establishment. An inferior man would not object to a superior one getting a higher rate of pay. I have considered whether there would be any advantage in having a special school for teaching men drawing and surveying for the work of the Department. This is one of the subjects on which I have as yet formed no conclusion. I shall bring it forward as a member of the Committee later.

Lieutenant-Colonel Longe's evidence continued on the 23rd February 1905.

Questioned by Sir John Farquharson regarding the recruitment of the Imperial officers.

41. I think I am satisfied with the present arrangements for the appointment of Imperial officers to the Survey of India. The course that is followed in making the appointments is that officers who have not yet completed five years' service in the Army are allowed, after their arrival in this country, to send in their applications for service in the Survey of India. They apply through their Commanding Officers to their General Officer Commanding, and their applications are forwarded to the Surveyor General by the Adjutant General of India with such recommendations as there may be available, and their names are registered in the Surveyor General's Office as candidates for present and future vacancies. The Surveyor General obtains as much information regarding their qualifications as he can get both officially and privately. When vacancies occur, the Surveyor General applies to the Government of India in the Revenue and Agricultural Department to be allowed to fill them up, giving the names of the officers whom he has selected for the posts. As a rule, he is obliged to take the most senior officer in the list, as he is not allowed to appoint a senior to the Department after a junior has already been appointed to the Department. He therefore has to give reasons in case he does not recommend the senior officer. This, I think, is entirely wrong; particularly because I do not consider that merely because a man sends in his application for an appointment, any reasons need be given for his not getting it. The above remarks apply to Royal Engineer officers.

42. As regards the Indian Army officers, they also, with the permission of the military authorities, record their names for service in the Survey of India. There is no rlue that these officers should not be appointed though senior in the Army to Royal Engineer officers who may have been previously appointed.

43. The proportion of Indian Army officers to Royal Engineers is recognized as one in four. The Indian Army officer has no examination to pass. He is appointed in the same way as the Royal Engineer, but he remains on probation for a year, at the end of which time he has to undergo a departmental examination.

I do not consider this quite satisfactory. I do not think that the recommendations we get can always be relied upon. I think an Indian Army officer sometimes applies to come to us, because he cannot get on well in his regiment, and the officers recommending him, having no knowledge of survey themselves, are inclined to say that an officer will make an excellent Survey officer, because they are interested in getting rid of him.

44. *Q.* (*Sir John Farquharson.*)—Colonel Hobday mentioned, as far as my recollection goes, that there is one objection to appointing Royal Engineer officers to the Survey of India, and that is that they are taken away to the Chatham Course. Do you regard this as an objection?

A.—I certainly look upon it as an inconvenience, but not as an objection. It is an inconvenience at the present time, and was more so very lately. When an enormous number of officers were required for special work beyond the frontier and outside India in Seistan,

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Somaliland, Aden, and China, it was a great inconvenience to have to send officers for instructional purposes to Chatham. And there is, in my opinion, no necessity for this course as regards officers who are permanently posted in the Survey Department. It is true that survey officers can revert to the Military Department, and in cases of their health breaking down and occasionally for private reasons they go home, but in no case that I know of has an officer, who intends to serve in India, ever left the Survey Department after once being appointed.

45. I consider service in the Survey of India as practically permanent, and I consider that to be an advantage. This applies to all officers. It is certainly an advantage that they should serve permanently in the Department once they are appointed.

46. I think the rule disallowing the appointment of a Royal Engineer officer to the Survey of India because an officer junior to him in the corps has already been appointed, is a case of hardship to Royal Engineer officers, and it would be much better for the Department if it did not exist. It is detrimental to the interests of the Department. We cannot appoint good men if they come too late, and we have no option now at all. It must be a rule laid down in the Military Department.

If the rule were altered, but the appointments remained graded and the pay consolidated' service being permanent, a Royal Engineer or Indian Army officer should on joining be appointed to the bottom of the list, but he should be warned that he will be junior in the Department to already appointed Royal Engineer and Indian Army officers who may actually be junior to him in the Army list.

47. Five years' actual service in India is not required before an officer can be appointed to the Survey of India. No Royal Engineer officer of over five years' service in the army can be appointed. No exact period of service is required before he can be appointed. But according to an unwritten law he cannot have his name entered in the list of candidates until he has arrived in India. If he has not got more than five years' military service, he is eligible for an appointment on arrival in the country.

The limit of five years' service applies equally to the Indian Army officers. They cannot, as a rule, come in if they have completed five years' service. I have applied in the case of one, if not two officers, for various special reasons, to register their names after they had more than five years' service.

48. I may say that no British Service officers other than the Royal Engineers can join the Survey of India. This rule I should like to see altered. For instance, I have had several applications from Royal Artillery officers, who would join the Indian Army if appointments could be guaranteed them in the Survey of India, but they cannot be guaranteed, and it seems a distinct hardship that their applications cannot be entertained. I think that this rule, that no officer of the British Service other than a Royal Engineer is allowed to enter the Survey of India, might be relaxed with advantage. It would give a wider selection, and would certainly be an advantage.

49. *Q.* (*Sir John Farquharson.*)—I understand you to say that there is no rule as to length of service in India before an officer can be appointed to the Survey of India. The object of my question is to ascertain whether any language qualifications, and consequently some minimum period of Indian service are or are not required.

A.—As a matter of fact, I am bringing forward a proposal about this, but have not done so yet. I have discussed it with many officers, and we have all come to the conclusion that, though Royal Engineer officers should not be obliged to pass any professional examination, it would be beneficial if they had to pass some language test, and also that they should come on a year's probation in the same way as the Indian Army officers. Indian Army officers are required to pass the higher standard examination in a vernacular language, whereas Royal Engineer officers are not obliged to.

I think Royal Engineer officers should be required to pass the lower standard language examination at least. At the end of their year's probation they need not, however, be required to undergo a departmental examination.

50. (*In reply to Colonel Kelly.*)—I do not think it would be impracticable to take an officer of over five years' service, of, say, the rank of Captain, into the Survey of India. It would, however, be impossible to do so without reorganising the whole system. But I think selected Captains might, if the organisation of the whole Department is entirely changed, be taken on at a pinch.

Q. (*Sir John Farquharson.*)—This differs from the decided opinion you formerly expressed. Would it be advisable to reorganise the Survey in that way?

A.—Officers can always go back to the regular line in the Army if they like. My opinion is that officers should in the first instance be appointed for five years only, at the end of which time they should revert to military employment, unless the Surveyor-General applies for their services to be continued in the case of each candidate.

This would give the Surveyor-General a chance of getting rid of any unsuitable men without any trouble. As I said before, I would only have senior men appointed to the Department for a temporary period at a pinch, if it were absolutely necessary, but not otherwise. Permanent service is decidedly advantageous.

Training.

51. *Q.*—(*Sir John Farquharson.*)—Do you find any difference in the amount of training required by Royal Engineer officers and by Indian Army officers in survey subjects?

A.—I have had nothing to do with the personal training of officers; that is carried on at Dehra. But from what I have been told, and what must necessarily be the case, Indian Army officers must require more training in computation and mathematics connected with survey work than Royal Engineer officers. As a rule, however, Indian Army officers are not trained in the more scientific branches of survey work. All officers joining the Department are trained together at Dehra. There is no absolutely fixed time for the training of either Royal Engineer or Indian Army officers. The idea is that they should undergo at least a year's training at Dehra. That includes theoretical as well as practical work. In order to give additional training actually in the field, we have now started a party in Berar, and once some years ago we endeavoured, by taking up the Survey of Tehri Garhwal, to give the Imperial officers practical training in the field. But we have never been able to carry out any systematic training owing to the demand for officers. But assuming all circumstances to be favourable, I should say that six months' theoretical training and one year's practical training are necessary to make an officer perfectly qualified to be attached to a party as an assistant. I think an officer can be put in charge of a party after a further training of one or two years as an assistant. I should not like to put an officer in charge of a party until he has undergone 3½ years' training altogether. He would be doing useful work in the second year because he would be doing actual field survey according to our present arrangements, but he would have to learn organisation and accounts, of which the latter has to be done by the officer in charge with the aid of a clerk. There are no special accounts officers in the Survey Department. The whole of the work has to be done by the Survey of India officers who have no special training in accounts except what they learn while attached to parties. I am referring to the whole Department. All the accounts are under the control of one of the Assistant Surveyor Generals.

Proposed appointment of a Superintendent of Cadastral Surveys.

52. *Q.*—(*Sir John Farquharson.*)—It was understood before that you were opposed to the Survey of India having entire charge of the extremely heavy work of the cadastral surveys of India. You have modified considerably that opinion. By "entire charge" I mean entire control, *i.e.*, having the power of ordering everything in connection with cadastral surveys.

A.—I never contemplated that. I should not think of interfering with the programme. All that I say is that, if the officers employed on cadastral work are members of the Survey of India, they ought to be under the control of the Surveyor General. I consider that all surveys should be made under the control of the Surveyor General.

In regard to the first portion of this, I should not interfere with the programme or with the class of detail surveyors, that is to say, I should consider that each local Government should have the power of deciding, in consultation with the Superintendent of Cadastral Surveys, whether they should employ *amins* or patwaris or any other agency. The Superintendent of Cadastral Surveys would be under the Surveyor General to the same extent as the Superintendent of Bengal Surveys. The reason for this is that it has been conclusively proved that in the plains cadastral surveys, as at present professionally executed, have been found sufficient for the insertion of topographical details on maps, with a little supplementary work of some sort. I do not think cadastral surveys could be sufficiently well executed if the professional control were withdrawn. I am strongly of opinion that no re-survey should be sanctioned by the Government of India on other than scientific principles, and that local Governments should be urged to accept this in cases where the Government of India has no absolute control. These are my reasons for suggesting the appointment of a Superintendent of Cadastral Surveys.

53. I should also like to remark here that, if no cadastral surveys are put under the Surveyor General, there will be no school in which either Provincial officers or others can be trained in cadastral work. The local authorities will therefore not be able to get the officers they require from the Survey of India. I have today received a letter from the Central Provinces asking for two provincial officers to replace Messrs. Dunne and Scott, one of whom has lately retired, and the other is about to retire after a very long service in the Central Provinces as a seconded Survey of India officer. This is in spite of the fact that the Surveyor General was informed that no officers would be required to replace these two. That Provincial officers will be required for cadastral survey purposes is fully borne out by the fact that I cannot get back from the United Provinces the officers originally lent to them for cadastral surveys, but who are at present employed on the revision of record of rights and the alteration of survey boundaries in already surveyed villages. I also cannot get back from Assam the Provincial officers lent there.

54. I should like to put in the whole of my notes as giving my reasons for suggesting the appointment of a Superintendent of Cadastral Surveys.

Q.—(*Sir John Farquharson.*)—Does that proposal include the consequence that this Superintendent of Cadastral Surveys is to be in charge not only of field surveys, but also of the reproduction of the maps?

A.—I do not consider that this is a vital consideration. The cadastral maps are required purely for revenue purposes, and the reproduction is purely a matter for the local Government

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to decide. I think the Superintendent should be the adviser of the local Government in this matter. The officers in charge of the parties doing the cadastral surveys could be responsible to the Superintendent for seeing that the plans were reproduced, if reproduction were decided on, and the Superintendent through the Surveyor General would be responsible to the local Government concerned.

55. The number of Superintendents would be one or more according to requirements. At the present time cadastral surveys are being conducted by the Survey of India only in Burma and Bengal. In order to overlook the whole of this, I consider that one officer is sufficient, and that, as the present Superintendent of Bengal Provincial Surveys is no longer required to undertake the actual charge of a party, he could take over the superintendence of cadastral surveys in Burma in addition to his present work, and act as adviser on cadastral surveys in Burma as well as in Bengal. This would obviate the Burma parties being under the Deputy Surveyor General. It would be much better if one officer could be the general adviser in cadastral matters to the Surveyor General as well as of the local Governments. On all revenue matters at the present time I think Major Crichton is competent to advise the other local Governments as well. This is on the assumption that cadastral work is not extended beyond the present limits. The Superintendent would be under the local Government as regards the budget and the programme, but all officers recruited and borne on the Survey of India list would be entirely under the orders of the Surveyor General (through the Superintendent) for discipline, pay, promotions, etc. They would be borne on the Survey of India list, but should be seconded. The local Governments should not be able to give them what pay they pleased. One of the greatest troubles we have had in connection with the dealings of local Governments with our men is that different allowances have been given in different provinces. This has caused a great deal of friction and ill-feeling. These allowances are not given at the option of the Surveyor General, but are fixed by local Governments. These allowances are given to Provincial officers, not necessarily seconded. I should not so much mind if they were given to seconded officers only. To the best of my belief the Surveyor General has no voice in the matter of local Governments giving allowances to men working under them, whether seconded or not, and the giving of the allowances causes friction in the Provincial Service, as the men are not permanently seconded, and they object most strongly to being reverted to the Survey of India because they lose the allowances. There has been great difficulty on that account.

56. *Q.*—(*Sir John Farquharson.*)—What do you propose for the future organisation of the Survey of India with reference to cadastral surveys under present conditions?

A.—That is a matter of general principle. For the present Major Crichton might supervise all the Survey of India parties doing cadastral work in Bengal and Burma, and he could advise other Governments. If, however, extensive cadastral surveys were undertaken, there would possibly have to be one or more Superintendents to do this. In much the same way as I have recommended Superintendents of Circles for topographical surveys there should be Superintendents of Circles for cadastral work.

At present all questions of cadastral surveys from other provinces besides Bengal and Burma could be referred to one Superintendent of Cadastral Surveys. For cadastral surveys the Superintendent would take the place of the present Deputy Surveyor General.

Q.—(*Sir John Farquharson.*)—You say that Major Crichton could be in charge, as I understand, of the actual surveys going on in Bengal and Burma, and that he might be the adviser in the case of other Governments who wanted advice on cadastral surveys in place of the Deputy Surveyor General?

A.—Yes. At present the Deputy Surveyor General is the administrative officer for all cadastral surveys conducted by the Survey of India, and all cadastral questions are referred to him for advice.

During the last few years in the United Provinces, there has been a cadastral party, but its work is almost finished, and I believe no more cadastral surveys are to be undertaken. Therefore Burma and Bengal are the only provinces in which provincial cadastral surveys need at present be taken into consideration. In the case of all other provinces, the Superintendent of Cadastral Surveys would be merely the adviser.

Q.—(*Sir John Farquharson.*)—Would he be in charge of, for instance, Mr. Hatchell and Mr. LeMesurier?

A.—No. They are not doing cadastral survey.

Q.—(*Sir John Farquharson.*)—Would you propose that the Government of Madras should not be allowed to undertake cadastral surveys under Mr. Hatchell as they propose to do, without the consent of the Surveyor General of India?

A.—No. As long as the system of survey remains, as it is at present, the Madras Government might decide the matter without reference to the Surveyor General. But if the Survey of India system is to be extended to Madras, then somebody would have to be put in charge, because in that case the work would be carried on under Imperial and Provincial officers of the Survey of India.

57. I said in my note that I would not insist on a re-survey of the country cadastrally, but in future I think the Government of India should insist on cadastral surveys being carried out on scientific principles. I also think that they should be carried out under the direction of the Surveyor General.

58. As to reproduction and publication of the cadastral maps, the question need not present any difficulties. The Superintendent would necessarily have a large head-quarters drawing office in each province in which cadastral surveys were going on. The reproduction of the maps (by the reproducing parties for cadastral surveys) by the Vandyke process would be most convenient and could be carried on without any great trouble in the same way as is being done now in Bengal. Lieut.-Col. F. B. Longe.

Major W. J. Bythell, R.E., Assistant Surveyor General, in charge Drawing, Engraving and Map Record and Issue Offices, Head quarters, Calcutta. Major W. J. Bythell.

[*Calcutta, 9th February 1905.*]

1. I am in charge of the Drawing, Engraving, and Map Record and Issue Offices and have been in charge since last May. Before that I was in charge of a survey party for some years.

2. *Q.*—Will you tell the Committee the general work that is now being done in the Drawing Office. Drawing Office?

A.—We are drawing general maps of India on the 32 and 64-mile scale; a ½"-map of Kashmir; and we are drawing some Punjab sheets from old surveys, and of course there is a lot of extra-departmental work, such as postal maps.

There is a special arrears section drawing maps of Bengal and Assam from old material; there is in it a retired Provincial officer and 10 draftsmen; they are bringing up standard maps of Bengal, that have never been published, from old material.

There is another section bringing up old sheets that were out of stock for reprint. In this work there is a very heavy item, taking out areas, that has never been done—I refer to standard sheets which have got out of print, and require bringing up to date; bringing to modern form, with footnotes, numbers and headings and areas.

The preparation of drawings for engraving is done in another section.

When reprinting standard sheets, we put on revised details when we have them, but we have not always got such material. The additions to railways for instance are generally not surveyed; they are supplied to us by Local Authorities and Executive Engineers.

The work in the Drawing Office also includes the compilation of new Atlas sheets which are being brought up to date, where possible, in the same way as the standard sheets.

The extra-departmental work consists of drawings in connection with manœuvres, special maps and postal maps, maps for gazetteers, etc.

3. The examining section examines everything that passes through the office; it is a part of the Drawing Office. All officers in charge of field parties are held responsible for the accuracy of their fair maps; we examine generally as to uniformity, and make a note if there is anything out of the common, and correct it here. In order to guarantee uniformity of symbols from the different field parties, tables of conventional signs have been issued to serve as guides; the same tables are issued to all parties; the signs provide for everything. At present I think about eight men are employed in the examining section. Last year 2,504 sheets were examined and passed; these are chiefly standard sheets; but everything that comes through the section is examined and passed. I do not think that all field parties' plans go to the examining section; they are just looked over by me, shown to the administrative officer, and sent for proof as soon as possible.

4. There is another small section, of only two or three men, examining printed proofs in the Printing Department. The work comes in by fits and starts; the men are not employed continuously on the work. But still the work is done in the Drawing Office. Extra-departmental work also comes through us.

I do not think they have a staff to examine first proofs in the Photographic and Lithographic Offices.

5. The present strength of the Drawing Office is as follows :—

Five European draftsmen and 63 native draftsmen; this latter total includes computers and all, and it includes colourists. I put in a statement* of the draftsmen on the 1st October 1904, showing the pay as sanctioned by Government. I cannot add to the permanent list or add to the pay without Government sanction; the posts marked "additional establishment" were sanctioned some years ago by Government. The list is exclusive of the arrears section and exclusive of the men actually colouring maps when coloured copies are wanted. The colourists are temporary men, and are just taken on when there is a demand.

* *Vide* Appendix A, p 110.

6. There is a large computing section of the Drawing Office, the members of which are included in the total of 63 natives. There are also 10 Provincial officers who are not shown in the establishment already given; they are employed in charge of various sections of the office. Six to eight out of the 63 men are employed on computing. The computing section is not solely employed on taking out areas; there are the copying of old traverse data and the tracing of plans.

7. There are men constantly employed on making tracings of original villages from old surveys done many years ago. These are for local requisitions, and are used chiefly for civil

Major W. J. Bythell. cases, boundary disputes and so on. This work is paid for by the public, and a certain amount is charged to Government, but I cannot say whether the amount is credited* to us.

8. We do very little actual drawing of 1″ sheets here. I should say, from the general experience I have had, that the average rate of progress in drawing a 1″ standard sheet is two to three months for a full sheet, but that does not include hill drawing. A 2″ sheet in the Himalayas would take six months; a 1″ sheet would take much the same time, the scale does not matter much, the sheet is the same size.

9. I put in a statement of the arrears of work in my office brought up to 8th December 1904. I send in a return of work received during certain fixed periods, and the balance remaining over from the previous year. This is in a form which I will produce. The statement now put in applies solely to standard sheets.

ARREARS OF DRAWING ON 8TH DECEMBER 1904.

General Abstract.

Serial No.	Provinces.	1 Number of sheets to be redrawn.†	2 Number of sheets to be reprinted.‡	3 Number of sheets awaiting *completion to* margin by photography.	REMARKS.
1	Kohat, North-West Frontier Province	*Nil.*	3	*Nil.*	This list excludes 77 Forest maps of which reprints will be printed at Dehra Dun by the Superintendent, Forest Surveys.
2	Punjab	52	30	*Nil.*	
3	United Provinces of Agra and Oudh .	39	55	80	
4	Central Provinces	87	5	13	
	Central India and Rajputana . .	*Nil.*	62	*Nil.*	
6	Bombay	*Nil.*	40	*Nil.*	
7	Nizam's Dominions	*Nil.*	1	*Nil.*	
8	Madras	*Nil.*	11	*Nil.*	
9	Bengal	171	52	1	
10	Assam	9	13	6	
11	Burma	2	11	*Nil.*	
	TOTAL .	360	283	100	

† Sheets to be redrawn are those, of which either no originals in standard form exist at all, or only lithographed copies or coloured originals.

‡ Reprints are sheets out of stock, of which originals exist, but they must be corrected in certain items and indents for them cannot be met.

10. *Q.*—Are there any other arrears except those entered in this return of standard sheets?

A.—Well, it depends upon what you call arrears. There are general maps like the 32-mile and 64-mile maps of India, and the Punjab map which should have been out some time ago. The latter is in abeyance because I cannot get a satisfactory settlement about the boundaries of the districts; the question is under reference to the local officials. The arrear is not caused by want of labour. The drawing is complete. Then, as regards the 32-and 64-mile maps, we are waiting for the same boundaries. This can hardly be called pending work in the Drawing Office. The sheets are practically in arrears for want of the boundaries of the Punjab and the new North-West Frontier Province, and the subject has been referred to the local officials by order of the Foreign Office.

11. *Q.*—What the Committee wishes to know is what arrears there are of absolute drawing work, and what increase of staff is required to work them off.

A.—This statement gives practically the chief arrears—they are standard sheets.

12. *Q.*—Then it appears there is no large amount of arrears?

A.—There is the Kashmir map, which is in progress; that I can only take up by fits and starts, because when orders are received from the Quarter master General and other outside authorities, I have to put my best men on to them, and have to drop the Kashmir map.

* *Colonel Longe* explained that it might be credited in the budget. The whole of the survey parties have to be supplied with data which they require for their work, this branch (computing) is also employed in providing traverse data.

Q.—Is that the only other thing?

A.—That is the chief thing; there are small bits of arrears.

13. *Q.*—You say in the first column of the above statement that the "number of sheets to be redrawn" is 360, and there is a footnote that "sheets to be redrawn are those of which no originals exist." What does that mean?

A.—That means standard sheets of which there are no originals in the standard form. The remainder of the footnote refers to the coloured and lithographed maps which are useless for photography.

Q.—Are these all complete sheets?

A.—We have to piece them together; we can compile them from various materials, but these are mostly old. There are demands for these sheets from Bengal and the Punjab. But I think the work of compiling these sheets is labour thrown away, because the surveys are so old that they are practically unreliable now. A good deal of this class of work has been done. These sheets have never previously been published as standard sheets. Maps of the area have been given to the public in some form or other, but not necessarily in the standard sheet form. This work was started before I took charge.

Colonel Longe thought the general cry for maps had caused the undertaking of this work.

14. As regards column 2 of the statement which I have put in, I may explain that these are entirely reprints; they are standard sheets of which we have the originals, and it is intended to take out areas, and bring them up to standard form. They are not in modern form; they have not been revised, and if we have new material, we put it in. By new material I do not mean only work done by the Survey Department but roads, railways and canals; this material is sent in by local officials, and we print it on the face of the map in red. If the men worked steadily at this work, they would bring it up to date in a short time. It is not a material arrear, though from the numbers it looks big.

The work on each individual sheet varies according to the nature and quality and year of the survey. It would take 12 men 18 months to complete these sheets. Last year there were 222 sheets requiring reprinting, and now they have increased to 283. The figure 283 cannot be taken as a final number. The number is increasing, and is entirely indefinite. These sheets that are being brought out are standard sheets, though they may not be absolutely complete to margin. It is not absolutely necessary to do revision of all the sheets before reprinting. The sale of these maps might go on in exactly the same form, without their being brought up to date. We could give certain sheets by selection to the public as they stand, but a certain number would undoubtedly want work. We want to improve the form of the map that is issued to the public. I suppose it is not an absolutely necessary part of the work of the Survey, but it is highly desirable; these sheets are in an antiquated form. For one thing areas are not taken out on the sheets in their present form, and the public want areas. The most necessary part of this work is the computation of areas. I think all the sheets noted in column 2 of the statement should be cleared off.

15. As regards column 3 of the statement—"number of sheets awaiting completion to margin by photography," I may explain that in these a portion of the sheets is generally blank. It was the custom in former days merely to survey for district boundaries or provincial boundaries. Now in completing a sheet to margin we have surveys which we can utilize, putting them on the sheet by photographing the portions which are blank from other surveys. As far as my office is concerned, the work necessitated by this is probably not heavy. It consists in adjusting the edges of these various surveys from photographic proofs; we have to do the margin, border-headings, foot-notes and extract the areas. We have the materials for the photographic prints, but they have not been photographed, and we have not therefore got photographic prints of the maps. I think that, even considering the variety of form in which these maps have been drawn, we can get a satisfactory map in a great many cases, but not in all, by compiling these surveys, and in these cases the work is worth while doing. In a good many cases the styles are so different as to make the map look ridiculous, but one would have to discriminate in most cases. I consider it desirable work, but it is not absolutely necessary. The figure 100 in the 3rd column is final, I should say, or at least it cannot increase very much.

16. *Q.* (*Colonel Longe.*)—For what reason are the Provincial Officers employed in the Office?

A.—They are employed to supervise the native draftsmen who require a good deal of supervision; also because the European draftsmen are not all capable of compiling Atlas sheets and dealing with traverse data, and technical matters generally. Some of these men are actually employed on draftsmen's work, but their work is chiefly supervision. Out of the 63 natives and the 10 additional men, about 7 or 8 supervise. The chief draftsman's work is to visit each section in turn. The work is materially interfered with and interrupted, if we are without these 10 additional men; they are essential to the work of the office. These extra 10 men are dealing with the work mentioned in column 1 of the statement. I had a return made for two months of the average number of men employed in the Drawing Office on extra-departmental work. It worked out to 15 men more or less constantly employed on extra-departmental work. For supervision there were two Provincial officers in addition in charge besides the chief draftsman and myself. These 15 men are actually draftsmen, and probably some of the best.

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17. Q. (*Colonel Grant.*)—In going through the Department I noticed that there is a large amount of reduction being done by means of the pentagraph and also by the method of squares. I presume that in any case in which photographic reduction is cheaper it is made use of?

A.—If the materials available are fit for photography.

Q.—The materials need not be very good, so long as it is a mere reduction in scale?

A.—I think photography might be more used than it is in the compilation of Atlas sheets. Burma is done by squares; undoubtedly a good deal of this might be done by photography.

Q.—Does the same apply to blue prints for rivers and hill drawings? It seems to me photography could be more economically employed.

A.—There would be great difficulties, and probably the Photographic and Lithographic Office would raise objections to that system being invariably employed because we should have paper of different hygroscopic properties; you would not get registration.

18. *Q.* (*Colonel Grant.*)—In going through the Surveyor General's Office I noticed that in many instances maps are being prepared of an inordinate size. Do you see any difficulties in providing for this?

A.—These maps are nearly all extra-departmental work. There is great inconvenience in this, but the authorities who ask for such work insist on having the maps as they wish. We do not prepare many for the Military Department; theirs are generally of standard size except manœuvre maps. The Quartermaster General, Intelligence Branch, asked the other day for a map which, with margin, would be 7′ by 24″, and wanted it to be printed in one piece. We could not do it to that size. Eventually it was reduced to two sheets which were limited to the largest size of plate in the Photographic Office. I have frequently pointed out the inconvenience. In the case of this large map I had to refuse to do it, being limited by the size of the plate available. The Director General, Army Remount Department, has some very large maps. I am also doing some very large maps for the Postal Department.

19. *Q.*—Do you find it impossible to get the Departments to accept a map in several sheets?

A.—They always prefer it in one sheet; it has to be photographed in so many sections and then pasted up.

20. *Q.*—As regards sending first proofs of standard sheets to field parties for examination and, if necessary, for correction, is this inconvenient in causing delay, and is it necessary if manuscript drawings are properly prepared in the first instance?

A.—We have no authority for corrections here; there may be corrections in small matters which want noticing in the proof, but we have no materials here. Therefore the proof is sent to the officer in charge of the party. As a rule, the new corrections are very small. The first proof always goes to the field party. There is not much delay in this; the colouring work is done on that proof at the same time.

21. *Q.*—The officer in charge of the Photographic Department is of opinion that the type used for drawing is very thick faced, that it is too heavy, and this becomes apparent when it thickens in process of production. What is your opinion?

A.—I have lately been reducing the size of the type in sheets being drawn here. The question of style is a big one which was gone into by the Surveyor General; the finer type was introduced a few years ago. I think the type should be reduced; we all object to it.*

22. My proposal for improving the class of men is to give them better pay. I have tried the various schools, also Roorkee and Sibpur; they tell me they have no men who will come on the pay I can offer them. The senior native draftsman gets Rs. 120. I have to bring every man in on Rs. 10 a month and then train him. I do not want so much to raise the higher as the lower rates of pay. A man cannot be taken in on the higher rates of pay because it is a fixed establishment. It would be rather hard on a man who had been working on, say, Rs. 25 or Rs. 30 for perhaps 15 years, to have a new man brought in on higher pay; it would block his promotion for good and all. As to whether there should be some means of introducing higher rates of pay, I think the pay should be raised, and I think the Drawing Office should have the power, in the case of pressure of work, to engage men on a separate fluctuating establishment. I should have more power. The Office is already practically in two sections, and certain appointments in the Senior Section are always filled direct. A man will not now come from the Art Schools on Rs. 10. I think I could get the men if there were some other division of the establishment. I have not thought out the scheme. The apprentices at first come in on nothing; every apprentice looks forward to rising to the top of the Junior Section; men can be recruited to the Senior Section direct without prejudice to the rights of the men in the Junior. I should like to recruit men on Rs. 50 and upwards. That would give a better class of men; they could be got; they would require to be trained for a year or two. Very

* *Colonel Longe* explained that it was the type most suitable for the class of men employed; they cannot use fine type.

Colonel Grant.—I understand that you are reducing your methods to the level of your workmen, rather than levelling the men up to the required standard?

Colonel Longe said that the Department perforce had to do so, because the amount of pay given is so small.

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few men from the Art Schools can print. Men brought in on the higher rate of Rs. 50 would be on probation till it was seen how they turned out. I cannot say if a diploma is given in the Art Schools. No men ought to be brought in on such low rates of pay as are given in the Department under any circumstances at all. I would give Rs. 25. If men were brought in on this pay, I would not reduce the total number, with the amount of work received at present. I do not think they would do more work. But they would do better work. A native draftsman is very slow. I cannot say if the Art Schools have been approached officially with a view to their teaching map drawing, printing, etc., to men who would eventually, if efficient, be employed by the Survey Department. I consider that the present draftsmen are unsuitable; they are uneducated and poor in every way; their prospects are such that no educated man would take such employment. The highest pay Rs. 120 is no doubt considerable, but only one man receives pay at this rate; the highest pay in the Junior Section is Rs. 50.* I do not know the object of having two sections. I agree that the original object was probably to enable a better class of men being recruited.

Colonel Longe gave it as his opinion that no man drawing Rs. 10 a month can dress sufficiently cleanly or keep a map clean.

Colonel Longe stated that specimens of map drawing had been sent to the Art Schools with a view to the encouragement of such drawing.

23. Some men in times of pressure work eight hours a day. It is not possible in Calcutta to increase the normal working hours owing chiefly to the climate; besides, many of the men live a long distance off, and in the rains in particular they cannot come sometimes till 11 o'clock. It might be possible to introduce longer working hours in other parts of India. There is no organised overtime system of working draftsmen; there is no source from which they can be paid.

Colonel Longe stated that this applied throughout the Department. The Surveyor General has no funds from which to pay piece work.

24. I put in a statement † showing approximately the number of impressions in stock, the number received daily in the Map branch, the average number issued and the number of the staff who deal with these duties.

Map Record and Issue office.

25. I do not think the buildings and fittings for the storage of maps are satisfactory; they are too open; the drawings are in open racks, except the originals which are in covered shelves; I do not know why the maps are in open racks.‡

I do not consider closed shelves of zinc or such metal would encourage damp and mildew. The originals are not in a fire-proof building; there are special arrangements against damp in the case of original documents generally.

26. Standard sheets are issued to all officers on lists maintained. Deputy Commissioners frequently ask why they are being supplied with maps. I can supply the Committee with the lists.

The figures of sales of maps for last year were:—

Rs. 12,000 to the public.

Rs. 185,000 to Departments of Government.

27. The Engraving office is now engaged on five general maps of India. These are practically new maps; the scales are 64, 80, 96, 128 and 256 miles to the inch. There are also a 32-mile map, a duplicate 64-mile, a 16-mile map of the Punjab, one sheet of India and adjacent countries (that is on the one millionth scale), a 16″ to the mile plan of Calcutta, a district map on the 8-mile scale of Assam; besides there are provincial maps on the 16-mile scale of Bengal, Bombay, Madras and Rajputana; there is a 32 miles to the inch map of the Punjab; there are a 6″ to the mile and 3″

Copper plate engraving.

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* *Colonel Longe* explained that to promote a man from the Junior to the Senior Section was very unusual, as it would mean a transfer from a post on Rs. 50 to Rs. 25, the lowest pay of the senior grade. He had no doubt the Surveyor General had the power to promote from the Junior to the Senior, but it was not customary to do it.

Mr. Hill, senior draftsman, was questioned on this subject, and explained that all the men come in as apprentices; no man is put straightaway into the Senior Division; the Senior Section is not entirely recruited from the Junior; in promoting a man the fact is taken into account whether he is conversant with English and is a good draftsman. He did not know the history of the two sections. He makes the recommendation that a man from the Junior should be promoted to the Senior Section.

Colonel Longe said that such a recommendation would have to come up to the Surveyor General, because it is not only the Surveyor General's office that is affected. The men in the Dehra Dun office are on the same list, and a man on the Dehra Dun list would not be superseded without a reference to the office there.

Mr. Hill (*continued*).—A man from the School of Arts could be put in straightaway on Rs. 50, if there was a vacancy. If an apprentice is efficient, he can fairly look forward to rising to the higher rate of pay.

Colonel Longe stated that there are hard-and-fast rules on the subject, and the President requested that they should be furnished to the Committee.

Mr. Hill said he considered the class of boys coming in as apprentices inferior; they are uneducated. There might be an improvement if Sibpur and the Presidency College were approached. Boys from these schools would not come on Rs. 10. The relatives of men in the Department often come in as apprentices; they generally turn out fairly well. The ultimate rates of pay offered are too low to attract a superior class of men. He would suggest an increase of pay in both grades, as he did not consider the present rates sufficient. The lower rate of Rs. 10 should be raised to Rs. 20; boys coming in to the Department should come in with certificates from the head of their school or college, otherwise they should not be enlisted; they should be between the ages of 16 and 18; 16 should be the lowest limit of age; the only way of knowing whether a certificate belongs to a particular boy is that his name is mentioned, and he is known to everybody.

† Not printed.

‡ Colonel Longe explained that this was to keep the rats and white ants out; the only way to prevent damage from them was to keep the maps away from the walls, so that the maps can be got behind and the shelves seen through. This does not apply especially to Calcutta. That difficulty is got over in the case of originals by the fact that they are very small in number, and there is a regular system by which they are opened and examined daily.

Major W. J. Bythell. to the mile plans of Calcutta; and a provincial map of the United Provinces. The 16-mile maps are in various stages; there are besides these all the Atlas sheets.

28. I put in a statement* showing the number of districts in each province, with the number for which the Department has engraved maps on the $\frac{1}{8}$" scale.

29. I cannot say if there are arrears in the Copper-plate Engraving Department, it depends on what are called arrears.

Q.—Take this one point, have you material in office from which you can complete any or all the remaining Atlas sheets, not yet published, but which you cannot take up with your present strength?

A.—No, there are several sheets in Burma for which we do not possess the material; it is coming in gradually. All the rest of India outside Burma is complete with the exception of a blank in Rajputana, for which we have no material ready. On the North-West Frontier, we have only small sketch surveys; we have no satisfactory material for Atlas sheets there. According to this, we have no arrears, but a good many sheets are out of print. There is no scheme of what we have to work up to, *i.e.*, there is no fixed date given, by which the whole work is to be complete.

30. *Q.*—As regards arrears, are there not 196 copper-plates of which the prints cannot be supplied owing to the necessity for carrying out corrections?

A.—There are 116 quarter sheets and 28 full sheets out of print out of a total of 550 quarter and 79 full. We will not be able to carry out corrections on these and complete them in the next 12 months as well as do our normal work. The sheets are not merely out of print; they require corrections and additions. We could print them in their present state, but the boundaries would be wrong and the spelling also. This would not apply to every sheet we have. It is not necessary in every case as each sheet runs out of print to bring it up to date. In some cases, the corrections are very small and of no great interest to the public, and do not affect the topography of the map.

31. When reprinting, I have 75 copies pulled as it stands, to meet current demands of the public, before the sheet goes to the engraver for correction. We print these 75 copies from the original plate. And we carry out all corrections on the original plate. We have no duplicates of any of these plates.

32. When the sheet is brought thoroughly up to date, the spelling is corrected as far as possible. We can tell when any corrections are required from the office copy which we keep When we receive notifications of changes of boundaries from the local authorities which are to be put on the standard sheet, the office copy is corrected accordingly. The corrections to Atlas sheets really depend upon what has been done with regard to the standard sheets.

33. *Q.*—Do you get information from local authorities in every case when a correction is required either on the standard sheet or on the local sheet?

A.—The Provincial Government notifies every occasion when there is a change of boundary or transfer of territory, and we receive copies of the notifications. With regard to details of railways which we also add to the Atlas sheets, we send periodically to enquire if there are any changes; the Public Works Department also send us blue prints of all new lines.

34. Electro-typing matrices of duplicate plates is work that the Photographic and Lithographic Office is concerned with. We print from the original engraved plates. Supposing it were considered necessary or desirable to have electro-typing in my office, there is no suitable room where the electro-typing baths could be used. I know of no room in the office.†

35. The Drawing Office draw on the dry print, getting their material from the standard 1" sheets; which are reduced to $\frac{1}{4}$" or Atlas scale. These reductions are not all photographic at present. I would propose that the system be more largely employed in future. At present the reductions are made by pentagraphing or by squares. New work is put on in red.

36. The number of new $\frac{1}{4}$" sheets which have been prepared since the engraved work was undertaken in India, *i.e.*, since 1869, is 202. Of these 97 were entirely new sheets of parts of the country of which no Atlas sheets existed before; and 104 were of parts of the country of which full sheets were already in existence, while one sheet had already been published as a quarter sheet.

37. The copper is purchased from the India Office stores in London. I have no complaints to make of it. I consider the buildings in which the copper plate engraving is done are entirely satisfactory. The fitments are up to date, but the hot press is certainly not up to date. I think that if the fitments were completely brought up to date, the output might be increased. I have asked the Assistant Surveyor General in charge for a hot plate in connection with gas. I made enquiries from the Public Works Department who said that, as the main was turned off all day, the gas could not be given during office hours.

38. *Q.*—Would there be any objection to removing the whole Engraving Department, separate from the Drawing Office and electro-typing, to another station?

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* Appendix B, p. 113.

† Colonel Longe stated that the work could be done in the Photo-zincographic office. There was room in the compound for building and he thought there was an existing room which might be adopted.

A.—It would be rather hard to remove the Engraving Department away from the Drawing Office. I think work would be better done in a hill station, and that Dehra would be better from an engraver's point of view. The men chiefly employed are Bengalis, who would probably object to going up country. The Europeans and Eurasians are mostly (Mr. Coard thinks) Calcutta people. I think the natives would certainly object to going to a hill station all the year round. I think that Bangalore or Poona would be more suitable places than Dehra Dun. Major W. J. Bythell.

Questioned as to the existing rules for the sale of maps.

39. We have no printed rules for the guidance of our Agents, but when appointing them we lay down the conditions. Our Agents do not sell maps required on Government service. The Agents do not stock maps, but indent upon us. Maps are supplied to agents only when indented for by them. The terms of commission vary between 10 °/₀ and 25°/₀, *viz.*, the Agents for Assam, Lahore and Rangoon get 25°/₀; Bombay, Madras, Mussoorie, Poona and Mandalay get 20°/₀, and at Simla get 10°/₀ only. A stock account is submitted yearly, and is checked in the Map Record and Issue Office. The value of the maps sold, less commission, is paid into the local treasury and the treasury receipt sent to this office for adjustment. The sales of all Agents last year amounted to Rs. 1,756, the Photo-zincographic office at Poona alone selling Rs. 1,359.

Mr. S. M. Coard, Head Engraver, Engraving Department, was called in and stated:—

There are 117 sheets for which there is no material at all. They are not in the Engraving Department. 141 sheets are in progress for which there is material. Portions of these are engraved. Some may have complete material. The sheets are not of new country. We are making new sheets of the parts of the country marked blue in this index map (shown). A great part of this is being prepared for the new edition of the Indian Atlas; *i.e.*, the portions marked by a circle. The circles show where there is a previous full plate. We have complete material for 14 quarter-inch sheets. Of these some are in Burma, and we are working on these Burma sheets now. Of the others one is in Madras. I cannot say what material we have got for that. By the statement "published sheets under correction" we mean that these are sheets that are being brought up to date in the Drawing Office. I have to bring them up to date on the copper-plate. As far as we are concerned, only 42 sheets are in arrears. Some of these have been taken in hand, but not all. I cannot say how many have been taken up. We complete one before taking up another. Of the 42 a dozen have been partially or completely taken up. This represents 8 months' work for my Department, and if we stopped all other work, probably about 6 months for the whole Department. None of these are Burma sheets.

It takes us 2½ to 3 years to engrave an ordinary quarter sheet. This includes both outline and hills. The men are divided into hill and outline engravers. I cannot give the average time taken by each separately.

It takes us from 5 to 7 years to train a native as an engraver. During that time he is working very little for progress. It takes about 5 years to train a European. The apprentice time is 7 years. His work is to a certain extent being made use of by his employers before that time. We take on both Europeans and Natives at about the age of 16. We train the European apprentices here also. I consider that we cannot increase in this country the available strength of the Engraving Department for 5 years to come. Hill work is the most difficult. Yet it does not require necessarily to be done by a European; Eurasians and Natives are qualified for that sort of work.

The cost of engraving when the sheets went home, used to be £100 on the average for quarter sheets. Some had only a little piece of work in the corner. I am basing my opinion on 20 sheets. The average area of mapping on the sheets that cost £100, was about half a sheet. Therefore the cost would be about £200 for a full quarter sheet. Nobody ever found out what the full sheet used to cost as engraved by Messrs. Walker in England. The approximate size of the quarter sheets is 20″ × 14″. It was in 1875 and 1876 that the above prices were paid to Messrs. Malby. I think their charge would be much about the same as the cost of engraving at Calcutta, making allowances for the cost of apprentices, supervision, house-rent and other *etceteras*.

Mr. Coard was asked to give a general description of the method by which the new quarter inch Atlas sheets are engraved on copper. He stated that the work comes first to the Engraving Department as a projection drawn on paper. This is prepared in the Drawing Office. The Engraving Department project it on to the copper plate, and then send in the dry print to the Drawing Office for compilation, from the projection.

Mr. Coard, asked to explain how the reductions were fitted on to the copper, stated that they did not fit successive standard sheet reductions to the copper plate, but made one complete drawing. The hills are brush shaded in the Drawing Office; the brush drawing is on the same scale as the engraved drawing. The brush drawing is as far as possible complete for the whole ¼″ sheet. That is handed to the engraver, and he fills it in as nearly as possible, as to depth of shade. This hill drawing is always done on the same plate as the ¼″ outline. He has had little experience of drawing hills on separate plates, but he does not think the engravers would have any great difficulty in engraving hills on a separate plate. They have done one such plate. None of the names are done by stamping.

Mr. Coard was asked whether he had any complaints to make against the climate of Calcutta, and stated that it is a very trying climate for engravers. The work undoubtedly falls off in the hot weather. There is no great difference in the amount of light between the rains and the rest of the year. The light is always good in India. The office has a north light.

Appendix A to Major Bythell's evidence.

Amulgamated list of draftsmen on 1st October 1904.

No.	Names.	Office to which now attached.	Date of first appointment.	Present pay.	Pay of post.	Remarks.
	European draftsmen.			Rs.	Rs.	
1	A. J. Musgrove	Calcutta	22nd April 1877	300	300	
2	A. S. Bateman	Do.	6th Dec. 1882	250	250	
3	Vacant	...	...	...	200	
4	.....	Forest	...	...	175	
5	C. L. Green	Calcutta	1st April 1893	150	150	
6	Vacant	Do.	...	...	125	
7	A. S. Nelson	Do.	26th May 1898	100	100	
8	.....	Mussoorce	...	...	75	
9	T. J. Jelicoe	Calcutta	14th May 1901	50	50	
					1,425	
	Native draftsmen.					
	Senior Section.					
1	Purna Chandar Sen	Calcutta	10th July 1877	120	120	
2	.....	Dehra	...	...	100	
3	Abdur Razak	Calcutta	3rd July 1873	100	100	
4	Bacharam Banarji (*a*)	Do.	1st July 1869	100	100	(*a*) Extension of service up to 24th December 1905.
5	Ram Chandar Sen	Do.	1st March 1879	90	90	
6	Tincowri Sen (*b*)	Do.	5th April 1869	90	90	(*b*) Extension of service up to 17th December 1905.
7	.....	Dehra	...	...	90	
8	.....	Mussoorce	...	...	80	
9	Narendra Nath Mukerji	Calcutta	1st Dec. 1892	80	80	
10	Subodh Chandar Sarkar	Do.	15th Nov. 1892	80	80	
11	Harendra Krishna Gupta	Do.	10th April 1895	70	70	
12	.....	Dehra	...	...	70	
13	Nasrat Husen	Calcutta	1st Sept. 1893	70	70	
14	Rash Behari Goswami	Do.	15th March 1894	60	60	
15	Rash Behari Sen	Do.	22nd March 1894	60	60	
16	Abinash Chandra Banarji	Do.	8th April 1895	60	60	
17	Nilmani Kundu	Do.	8th April 1895	50	50	
18	Bepin Behari Ghose	Do.	11th Nov. 1895	50	50	
19	Muhammad Baksh I	Do.	9th April 1895	50	50	
20	Sarat Chandar Kumar	Do.	10th April 1893	45	50	
21	Chuni Lal Dutt	Do.	9th July 1896	40	40	
	Carried over	.....	...	...	1,560	

Note.—The posts, such as Nos. 4 and 8, etc., which have no names entered opposite them, are held by men at Dehra or Mussoorce.

Amalgamated list of draftsmen on 1st October 1901—contd.

No.	Names.	Office to which now attached.	Date of first appointment.	Present pay.	Pay of post.	Remarks.
	NATIVE DRAFTSMEN—*contd.*					
	Senior Section—concld.			Rs.	Rs.	
	Brought forward .	.....	...	...	1,560	
22	.....	Dehra .	...	...	40	
23	Habibar Rahman . . .	Calcutta .	1st Aug. 1890 .	40	40	
24	Abdul Latif II . . .	Do. .	1st May 1889 .	40	40	
25	.....	Dehra .	...	...	30	
26	Khoda Baksh . . .	Calcutta .	14th May 1887 .	30	30	
27	Sarat Chandar Das . .	Do. .	5th Feb. 1891 .	30	20	
28	.....	Mussooree .	...	...	25	
29	Sib Krishna Roy . . .	Calcutta .	19th Jan. 1888 .	25	25	
					1,820	
	Junior Section.					
	Kadrat Ali . . .	Calcutta ,	1st July 1878 .	50	50	Additional Establishment.
1	Muhammad Yasin . . .	Do. .	1st March 1875 .	50	50	
2	Mogal Jan	Do. .	15th May 1875 .	50	50	
3	Behith Husen . . .	Do.	1st July 1889 .	50	50	
	Muhammad Buksh II . .	Do. .	1st Dec. 1900 .	50	50	Do. do.
	Ambika Charan Das . .	Do. .	1st April 1874 .	50	50	Do. do.
4	Ebaratulla	Do. .	1st May 1876 .	40	40	
5	Sheik Ahmad	Do. .	1st March 1890 .	35	40	
6	Muhammad Ismail . .	Do. .	15th July 1893 .	40	40	
7	Nazimuddin . . .	Do. .	1st Oct. 1879 .	30	35	
8	Abdul Gafur . . .	Do. .	1st Nov. 1885 .	35	35	
9	Krishna Mohon Das . .	Do. .	1st June 1890 .	35	35	
10	Hari Nath Das . . .	Do. .	15th July 1880 .	30	30	
11	.....	Dehra .	...	...	30	
12	Abdul Jabar . . .	Calcutta .	1st November 1892	30	30	
13	Vacant	Do. .	...	...	30	
14	Muhammad Abdul Hai . .	Do. .	1st Nov. 1892 .	25	25	
15	Ghulam Hydar . . .	Do. .	1st Sept. 1899 .	25	25	Temporary.
16	Abdul Latif III . . .	Do. .	1st Dec. 1892 .	25	25	
17	Azizur Rahman . . .	Do. .	1st Dec. 1892 .	25	25	
	Ramanath Bardhan . .	Do. .	1st Dec. 1892 .	25	25	Additional Establishment.
	Muhammad Husen Khan .	Do. .	6th Jan. 1896 .	25	25	Do. do.
	Gulam Athar . . .	Do. .	1st Nov. 1893 .	25	25	Do. do.
	.....	Dehra .	...	...	25	Do. do.
18	Chuni Lal Das . . .	Calcutta .	22nd April 1898 .	20	20	
	Carried over . .	...	...	...	865	

Major W. J. Bythell.

Amalgamated list of draftsmen on 1st October 1904—concld.

No.	Names.	Office to which now attached.	Date of first appointment.	Present pay.	Pay of post.	Remarks.
	NATIVE DRAFTSMEN—concld.					
	Junior Section—concld.			Rs.	Rs.	
	Brought forward .	...	...	...	865	
19	Benod Lal Dutt . . .	Calcutta .	20th Sept. 1898 .	20	20	
20	Abdul Sobhan . . .	Do. .	15th July 1893 .	20	20	
21	Ganandra Nath Shaw . .	Do. .	3rd July 1895 .	20	20	
22	Nesar Ahmed . . .	Do. .	16th May 1898 .	20	20	
23	.....	Dehra .	...	...	20	
24	Karali Charan Guha . .	Calcutta .	29th Nov. 1899 .	20	20	
25	Munmothanath Nandan .	Do. .	12th March 1899 .	20	20	
26	.....	Dehra .	..	...	15	
27	.....	Do. .	...	...	15	
28	.....	Do. .	...	...	15	
29	Muhammad Yeasin Ali .	Calcutta .	8th Nov. 1901 .	15	15	On probation.
30	Suropodo Roy Chowdhuri .	Do. .	1st March 1902 .	15	15	Ditto.
31	Satya Charan Haldar . .	Do. .	13th May 1902 .	15	15	Ditto,
32	Abdul Huq . . .	Do. .	1st June 1903 .	15	15	Ditto,
33	Nibaran Chandar Dey . .	Do. .	1st July 1903 .	15	15	Ditto.
34	Bhuth Nath Shaw . .	Do. .	4th Dec. 1903 .	15	15	Ditto.
35	Satish Chandar Chakarbaty .	Do. .	7th April 1904 .	12	12	Ditto.
36	Vacant	Do. .	...	...	12	
37	Syed Baksh	Do. .	21st April 1904 .	10	10	Ditto.
38	Abdul Khalik . . .	Do. .	17th May 1904 .	10	10	Temporary.
39	Abdus Sattar . . .	Do. .	3rd June 1904 .	10	10	On probation.
40	Abdul Aziz	Do. .	23rd July 1904 .	10	10	Ditto.
41	Mogal Jan	Do. .	1st Aug. 1904 .	10	10	Ditto.
42	Muhammad Yaqub . .	Do. .	18th Nov. 1904 .	10	10	Ditto.
43	Vacant	Do. .	...	...	10	
44	Vacant	Do. .	...	...	10	
45	.....	Dehra .	...	...	6	
46	.....	Do. .	...	...	6	
47	.....	Do. .	...	...	6	
	.....	Do. .	...	...	6	
49	.....	Do. .	...	...	6	
50	.....	Do. .	...	...	6	
51	.....	Do. .	...	...	6	
52	.....	Do. .	...	...	6	
Writer.	.....	Mussooree .	...	...	50	
			Total .	...	1,342	

APPENDIX TO MAJOR BYTHELL'S EVIDENCE. Major W. J. Bythell.

Statement showing the number of districts for which engraved maps on the $\frac{1}{8}$" scale have been prepared.

PROVINCES.	NUMBER OF		ENGRAVED PLATES (MAPS).	
	Districts.	States.	Districts.	States.
Assam	12	3	5	...
Bengal	45	5	45	...
Bombay	16	12 or 13	...	...
Burma	36	2 Shan	...	...
Central India Agency	...	30	...	...
Central Provinces	24	12	23	...
Gujarat	14 and States	...	...	...
Hyderabad	18	...	...	...
Madras	21	3	...	...
Mysore	8	...	...	...
North-West Frontier Province	7	...	4	...
Punjab	27	6 or 7	26	...
Rajputana	...	18	...	...
Sindh	6	1	...	...
United Provinces	48	2	48	...

Mr. T. A. Pope, Assistant Surveyor-General, in charge of the Photographic and Lithographic Offices, Head-quarters Calcutta. Mr. T. A. Pope.

[*Calcutta, 9th February 1905.*]

1. I have been in charge of the Photographic and Lithographic Office since 1897, and have been attached to it since 1886. The office does not undertake map engraving, but it executes photographic engraving, or photogravure, for other departments.

Photographic Department.

2. We have five cameras employed on map work in the Photo-Lithographic Office, one large and four somewhat smaller. The year 1903-04 was one of great pressure of work and the whole office was more or less working at its full power. The number of negatives taken during that year was roughly 2,000. I consider the possible daily output of a camera to be six or seven negatives a day, *i.e.*, 1,500 in a year. We have no arrears now, properly so called, in the negative section, so that there is not likely to be any pressure of photographic work in 1904-05 or in the immediate future. This is entirely due to the introduction of the Vandyke process, which has relieved the cameras of much work that would otherwise have to be done by photography.

Printing Department.

3. We have five lithographic machines and 30 hand presses. Assuming that 15 of the hand presses are used for proving, transferring, and work of that nature, it leaves 5 machines and 15 presses available for other work. I accept the daily output of a hand press to be 80 to 100 pulls and of a machine working at its full power 1,000 pulls a day, but the average outturn would be considerably smaller. Taking into consideration that we have 250 working days in the year, I am prepared to accept 1,500 pulls as the average daily output. The total number of pulls that the machines and presses are capable of giving in the year is therefore 1,500,000. In 1903-04 the total output was 1,300,000 pulls.

4. At the end of the year there is always a large amount of printing work left over to be done during the ensuing year. Arrears, however, did not increase in 1903-04, at any rate appreciably.

We have sufficient machine power to cope with the work now sent us. We do not allow arrears of survey work to accumulate, so that what goes to the wall is only extra-departmental work. Formerly the survey work was at times delayed by extra-departmental

Mr. T. A. Pope.

work, but lately the practice has been to make extra-departmental work give way to survey work. I put in a statement * showing the exact state of arrears on the 1st of this month. The output of departmental work in 1903-04 was 358,000 pulls. Of this number, the work which the Committee considers as work which should properly have been undertaken at the Survey Office, Calcutta, amounted to 177,000 pulls. We have a printing capacity here of about 1,500,000 pulls annually.

* Not printed.

5. I do not think it is true in practice to say that this still leaves a capacity at Calcutta for additional extra-departmental work to the extent of 960,000 pulls, for the reason that at all times during the year we have not work to keep all the five presses going. Large work can only be done by two of the five machines, and when the bulk of the work to be printed is on large plates, it follows that one or two of the smaller machines have sometimes to lie idle, while there is a large pressure of work on the others.

We have had only four of these machines for the last five years. One of these was brought out from home last year to replace an old machine which had completely broken down. This is the only change we have had during the last five years, but at the close of last year we received a fifth machine from England.

6. I have nothing more to say as regards quantity. We are quite competent to turn out all the work required of us at the present time, so long as the amount does not increase. But we could not deal with an increase.

7. When the Surveyor-General asked for an estimate of the work each machine is capable of turning out daily, I gave it as 2,000 pulls, because I understood that he referred to an emergency such as mobilisation. The standard sheets which would require to be printed in such a case would involve no change of plates and colours, and the machines could work at full pressure continuously throughout the day. The figure 1,500 has been taken as the *average*, taking into account all the changes unavoidable in a printing office, but these would not need to be taken into account in dealing with a large and sudden demand for copies of standard sheets only.

If no new work came in, the whole of the arrears standing on any given date could as a rule be cleared off in two months.

8. *Q.* (*Colonel Grant.*)—Have you considered the possibility of increasing the output by three following methods?

(1) Adopting piece work;

(2) Working overtime;

(3) Increasing the normal daily hours of working.

A.—I have never considered (1). I do not see how it could be made applicable to machinery. It could be introduced in some of the sections, such as the one engaged in graining plates, but I doubt if it could be introduced into the printing section.

(2) Would be the same thing as (1), except that overtime would be piece work after office hours. Like the piece work system it could be introduced in some sections.

I have considered (3) over and over again for many years past. I am afraid it cannot be introduced, unless the men are given more pay. The better class of men, drawing say Rs. 20 and upwards, say they cannot afford to live near the office, where rents are very high, and consequently they have to come from great distances, often starting for office as early as 8 A.M. The poorer classes, on the other hand, herd together in the bustees near the office, but they all engage in outside work before and after office hours, as they cannot possibly support their families on their pay.

I have never therefore proposed lengthening the hours officially, because it would mean a very large increase of pay all round. The working hours at present are 10 to 4 with half an hour for lunch. I think the hours in the Government Press are half an hour longer, and the men work there overtime also.

Processes of reproduction.

9. *Q.* (*Colonel Grant.*)—In the two reports, or series of notes prepared by the Surveyor General for the use of the Committee, I think there is a general tone of appreciation of photographic transfer work. I presume that you have no objection to replacing photo-zincography by the general practice of helio-zincography?

A.—I think that it is extremely desirable that this change should be introduced in all map-reproducing offices in India. The difference in the two processes is that in photo-zincography the image is transferred from the negative to the zinc plate by means of a carbon transfer, a method which gives results inferior to those obtained by the latter process, in which the image is transferred direct from the negative to the zinc plate.

10. *Q.* (*Colonel Grant.*)—There is also in the same papers a general tone of appreciation of the process of lithography. Do you demur to the statement that lithography is in some cases almost as expensive as copper engraving?

A.—I should not have thought that was the case. I have no experience of the cost of copper engraving.

11. I produce two sample maps produced by helio-zincography, as showing the quality of work turned out by the Calcutta Office. (Degree Sheet No. 40, part of the Northern and Southern Shan States, and Sheet No. 95, India and adjacent countries.)

Colonel Grant produced a sample of similar helio-zincographic work done at Southampton, to show the standard to which this work has been brought in England.

I do not think we can turn out anything better than the samples produced. These are fair types of the work we turn out. Mr. T. A. Pope.

I do not consider our work as good as the English.

12. *Q.* (*Colonel Grant.*)—Will you explain to the Committee how in your opinion the quality of your work can be improved?

A.—In the first place it is necessary to improve the style of the original submitted; secondly, we must have a better class of men to do the work, particularly better printers. The excellence of the English specimen is very largely due, I think, to the amount of work which is put on the negative. In Calcutta this class of work is done by low-paid natives who cannot possibly be expected to turn out the same class of work as is done at home. Then the process of transferring the plates from the negative to zinc is now done entirely by a staff of Eurasians and natives who are more or less incompetent. I have applied to Government for a European to take charge of this work. Thirdly, the quality of the paper on which the printing is done might also be improved.

The question of supervision has been gone into, and I think it is now in a fair way of being put right. We are expecting two additional European assistants from home shortly.

13. I do not think that the inferiority of our work is due to climatic reasons, not at any rate since we introduced helio-zincography.

As specimens of what I call bad originals for photographic work, I produce a number of old originals of standard sheets much discoloured and with many additions pasted upon them and also an original map of Burma in two sheets, one of which is outline and the other hills. I call this last original bad because the hill sheet is half an inch shorter measured diagonically from one corner to the other than the outline sheet, so that the correct registration of the hills on the outline is impossible. I also think that the paper on which it is drawn is not suitable. This sheet has been reproduced before, but is now out of print, and came into my office two or three days ago to be reprinted. The copies were printed in October 1898 (Sheet No. 382). The sheet originally registered all right, because the paper at that time had not contracted as it has done since.

14. As regards the inferior class of artisans, and obtaining a better class, we ought, I think, to have a European in charge of each of our large machines. We have now in charge of the five machines—one European, who is by no means a first class man; two Eurasians trained in the office; and two Natives.

I do not consider this a sufficiently competent staff to turn out good work. We have had new machines from time to time, but no arrangements have been made for providing a proper establishment to work them. This is, I think, the principal reason why our zinc printing is not as good as it should be.

15. As regards the improvement of the printing paper, we are entirely at the mercy of the India Office. We do not know, as we ought to know, what the best printing paper is, and we have therefore to be content with what is sent out. I think if we knew what the best kind of paper was and had the power to get it, it would tend to improve matters. We get all our paper from the Stores Department, India Office, and in recent years the quality of the paper has been lower than it was formerly.

Printing paper.

Independently of the quality, I do not think that the sort of paper supplied, on which the standard sheets are printed, is a satisfactory lithographic paper. I am inclined to think that the paper used at present is too hard. I have no doubt that the quality of our work would be improved by the use of softer paper, though the impressions might not stand wear and tear so well.

I should say that printed maps should last 100 years if they are kept away from light and air and white ants. It really depends entirely on the amount of handling they have to undergo, and I do not see any reason why they should not last for ever if they are well protected.

16. *Q.* (*Colonel Grant.*)—Do you know if the India Office takes any steps by examination—microscopic or otherwise—to see what the paper is made of, and also if it examines samples of the paper before purchase—chemically or otherwise—to ascertain its quality?

A.—I do not know what the procedure is in the India Office. I do not think anything of the kind is done there, where the object seems to be to send the cheapest paper procurable for our requirements. We are constantly asking for better paper. In fact we invariably ask the Stores Department to send us the best paper that can be obtained. I made enquiries about this the last time I was at home, but with no satisfactory result. On our part we send them samples of the best paper we have got out here, but in all probability there is very much better paper to be had. At the same time we also specify the paper we want and its weight, but there might be many qualities of the same weight. We spend from £1,000 to £2,000 a year on paper.

Colonel Sir John Farquharson asked Colonel Grant whether there was not considerable difficulty some time ago at Southampton in getting the superior quality of paper which was thought necessary for the publication of maps. Did not the Board of Agriculture desire that its supply should be made, like any other contract system, by tender from the paper makers, instead of the Ordnance Survey selecting the necessary quality of paper. Has that system since been improved and does the Ordnance Survey now select for itself the kind of paper required.

Colonel Grant stated that the Ordnance Survey purchases its paper at open tender, but retains power of selection.

Mr. T. A. Pope.

Mobilisation maps.

17. I think that the printing of mobilisation maps or maps for the army should be undertaken by the topographical section of the Survey of India. We are prepared at any time to stop all other work and put all our printing power on to maps for mobilisation purposes. I think we have ready all the essential plates, or the corrected negatives of all the plates, that would be required by the military authorities. There are a good many of them at Dehra, but the rest we have here in Calcutta. We keep all the plates of trans-frontier sheets. These can be printed at a moment's notice.

Examination of copies.

18. We have no system of examination of each copy printed in our presses. Each printer, whether Eurasian or Native, is supposed to be responsible for the quality of the work turned out by his own machine press. If it is found that he is allowing bad pulls to pass, he is fined or otherwise punished, but it is undoubtedly desirable that every copy should be examined by an independent examiner. We have no one in the office who can be spared for this work, and until some arrangement of this kind can be made, it will be impossible to prevent a considerable number of bad impressions from passing undetected.

Seasoning of printing paper.

19. Our arrangements for seasoning the paper before printing are as follows:—Whenever we get a large printing order for any particular map that has to be printed in colours, the paper is taken out and hung up for one or two days before the printing begins in order that it may get as dry as possible. We hang it either in the stone godown which is the driest and airiest place we have, or round the gallery of the printing room. The object of hanging the sheets out in this way is to get them equally dry. By hanging them in the open air we get them all uniformly dry. No attempt is made to see that the maps do not shrink or expand after publication. I do not see what steps could be taken to ensure this in this climate.

In printing black impressions only, the paper is taken from bulk direct to the machine. This is chiefly because we have no room to provide for the hanging of all the paper required for printing. It is undoubtedly advisable to hang it all.

Type.

20. I think the type used in typing manuscript plans is too heavy or broad-faced for the purpose.

Photogravure Section.

21. *Q.* (*Colonel Grant.*)—In case of the necessity of getting more space or reducing the amount of work done in the Calcutta Office, what is your opinion about removing the Photogravure Section to some other office under the Government of India?

A.—The removal of the Photogravure Section would provide a certain amount of extra accommodation which might be utilized either for printing purposes or for draftsmen. But I should be sorry to have this section removed, because I believe that in the near future we shall be able to employ it on departmental work which we have never done before; that is, in the preparation of photo-etched copper plates from brush shaded hill drawings. I think we are now in a position to introduce this system, provided that the Drawing Office can supply the brush shaded originals. I think the system of photo-etching for hill printing might be introduced for the map of India and adjacent countries, the degree sheets and small scale maps generally. Up to the present the Photogravure Section has been exclusively used for extra-departmental work, except that it is employed to produce matrices and duplicates of a large number of hand-engraved copper plates prepared in the Engraving Office. This portion of the work, however, might equally well be done in the Engraving Office itself. I cannot say how many copper plates of the Atlas sheets we have made matrices and duplicates for. It is a question which the Engraving Office should be asked.

By photo-etching I mean the reproduction of hills by a photo-mechanical process, as in the case of the Ordnance Survey map of Scotland produced by Sir John Farquharson.

The annual cost of the Photogravure Section is about Rs. 13,500. The work of supervising this section takes up a share of my time, but not such a large share as the other sections, because it is supervised by a skilled photographic engraver. It takes up also a good deal of space—three rooms—which could be used for other purposes.

Letter Press Printing Section.

22. *Q.* (*Colonel Grant.*)—Is your Letter Press Printing Department strong enough not only to provide for transfers and proving, but also for printing all the forms for the Survey of India?

A.—It requires strengthening, though it does all the work required of it. I do not think anything would be gained by having all forms printed in some other Department and relieving the Photographic Printing Department of some of its work. The work would not cost less if done elsewhere, and the Department would not be so well served. The annual cost of the Printing Department is about Rs. 8,200.

Stores.

23. I am satisfied with the stores (including chemicals) that we purchase either direct from the manufacturers or through the Stores Department, India Office. With the single exception of the printing paper I think all the stores that we receive are of the best quality. We hardly get anything locally except the common acids and so on. I have no complaint to make of the stores sent out from home. We can get graining sand locally, but it is not of so good a quality as that sent from home.

24. *Q.* (*Colonel Grant.*)—Are you satisfied with the equipments and fittings generally for your work ?

Equipments and Fittings.

A.—I think a great many of the things required in England are not required in a hot climate like that of India. I am on the whole satisfied with the fittings as they stand now in the office. Our arrangements are not such that we can at any moment find any zinc plates. required. This is a matter which is being arranged for. We are building a place for the storage of zinc plates.

25. I have never found the necessity for artificially drying the zinc plates even in the damp weather to keep them from oxidizing. They are put out in the sun before printing, and that seems to answer the purpose quite well. We never seem to have had any special trouble from oxidation.

26. There are no arrangements for the officers in charge of the various reproducing offices in India to visit each other from time to time. I have never been to Poona or Roorkee.

27. *Q.* (*President.*)—Supposing you had better paper than is supplied at present, what additional expense do you think would be incurred ? Would it be double as much ?

Cost of better paper.

A.—I do not think it would affect the price at all. The fact is that we at present get inferior paper for the price we pay, and I am sure if there were some means of checking the quality of the paper sent, there would be no extra cost involved in obtaining a very much superior quality.

28. I have no register to show the amount of work pending at any given moment. We have, however, a register in which each item of work is entered as it comes in, and the stage of its progress is recorded. But we have nothing to show what the arrears were about this time last year as compared with arrears standing on the 1st February of this year. We do not prepare any statement showing the amount of work that comes in during the week or the month, and the amount of it that is done. The Surveyor-General can only get an idea of the state of work by asking for information. Our work comes chiefly from the Drawing Office and some from various extra-departmental sources. The extra-departmental work does not always come to me direct. All my survey work comes through the Drawing Office. There would be no difficulty in preparing a statement of departmental work received from the Drawing Office showing the amount completed and the balance remaining to be finished. We do prepare a monthly statement for departmental work which goes regularly to the Surveyor-General. There would be no difficulty at all in preparing a similar statement for extra-departmental work. It would be useful for myself as well as for other authorities.

Questioned as to arrears.

Mr. Pope produced the statement he referred to.

A diary is kept up by each printer showing the number of pulls taken and the amount of work that is being done by him. The head and assistant printers also maintain a similar register, and all the diaries are sent to me each month for inspection.

29. I have only four men engaged in supervising work, *viz.*, one head assistant, one second assistant, one photographic engraver and one foreman lithographic printer.

Establishment.

Mr. LeFranc, Head Zinc Printer, is in charge of the transferring and proving of zinc plates and of five hand presses engaged on printing work. He is not a highly efficient man, but very hard-working and gets Rs. 350 a month. He is rather out of date, and is a man trained in the office.

Mr. Deas is the only European we have in charge of a machine. He is in charge of the most important of the five, and gets Rs. 330 a month. I do not consider him a first class man. He has worked himself up in the ordinary course of promotion through the graded establishment.

Mr. D'Pyvah is the Head Type Printer. He is a very useful man.

Mr. Meade is in charge of the Silver Printing Section.

Mr. Ravenscroft gets Rs. 175. He is in charge of the new machine, but is not sufficiently qualified for the work. He had never been out of this country till lately. He is a man entirely trained by us.

We could not get better men than these for the pay we give them.

30. Most of our young draftsmen come from the School of Art. They come as apprentices on no pay, and are trained until their qualifications are good enough, and then when vacancies occur at the bottom of the list, they are given to the most promising of these unpaid men. They get Rs. 12 a month.

Draftsmen.

31. *Q.* (*Sir John Farquharson.*)—Have you any power of increasing or decreasing the pay given to the men, or do they rise mechanically by promotion according to seniority ?

A.—I have no power to modify their pay, but have of course the ordinary control over promotions from one grade to another.

32. *Q.* (*Colonel Grant.*)—What do you think of Calcutta in comparison with other places in India as regards the suitability of its climate for photographic work ?

Climate of Calcutta.

A.—I cannot say Calcutta has an ideal climate for photographic work of any kind. A drier climate, I think, would be preferable. I know nothing of Poona, but judging from hearsay

Mr. T. A. Pope.

I think the climate of both Roorkee and Dehra is certainly better than that of Calcutta. I do not say this from personal experience.

Quality of the labour supply.

33. For the purposes of training as printers or labourers the natives of Bengal are inferior to those of Madras, Poona or Roorkee. As regards general intelligence, I consider them very much inferior, certainly to the people of Madras and probably to the United Provinces men also. We are not tied down, however, in the matter of recruitment, but up-country men will not come on the pay that is offered.

34. *Q.* (*Colonel Grant.*)—I believe it is customary in the Zinc Printing Department to work five men at a hand press and on occasions six at a machine and two at a platen letter press. Paragraph 199 of the rules for the working of the Photographic and Lithographic office states that one printer and two pressmen should be attached to a hand press. Cannot economies be effected by reducing the number of men working at the machines ?

A.—As regards the hand presses, the rule quoted apparently omits the sponge-man who is an assistant to the printer. We have, therefore, for each hand press four men—one printer, one sponge-man, whose business is to keep the plate damp, and two pressmen, one of whom is an ink man.

As to machine presses, we cannot possibly do with less than six men in a machine in which large work is being done, but these men get such wretchedly small pay that it is hardly worth while trying to effect an economy in this direction.

As regards the platen letter press machines, we are unable to work with less than two men, one laying on the paper and the other taking it off. No man that we can get in Calcutta would attempt to do it singly. An English boy might possibly be able to do it, but then he is different to the ordinary native. The men simply will not do the work singly. I am not sure they would do it even if they got better pay.

Extra-departmental work.

35. (*President.*)—I understand extra-departmental work comes to you direct ?

A.—Not necessarily, though a great deal comes to me direct. Under the rules applications for lithographic and photographic work are submitted direct to the Assistant Surveyor-General in charge of the Photographic and Lithographic Office, but indents from public servants must be duly approved and countersigned by the Heads of Departments and Governments under which the indenting officer may be serving, before they can be complied with. An indent properly countersigned is generally complied with without reference to the Surveyor-General, unless I see that it is likely to cause delay to other and more important work, in which case I usually refer it to him unofficially.

I submit weekly a statement of extra-departmental maps and drawings received and issued by the Photographic and Lithographic office, to the Surveyor-General. This statement goes round the Surveyor General's Office for information.

Questioned as to the issue of instructions regarding the forms in which drawings should be prepared.

36. There is a leaflet which was published many years ago describing how drawings should be prepared for photo-zincography, and it has been very largely circulated among the officers who generally send that class of work. With regard to the Vandyke process, I prepared a leaflet two or three years ago giving a description of the whole process and sent copies to everybody to whom it was likely to be useful. I now send it to anybody who sends me originals for reproduction by photography, which I think might be done by the Vandyke process, and this has resulted in a good deal of work being done by this process which would otherwise have been executed by photography.

The preparation of another pamphlet dealing with all the methods of reproduction in use here is also under consideration.

* Not printed.

37. When originals sent to us for reproduction are not suitably drawn, we have been returning them in several cases lately. Formerly, we either refused them altogether as being unsuitable, or we did what we could with them. I put in a set of rules * for the execution of such work.

38. I do not think there is any objection to applications for extra-departmental work being addressed in the first instance to the Surveyor-General. On the contrary, I should be very glad if this change were introduced.

Photographic and Lithographic Office.

Statement of Work done during the year 1902-1903 for the Survey of India.

Specification of Plate or Print.	Sheets or subjects.	Negatives	Photo-zincographic and Lithographic Printing.										Type Printing.			Silver and other Printing.		Heliogravure & Electrotyping.				Value.
		Negatives and transparencies.	Photo-transfer Prints.	Zinc plates prepared from Photo-transfers.	Zinc plates prepared by Heliozincography.	Zinc plates prepared by Direct Process.	Zinc plates printed.	Stones.	Pulls.	Number of copies. Coloured.	Uncoloured.	Total.	Pages or items.	Pulls.	Copies.	Silver Prints.	Blue Prints.	Heliogravure Plates.	Heliogravure Prints.	Photo. Blocks.	Electrotypes.	Rs. A. P.
Abstract of Departmental Maps.																						
General Maps	55	78	66	22	22	...	37	6	9,100	1,200	2,600	3,800	...	...	...	...	...	...	...	...	...	2,390 0 0
Provincial Maps	8	11	11	4	...	...	1	1	500	200	...	200	...	...	...	...	...	...	...	...	...	482 0 0
District Maps	11	...	...	...	...	...	...	11	2,300	...	2,300	2,300	...	...	...	2	...	...	...	...	...	3,262 2 0
Plans of Cities and Cantonments	21	42	26	19	6	...	25	...	3,145	...	1,985	1,985	...	...	...	...	...	...	...	...	...	1,278 8 6
Standard Sheets	865	964	709	222	140	...	300	...	48,816	120	38,256	38,376	...	...	...	40	771	...	...	...	...	24,754 10 6
Index Maps	15	11	11	20	...	...	41	14	26,495	12,625	2,585	15,210	...	...	...	...	...	...	...	...	...	1,980 6 6
Technical Charts	...	...	...	...	...	...	3	...	75	...	100	100	...	...	...	...	...	...	...	...	...	36 6 0
Miscellaneous Maps, Plans, etc.	405	397	187	59	24	8	164	26	49,706	1,226	51,149	52,375	...	...	...	68	1,193	1	501	...	5	12,763 5 9
Transfers and Proofs	...	...	...	...	...	...	...	...	1,992	...	7,163	7,163	...	...	...	...	...	...	...	...	...	...
Departmental Forms	5	...	...	...	...	3	1	7	130,100	...	65,100	65,100	...	...	...	...	...	...	...	...	...	3,353 6 0
Type Printings	...	...	...	...	...	...	...	...	...	...	...	...	11,587	2,018,031	1,039,757	...	...	...	...	...	...	27,201 0 6
Total	1,385	1,503	1,010	346	192	11	572	65	272,229	15,371	171,238	186,609	11,587	2,018,031	1,039,757	110	1,964	1	501	...	5	77,501 13 9
Cadastral Maps.																						
Burma Survey	3,870	1,219	1,353	1,584	...	2,651	4,235	...	126,203	...	126,203	126,203	...	...	...	...	...	...	...	...	...	39,128 0
Transfers and Proofs	...	...	...	...	...	...	...	...	4,437	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	3,870	1,219	1,353	1,584	...	2,651	4,235	...	130,640	...	126,203	126,203	...	...	...	...	...	...	...	...	...	39,128 0 6

Mr. T. A. Pope.

LIST B.

PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE.

Mr. T. A. Pope.

Statement of Work done during the year 1902-1903 for other Departments.

FOR WHOM WORK WAS DONE.	Sheets or Subjects.	PHOTO-ZINCOGRAPHIC AND LITHOGRAPHIC PRINTING. Number of Copies.	Blue Prints.	Heliogravure Prints.	Value.
					Rs. A. P.
Government of India, Financial Department. . .	1	24	...	...	64 14 0
„ Foreign Department . . .	41	2,411	...	...	2,370 13 9
„ Home Department . . .	19	8,000	...	1,003	718 2 0
„ Military Department . . .	21	1,693	...	4	464 14 6
„ Public Works Department . .	216	87,644	...	10	8,212 7 6
„ Revenue and Agricultural Department.	41	30	...	8,428	2,497 9 3
Government of Bengal	80	18,502	...	1,200	3,851 13 9
„ Burma	2	300	...	...	172 4 6
„ Madras	106	...	170	...	647 4 0
„ Punjab	40	36,700	...	...	3,005 10 6
„ United Provinces of Agra and Oudh .	7	60	...	...	166 13 0
Military Authorities	195	97,365	...	10,578	15,120 13 0
Railways other than Public Works Department . .	167	38,073	...	824	4,720 13 3
Departments Imperial, Post Office, Telegraphs, Sanitary Commissioner, Civil Veterinary, Census, Geological, etc.	253	73,886	...	3,451	13,475 4 0
DEPARTMENTAL PROVINCIAL.					
Assam	...	165	...	...	36 7 0
Bengal	91	35,182	...	6,225	6,018 8 0
Burma	16	4,896	...	...	1,315 9 0
Central Provinces	20	3,700	...	1,053	1,372 13 9
Central India and Rajputana	2	100	...	...	153 5 0
North-West Frontier Province	...	100	...	...	16 12 0
Punjab	15	2,250	...	...	356 1 0
United Provinces of Agra and Oudh	87	2,187	...	15,023	3,649 4 0
Meteorological Departments	36	244,133	...	...	3,961 10 0
Commissions	1	11,824	...	...	3,401 3 0
Municipalities	71	11,495	...	...	1,045 9 3
Miscellaneous	51	18 740	...	1,105	5,233 14 9
Work done for Trade and private individuals . . .	74	17,232	...	11,593	4,531 9 0
	1,653	716,692	170	60,497	86,582 3 6

LIST C

Statement showing the comparative outturn of work done in the Photographic and Lithographic Office for the Survey of India and for other departments during the 17 years 1886 to 1903.

Mr. T. A. Pope.

Year.	Number of copies of maps printed for the Survey of India.	Number of copies of maps, plans and diagrams printed for other Departments.	Totals.	Remarks.
1886-87 .	299,946	215,444	515,390	
1887-88 .	296,158	370,959	667,117	
1888-89 .	205,751	439,860	645,611	
1889-90 .	235,004	427,699	662,703	
1890-91 .	315,451	444,917	760,368	
1891-92 .	264,564	477,693	742,257	
1892-93 .	344,722	662,463	1,007,185	
1893-94 .	511,144	564,761	1,075,905	
1894-95 .	350,599	571,243	921,842	
1895-96 .	316,924	631,133	948,057	
1896-97 .	252,370	600,702	853,072	
1897-98 .	250,483	445,329	695,812	
1898-99 .	271,724	693,729	965,453	
1899-1900 .	261,909	588,593	850,502	
1900-01 .	445,461	708,355	1,153,816	
1901-02 .	521,896	632,233	1,154,129	
1902-03 .	312,812	719,683	1,032,495	

Lieut.-Col. T. F. B. Renny-Tailyour.

Brevet Lieutenant-Colonel T. F. B. Renny-Tailyour, R.E., Assistant Surveyor General, in charge Mathematical Instrument Office.

[*Calcutta, 10th February 1905.*]

Examination by President.

1. The Mathematical Instrument office was established first to look after the instruments of the Great Trigonometrical Survey. It is now a depôt of mathematical instruments for all departments. The instruments are supplied to any Government department, and if we can spare them we also issue them on payment to Government officers for private purposes. We also repair instruments for the different offices. Practically we do no work at all for the outside public. We sometimes repair telescopes for pilots, but they are more or less Government servants. We supply Survey colleges if they cannot get their instruments locally. We do our utmost, however, not to clash with private firms.

Any Government department may indent on us for mathematical instruments or send them to us for repair, and if we can, we take up the work.

2. We get most of our instruments from England through the Director General of Stores: we also purchase some locally and manufacture some in our workshop.

Last year we purchased instruments to the value of Rs. 1,21,429 from England and to the value of Rs. 11,641 from the local market. We have a special grant for local purchases.

3. The instruments manufactured in the workshop are valued at Rs. 57,095. Also we repaired instruments returned to us and made them serviceable at a cost of Rs. 77,332.

4. We have a fairly large stock in hand, but we have no record to show how much of it was purchased from England, how much was purchased locally and how much was made in the workshop.

We are reducing our local purchases; they have been going down each year. I have a statement showing the amounts spent on local purchase during the last three years. They are respectively:—Rs. 17,793, Rs. 13,329 and Rs. 11,641.

5. The value of the instruments manufactured in the workshop has gone up. The figures for the last three years are respectively Rs. 33,427, Rs. 47,429 and Rs. 57,095 and for the first eight months of this year the increase has been about Rs. 9,000.

The idea is to manufacture as much as we can, if we can thereby reduce their issue price. I should not say that it is easier for us to purchase instruments from the local market than for the officers for whom we buy them to do so themselves. I do not think there is much difference in the case of instruments that do not require adjusting, etc., if they could buy without having to obtain special sanction each time. The accounts of some departments are, I believe, so arranged that it would take them a considerable time to get sanction. We stand in the same relation to them as the Director General of Stores does to us in respect of European stores. We may not purchase stores from home except through him. We have authority to purchase from the local market articles that we may require, and also if we run short of such articles as levels, etc., we can get there locally, if necessary, although they are obtainable from England.

6. *Q.*—I find that a Committee reported in 1875 that an office for the purchase of stores existed, and that it was objectionable that stores should be obtained otherwise than through the agency of this office. Do you think so still?

A.—I think there are certain things which we might well get rid of. Some departments, the Meteorological and Excise for instance, indent for instruments which are of no use for survey purposes, and we have to get some of these from England specially for them. The Excise Department I refer to principally is the Bengal Excise Department.

I think both the Excise and the Meteorological Departments might just as conveniently obtain direct from England such stores as do not require to be tested by us.

We also get special stores for the Forest Department, *e.g.*,—Brandis clinometers and tree-borers.

We get very few things from England for the Meteorological Department.

7. We test hydrometers if they are made of brass, but not if made of glass. We do not test all instruments issued to other departments, but only some of them. All instruments that are liable to get out of order are tested, such as theodolities, levels, etc. I only want to get rid of things that do not require to be tested by us.

8. The actual cash expenditure of the Mathematical Instrument office for 1903-04 was Rs. 1,23,696. That represents cost of establishment, instruments, etc., purchased locally, and contingencies. It does not include the cost of stores obtained from England.

Rupees 64,295 is credited to the office for the cost of instruments supplied to the Survey of India. This really represents the difference between the cost of instruments issued plus cost of repairs and the value of instruments returned "on deposit."

We debit Survey parties with actuals. We know nothing in this office about the 4 per cent. fixed charge, made on parties in the estimates. It is an arrangement for purposes of accounts made in the Accounts offices.

In our "abstract of expenditure" the expenditure of the office is Rs. 1,23,696, and the book debits from survey parties are Rs. 64,295, leaving the net cost of the office at Rs. 59,401.

9. A profit and loss account of the workshop for 1903-04 has been made out on the usual system. It shows a profit of Rs. 22,916. This system has been accepted by the Comptroller and Auditor General's office in former years, but I do not consider it correct. Our accounts are audited every year by a special auditor from that office who comes here for some months. The particular account put in has not been audited yet, but it is drawn up in the same form as those for the previous years.

The credits in the profit and loss account partly represent actual amounts charged to Departments or paid in cash, and partly articles manufactured for stock which would be issued hereafter.

The amount Rs. 6,868 for packing cases, etc., is an actual. When instruments are despatched, the receiver is debited with the value of the packing cases.

10. There is no profit and loss account for stores because we do not charge as much as we ought to. We issue stores to Government departments, except railways, at the same cost at which they are obtained by us, and we make no charge for examination, superintendence and storage.

This is why there is a loss. If we were allowed to put on from 12 to 15 per cent. to the value of articles issued for the above, we would be absolutely self-supporting.

11. *Q.*—Have you any figures to show the amount of stock you began with on the 1st of April 1871, the amount added to it since then, the issues and the amount of stock in hand? The Committee referred to above gave the value of the stock on 1st April 1871 as Rs. 2,13,358.

A.—No, we have never taken stock of the stores. The value of the stock has been carried on from year to year by adding the total receipts and by subtracting the total issues. We sometimes find in the case of certain articles that we have more in hand than the amount shown in the books; on the other hand, we sometimes find there is less. The book value of the serviceable stores at the end of March 1904 was Rs. 3,85,145.

12. The receipts during the year ending 31st March 1904 in the serviceable store were:

	Rs.
(1) Stores from England	1,21,429
(2) Stores purchased locally	11,641
(3) Manufactured in workshop	57,095
(4) Transferred from repairable stores after repairs	98,463
(5) Returned by Government departments	30,420
(6) Miscellaneous	495
TOTAL	3,19,543
Amount at the end of the year 1902-03	4,72,065
GRAND TOTAL	7,91,608
The total issues were	4,06,463
Giving balance in hand on 31st March 1904	3,85,145

13. *Q.*—What is your opinion, are the advantages to Government in having the Mathematical Instrument Office.

A.—(1) It is absolutely necessary that there should be a central depôt for stores. The Government cannot allow each unit to indent for its own instruments without incurring a great loss owing to the large amount of instruments that would be required, for each separate unit must then keep a year's *possible* supply.

The central depôt, however, need only keep a little over a year's *average* supply and, if necessary, can generally meet the extra demands of any one unit with the stores obtained for another which are not required.

(2) It is necessary that many of the new instruments should be examined and adjusted before they are issued, and in some cases this work can only be done at the Mathematical Instrument Office by an expert.

(3) The Mathematical Instrument Office also manufactures instruments for Government departments. These are issued at a lower price than would have to be paid if they were bought elsewhere, and this is of course a saving to Government.

(4) In addition to manufactures, the Mathematical Instrument Office does a lot of repairs which cannot be done elsewhere; for this work trained men are essential, and as they cannot be obtained locally, it is necessary to teach the men, and the best way to do so is to put them on manufacture work. You cannot take an untrained man and put him on repairing work, but you can put him on manufacture work and he gradually becomes a trained man.

This repair work is of enormous advantage to Government, as when instruments get damaged or out of order, and are consequently useless for work, they can be sent to the Mathematical Instrument Office and be repaired at a small cost, otherwise they would have to be replaced by new and expensive instruments.

14. We do manufacture articles which can be made elsewhere, as well as those which can only be done here, *e.g.*, chains, staves, plane-tables, compasses, etc. I cannot say what the

Lieut.-Col. T. F. B. Renny-Tailyour.

value of articles manufactured for the Survey Department and other Departments has been. There is no account kept for the stores we manufacture as to where they go : there is no distinction made between articles manufactured for the Survey Department and those for other Departments. The Mathematical Instrument office is certainly not run altogether for the Survey of India. The Survey Department is practically on the same footing as any other Department.

15. I put in a list A, showing the proportional distribution of charges for supplies and work done during 1903-04. The amount of supplies to the Survey Department was Rs. 1,02,359 out of a total of Rs. 3,47,106. The work done for the Survey Department was Rs. 7,015 out of a total of Rs. 34,706. This shows that the survey part of the work is small. Of course it is advantageous to work for the Railways and the Public Works which take the same class of instruments as the Survey of India. If there is a heavy demand from one Department, there is frequently a falling off in that of another at the same time, so that we can generally order from England and replace articles supplied before we run out of stock. This is where some of the saving comes in, but there are no figures to show what the saving is.

16. When instruments get out of order, they would be put away on one side, and new ones indented for, if there was no place for repairs, and that would mean an enormous loss to Government, while now they come back here for repairs and re-issue. I have figures showing the amount repaired in the year.

17. The total number of men in the establishment is about 340, including boys. 150 of them are employed on piece work. We have about 70 boys.

18. Our figures are independent of those of the Survey of India to a certain extent. Only some of our figures are entered in the main Survey budget. This office is practically not a branch of the Survey Department, though it is under it. The different Departments do not send in their estimates of requirement. This was discontinued many years ago.

19. *Q.*—Is there any part of the work you ought to give up?

A.—If it could be conveniently arranged, instruments which do not require testing or examining before issue and have to be got out from England, might be obtained direct by the indenting Departments. Perhaps the Excise Department might be got rid of altogether. But in the cases of the Public Works and Forest Departments who indent for only a few instruments of this description, it would probably be more convenient for us to get them out. The Meteorological Department gives us a good deal of trouble, some of its instruments being very delicate, are often broken in transit, and as they have nothing to do with surveying, I should like to get rid of the work. The Archæological office only indents for things like drawing instruments.

We might get the Excise Department to indent through its own Government for articles which we have not to test.

20. We make very few issues to Madras and Bombay : when their store depôts are out of things, they occasionally come to us. We sometimes issue to the Great Indian Peninsula and North Western Railways. We issue instruments to any Government Department. We have large demands from all Departments in Burma. Our largest customers are the Railways and the Public Works.

21. Table B gives the number and prices of some of the instruments manufactured at the Mathematical Instruments office during the last two years, it also gives the prices charged for them by English and Indian firms. We find our prices are higher than necessary, and a reduction will probably be made from the 1st April.

22. Table C gives approximately some particulars about the most important kinds of instruments repaired in the workshop during the last two years. The numbers were 3,162 and 2,359, the costs of repairs were Rs. 37,665 and Rs. 30,200, and the prices of similar instruments, when new, are Rs. 2,26,320 and Rs. 2,02,343 respectively. This shows that a great saving to Government results from the ability of the workshop to repair instruments, which would otherwise have to be replaced by new ones.

A

List showing proportional charges for supplies and work done during 1903-04.

Lieut.-Col. T. F. B. Renny-Tailyour.

Departments.	Supplies.			Work done.		
	R	*a.*	*p.*	*R*	*a.*	*p.*
1. Archæological	364	15	0	...		
2. Botanical	31	4	0	...		
3. Civil	27,426	7	0	1,873	9	0
4. Customs	175	8	0	...		
5. Education	2,528	12	0	589	15	0
6. Forests	6,090	4	0	1,199	10	0
7. Geological Survey	435	8	0	83	11	0
8. Land Records	1,426	3	0	8	2	0
9. Marine	402	3	0	1,157	14	0
10. Medical	93	0	0	136	13	0
11. Meteorological	1,618	4	0	886	14	0
12. Military	34,171	6	0	5,626	15	6
13. Mines	687	7	0	...		
14. Political	8,228	6	4	...		
15. Public Works	77,194	7	6	13,067	12	0
16. Railways	81,154	3	6	2,690	14	0
17. Supply and Transport	1,942	2	0	285	8	0
18. Survey	1,02,359	2	8	7,015	12	0
19. Telegraph	773	7	0	82	13	0
20. Mint	3	12	0	...		
Total	3,47,106	10	0	34,706	2	6

B

Manufactures.

Instruments.	Number manufactured in M. I. O.		Price charged by English Firms.				Price charged by Indian Firms.					M. I. O. price.
	1902-03.	1903-04.	Chesterman.	Cooke.	Stanley.	Davis.	P. Orr and Sons.	Thacker Spink.	Lawrence and Mayo.	Roorkee.	Mitra and Co.	
			₹ a.	₹ a.	₹ a.	₹ a.	₹ a.	₹ a.	₹ a.	₹ a.	₹ a.	₹ a.
Chains, iron, 66′	930	1,339	5 1	...	...	...	8 8	...	8 0	8 13	...	3 8
„ „ 100′	100	185	5 11	...	...	...	11 0	...	...	11 0	...	5 0
„ steel, 66′	252	304	9 12	...	...	...	...	15 0	...	13 4	...	5 0
„ „ 100′	...	...	11 6	...	...	...	...	17 8	...	16 8	...	6 8
Compasses, rectangular	56	148	...	...	...	...	...	...	...	...	12 0	12 0
Rules, sight	400	451	...	...	...	...	...	...	...	...	3 8	3 8
Squares, optical	29	519	...	22 6	...	24 6	...	...	...	...	6 8	6 8
Staves	548	519	...	48 12	36 9	36 9	33 0	45 0	40 0	32 0	...	25 0
Stands for plane-tables	780	870	...	...	...	...	...	...	...	...	7 0	7 0

C

Repairs.

Names of Instruments.	Repaired for Public Offices, 1902-03.					Repaired for Public Offices, 1903-04.					Repaired for Store, 1902-03.					Repaired for Store, 1903-04.				
	No.	Cost of new instruments.		Cost of repair.		No.	Cost of new instruments.		Cost of repair.		No.	Cost of new instruments.		Cost of repair.		No.	Cost of new instruments.		Cost of repair.	
		Rate	₹	Rate	₹		Rate	₹	Rate	₹		Rate	₹	Rate	₹		Rate	₹	Rate	₹
Barometers, Aneroid	39	50	1,950	8	312	31	50	1,550	8	248	48	50	2,400	8	384	32	50	1,600	8	256
„ Mercurial	62	100	6,200	20	1,240	34	100	3,400	20	680	...	100	...	20	...	...	100	...	20	...
Clinometers, Survey pattern	38	30	1,140	8	304	21	30	630	8	168	48	30	1,440	16	768	43	30	1,290	16	688
Compasses, rectangular	141	12	1,692	3	423	154	12	1,848	3	462	415	12	4,980	6	2,490	58	12	696	6	348
„ prismatic	150	40	6,000	10	1,500	175	40	7,000	10	1,750	165	40	6,600	20	3,300	49	40	1,960	20	980
Instruments, drawing	110	40	4,400	8	880	120	40	4,800	8	960	169	40	6,760	18	2,704	60	40	2,400	16	960
Hydrometers	58	60	3,480	10	580	60	60	3,600	10	600	24	60	1,440	10	240	11	60	660	10	110
Levels, Dumpy	156	...	...	16	2,496	178	...	...	16	2,848	39	...	...	32	1,248	43	...	...	32	1,376
„ Reversible	112	200	22,400	16	1,792	89	200	17,800	16	1,424	63	200	13,600	32	2,176	18	200	3,600	32	576
Squares, Optical	389	6-8	2,528	2	778	86	6-8	559	2	172	163	6-8	1,060	2	326	273	6-8	1,775	2	546
Staves	154	25	3,850	8	1,232	150	25	3,750	8	1,200	9	25	225	8	72	58	25	1,450	8	464
Telescopes	292	25	7,300	6	1,752	272	25	6,800	6	1,632	3	25	75	6	18	17	25	425	6	102
Theodolites, Everests	115	400	46,000	25	2,875	116	400	46,400	25	2,900	95	400	38,000	50	4,750	95	400	38,000	50	4,750
„ transit, with v. c.	43	450	19,350	25	1,075	57	450	25,650	25	1,425	13	450	5,850	50	650	22	450	9,900	50	1,100
„ without v. c.	36	400	14,400	25	900	15	400	6,000	25	375	8	400	3,200	50	400	22	400	8,800	50	1,100
Total	1,895		1,40,690		18,139	1,559		1,29,787		16,844	1,267		85,630		19,523	801		72,556		13,356

Lieut.-Col. T. F. B. Remy-Tailyour.

Lieut.-Col. S. G. Burrard.

Lieutenant-Colonel S. G. Burrard, F.R.S., R.E., Superintendent, Trigonometrical Surveys.

[*Dehra Dun, 7th and 8th March 1905.*]

Triangulation.

1. The work of the principal triangulation still left to be done is chiefly in Burma and Baluchistan. In Burma we have to extend one series north to Sadiya, and another south along the Salween by Mongsat, so as to measure our boundary with France or Siam. No work is going on there now, as our only triangulation party was moved from Burma to Baluchistan this year.

In Baluchistan, we are running a series of triangulation to the west from Kelat, to co-ordinate the various surveys made in those parts. It will take us two more years to reach the Persian boundary. If we are allowed to, we should like to carry the triangulation through Kerman and Southern Persia.

There is no work left in India proper. In Baluchistan there is two years' work to the Persian border, and five more if it were decided to join on to the Makran series, apart from any future operations in Persia itself. In Burma there is about six years' work on the two series I have mentioned. The triangulation of Burma will not be completed until it has been verified by the measurement of base-lines.

We ought, however, to re-do the Quetta triangulation, which was done hurriedly in the Afghan War. This would be the work of another year and a half.

2. At present we have only one triangulating party consisting of one Imperial and two Provincial officers, with a few computers, costing about Rs. 60,000 a year.

The cost of carriage, transport, and sometimes of guards is very high. We used often to have two officers, and it would quicken work by 50 per cent. if we had two now. We should increase the numbers of the party if we had a second officer. If triangulation is confined to one region, it is probably better on the whole to have one party with two officers than two parties. If triangulation is being carried on simultaneously in Baluchistan and Burma, it is better to have two parties. We should have no difficulty in organising the extra party. In former years Provincial officers were put in charge, but not recently. We have no men who have been trained to the work as in old days. I would not say that the present men are not so good as the old, but they have not been so well trained, and across the Frontier there are advantages in having Military officers in charge.

3. An Imperial officer from Chatham can learn the work in six months. Very little extra training is required for such a man. A Provincial officer has not, at starting, the same education. He gets years of training. The men who used to get charge of parties were probably over 40.

4. I have native Provincial officers doing work in the Magnetic party and Pendulum party and in the head office. For the work they are on now they are as good as the European Provincials. I think they are rather weak for superintendence. They come to us as good mathematicians, and have to pass our examinations.

It might be possible to get men on lower pay than the Provincial Service draw, to do the work that some of these officers are employed on, but only experience would settle this. Men of the sub-surveyors class would not do at all. They are not sufficiently educated, and are of too low a class.

5. *Q.*—(*Sir John Farquharson.*)—Would it be possible for the Trigonometrical Branch to relieve the parties of the work of minor triangulation at present falling on them?

A.—We do do some minor series of triangles, but we do not do the actual net work. When you get to that, there is some advantage in having a man in each topographical party who understands triangulation and the selection of points. I think, for example in Sind, it is an advantage to have the topographer and the triangulator under one officer. If he finds his detail survey is catching up his triangulation, he can put an extra officer on to the latter. The balance of convenience is, in my opinion, in favour of the present arrangement.

6. Triangulation is always done by Provincial officers. We preserve all the principal and certain secondary triangulation stations. Tertiary stations are not preserved. Trijunction stations are preserved by the local authorities. I think it would be difficult to get tertiary stations preserved.

Atlas sheets.

7. I do not think the present projection should be extended into Burma or Baluchistan.

I think Degree sheets, each representing a certain number of standard sheets, would be better, though it should be considered whether the projection of the $\frac{1}{1,000,000}$ map should be used. If there are to be Degree sheets for some parts of India, I think it would be better to have the same throughout.

Levelling.

8. *Q* (*Sir John Farquharson.*)—Suppose the Committee thought that every standard sheet should have a certain amount of cheap levelling, could you take that work under your charge?

A.—We should hesitate to erect our bench marks on work so done. If a single Provincial officer were attached to a topographical party, he could level well enough for topographical purposes, but we should not like to be responsible to engineers for the reliability of his bench marks, unless they were subjected to our tests.

Q.—But the lines of level would require to be co-ordinated with reference to your standard sheets. Lieut.-Col. S. G. Burrard.

A.—I do not think we could supervise single levellers all over the country, but we could compute the results. The actual supervision in the field must be exercised by the party officer. Our main lines of levels are still an enormous distance apart. The main lines of levels are not yet complete. This work is being interrupted to allow of our putting up standard bench marks. We took up this latter work, because we found we were losing our bench marks.

9. The Levelling Party consists of two Provincial officers with recorders and khalasis. They are under the officer in charge of Tidal operations. The two Provincial officers work over the same lines. We have closed some of our circuits, but have not yet distributed the errors. The annual cost of the operation including ⅓rd of the Imperial officer's pay is about Rs. 21,000.

10. The first work to be done in levelling is the closing of our circuits, so as to make our present work strictly accordant.

11. To enable me to accelerate the conclusion of the main lines of levelling, I consider that we should have a second levelling detachment. A levelling detachment consists of two Provincial officers with a small staff, and costs about Rs. 13,000 a year. About 300 miles of levelling are done in a season. Up to four years ago the outturn was about 400 miles, but this outturn was obtained by placing the staves too far apart to admit of reading correctly through the telescope, owing to radiation of the atmosphere which is very great in India. As a consequence, there was a good deal of guess work in reading the staves. It was then suggested that the distance between the staves should be shortened, and this has been done. We now place them 130 yards apart in place of 200 yards, thus making their distance from the telescope 65 yards instead of 100.

12. I gave my estimate of the cost of our present levelling establishment as Rs. 21,000 yesterday. The reason that I now place the cost of a party at a lower figure is that the former statement includes ⅓rd of the pay of the officer in charge, who is also in charge of Tidal work. The cost rate would thus work out to about Rs. 50 * per linear mile. In America the cost appears from a report to Congress to be Rs. 35, but no details are given. There the staves can be read at greater distances from the telescope—up to 150 yards; whereas in India we can read only up to 90 yards, and seldom beyond 65. The difference is due to the great radiation in India and possibly also to inferior telescopes.

* Sir John Farquharson stated that in England only one leveller was employed at a time, and that the cost was something like Rs. 20 to Rs. 25 a mile.
Colonel Burrard replied that in France and Germany the system is the same as in India, *i.e.*, two levellers are employed, one checking the other's work.

13. We occasionally employ natives on levelling work. One of our levelling officers is a native Provincial officer. Up to four years ago we had one Provincial officer and one sub-surveyor, who checked each other's work. But it was found that the Provincial officer objected to being corrected and called back by the sub-surveyor to revise his work, and collusion was suspected. Colonel Gore thought also that the two levellers should be of equal rank; we have, therefore, two Provincial officers now instead of one Provincial and one sub-surveyor. The Provincial officers might draw up to Rs. 500 a month. We should hardly employ officers above the Rs. 500 grade on such work.

There is, however, no necessity for employing on levelling work, two men drawing such a high rate of pay as Rs. 500. We have never had two native subordinates working together. I think it would be unsafe. We regard our Great Trigonometrical Survey levelling as sacred, and we take all possible precautions that it should be done most accurately, and I am afraid we cannot trust it to purely subordinate agency.

14. I think it would be possible to have two systems of levelling,—the Great Trigonometrical levelling and a less rigorous system for topographical survey, such as the French have.

For secondary levelling it would be possible to employ men of the rank of sub-surveyors under the officers in charge of topographical parties. It would be necessary to send all their work to this office to be checked. I cannot at present give any opinion as to the exact limit of error that should be fixed, but there can be no doubt that a limit must be fixed for secondary levelling as well as primary. The permissible limit of error would of course vary with the nature of country, being a certain percentage of the total rise and fall.

This secondary levelling would be necessary only in the plains. It would not be required in hilly regions, such as the Himalayas, Nilgiris, Vindhyas, Satpuras, etc.

A sub-surveyor ought to be able to do two miles a day with ease, that is to say, 300 miles in a season. The cost of the secondary levelling would be about five rupees per mile.

15. I think that the length of the main lines of levels still required to be run in India would be about 10,000 miles in addition to the 15,000 we have already completed. The new work is more important than any revision of the old: we should therefore like to devote most of our attention to the new work and only revise weak portions of the old work as opportunity occurs. Some of it ought to be revised, particularly the line from Bombay to Madras, where there is a 3-foot error.

16. The levelling charts are the ½″ maps shown to the Committee yesterday: they have been pentagraphed down from 1″ maps. They do not appear in the general catalogue of the Survey, but only in a special catalogue.

Lieut.-Col. S. G. Burrard.

17. If levellers were appointed to parties, it would be necessary to have them taught at Dehra first.

Tidal operations.

18. Tidal operations are not now necessary for levelling. They are paid for by the Port authorities. Only last week we were asked by the Moulmein officials to erect a tidal station there.

Preservation of stations.

19. We have had very great difficulties about the preservation of Trigonometrical stations. I think it would be quite possible to lay down a principle that wherever Trigonometrical stations come within the scope of the authority of a Local Government, the Government should be held responsible for their preservation, and I think it is most desirable that this should be done. The principal stations have already been made over to local authorities, and it only remains now to hand over the secondary and tertiary stations as well. At present Deputy Commissioners and Collectors all over the country carry out the repairs of the principal stations. They send in to us annual reports of the condition of the Trigonometrical stations, which, I am afraid, cannot be thoroughly relied on. For instance, we have had reports of certain Trigonometrical stations having been washed away by the Indus, while three years later they were reported by the same authorities as being in good condition. For this reason I think that it would be of no use our getting in this office similar reports on minor stations, and that the local authorities should be made entirely responsible for their preservation. I am, however, far from holding them responsible for these conflicting reports, knowing as I do that they have to trust entirely to subordinate officials for their information.

20. There is a printed list of descriptions of all the principal Trigonometrical stations of the Great Trigonometrical Survey, but there are no published descriptions of the secondary and tertiary stations.

21. *Q.* (*President.*)—We are assured by the Rectors of the European schools that there would be no difficulty in getting additional candidates for the Provincial Survey if we went the right way about getting them. The only point raised is whether the statement in the directions to candidates that "the most suitable candidates who qualify should be selected" should be maintained. Would it be possible to preserve the principle of selection and at the same time meet the objections raised? It might be done by selecting the men first on such grounds as their parentage, history, physique, general smartness, and then take on only those among them who could pass a qualifying examination. If the examination comes first, there are objections to applying a process of selection later.

A.—I think if there is selection at all it should precede the examination. It is hardly fair on the men to have selection after examination. I feel certain, however, that as a matter of fact in recent years, only the top men have been appointed to the Survey. I do not think there would be any objection to omitting the sentence complained of, which may prevent some candidates from coming up.

There are many centres for the examination—Calcutta, Poona, Bangalore, Dehra Dun and other places where candidates happen to live.

22. I cannot say whether it would be advisable to have different examinations for Native and European candidates.

23. I think it is enough to test general education, and I agree with the objection raised by some of the school authorities that their pupils should not be required to pass in topography. As regards general education, I would not go back from the present system of accepting the High School certificates to the old system of having an examination in English before admitting the candidates to the Survey, but I think there is a falling off in the standard in consequence of the abolition of the examination in English.

In Dehra we only set the mathematical paper.

The Calcutta Office notifies to the public how many vacancies are likely to occur during the year.

Mr. J. Eccles.

Mr. J. Eccles, M.A., Superintendent, 2nd Grade. In charge of the Computing Party.

[*Dehra Dun, 8th March 1905.*]

1. *Q.* (*President.*)—I understand most of your maps are done by heliozincography?

A.—Yes; but a few are done by photozincography.

2. *Q.*—You made some change lately in your material on Colonel Grant's suggestion?

A.—Yes, we use albumen in place of fish glue in sensitising the plate. I have found no difficulty in using it. We have not yet had sufficient experience to enable me to say that the results are superior to the old method, but they are certainly not inferior. The albumen has the advantage of being cleaner and easier to work with, and it saves one process. I do not think there would be any difficulty in using it during the hot weather. It is a harder substance than fish glue and, therefore, is likely to be less affected by heat.

Major P. J. Gordon, I.A., Offg. Superintendent, 2nd grade, Superintendent of Forest Surveys. Major P. J. Gordon.

[*Katha, 31st December 1904.*]

Organisation of Forest Survey Branch.

1. I have been in charge of Forest Surveys since the 1st October 1900. Before that Mr. Reynolds held charge. He was originally in the junior grades of the Survey of India—now known as the Provincial Service—then he was transferred to the Forest Department to act as assistant to Colonel Bailey of the Forest Department, the then Superintendent of Forest Surveys, and was finally brought back to the Survey of India and held the appointment of Superintendent, Forest Surveys, till his retirement in 1900. According to the Annual Report for 1899-1900, he held administrative charge under the orders of the Inspector General of Forests, and the professional control of the Surveyor General, but this control was practically a nominal one, Since I took over charge, the Surveyor General has exercised the control claimed for him.

2. Up to 1901 the cost of Forest Surveys in the Bengal Presidency was, with certain exceptions, borne entirely by the Forest Department. The most notable exceptions were the surveys of the Bashahr and Chamba Hill States, where the forests were surveyed on the 4″ scale and the remainder of the country on the 1″ scale, half the cost being borne by the Survey of India and half by the Forest Department. Also in the case of No. 20 Party (Survey of India) employed on Forest Surveys in Burma, and I think No. 14 Party similarly employed in the Central Provinces, the cost was borne in equal shares by the Survey and Forest Departments. In the Madras Presidency up to April 1st, 1904, the Survey of India and the Forest Department, each paid a moiety of the cost of Forest Surveys carried out by No. 19 Party (Survey of India) which worked directly under the Surveyor General. In the Bombay Presidency the cost of No. 17 Party, which was placed at the disposal of the Bombay Government for Forest Survey work, was paid by that Government,—in respect, however, of the value of the survey of the North Kanara district to the Survey of India for mapping purposes, the Imperial Government relieved it to the extent of Rs. 10,000 annually.

3. In 1901 the Imperial Government issued revised orders * for the adjustment of expenditure on Forest Surveys throughout the Bengal Presidency, by which it was provided that the cost of all such surveys should be uniformly distributed in the proportion of 30 per cent. to topographical surveys in consideration of the topographical value of the work, and 70 per cent. to Forests. Forest Surveys in Madras and Bombay came under the same rules on the 1st of April 1904.†

*Government of India (Department of Revenue and Agriculture) Circular No. 7-F., dated 25th April 1901.

†Government of India Resolution (Department of Revenue and Agriculture) No. 3—213-5, dated 11th February 1904.

4. The Inspector General of Forests has now no administrative control over the Forest Survey Branch. The accounts of the Forest Survey Branch, which were formerly kept according to the Forest Department Code and audited by the Accountant General, are now, like those of the rest of the Survey of India, kept in accordance with Survey of India rules and audited by the Comptroller of India Treasuries.

5. Proposals for Forest surveys are made by Local Governments and require in the case of the Bengal Presidency, the approval of the Inspector General of Forests before they are included in the general programme of the Forest Survey Branch, which is prepared by me and submitted to the Surveyor General, who, after consultation with the Inspector General of Forests, includes it in the general programme of surveys in India which is submitted to Government. An important point is the utilization of the Forest Survey work for topographical maps; when orders are given by the Surveyor General for the topographical survey of a district where forest surveys are likely to be carried out in the near future—say two years later—the survey party omits the forest portions, to be filled in afterwards from the forests survey maps, thereby saving the necessity of surveying the same area twice. If the staff is available, forest surveys are usually sanctioned on the application of Local Governments. The Inspector General of Forests has the power of refusing his approval when he, for instance, considers that the value of the forests for which surveys are proposed does not justify the expenditure on the survey or when, owing to there being no immediate prospect of the forests being exploited, there is no urgency for a special survey.‡

6. As Superintendent of Forest Surveys, I have the same position and powers as the Superintendent, Trigonometrical Surveys. I draw Rs. 100 a month staff pay in addition to the pay of my grade. I have a map issue and record office at Dehra Dun, in which I keep forest maps up to date, and prepare such special maps for the Forest Department as may be sanctioned by the Inspector General of Forests. All such maps are paid for by the Forest Department. As an example of the special maps I prepare, I produce an index map on the 1″ scale for the working-plans of certain forests in the Toungoo Division in Burma. It is a reduction from the 4″ map, with hills omitted, and was published from the Trigonometrical Branch Office at Dehra Dun. I also produce a Burma standard sheet (No. 210), in which forest survey work has been utilised to complete the topography, the forest area not having been surveyed by other parties. The western portion of the sheet has been reduced from

‡ Note.—Colonel Longe, as an instance of the Surveyor General objecting to a Forest Survey, objected to a survey being done in the Sunderbans this year, because he thought it unnecessary for topographical purposes from an imperial point of view. He, however, explains that, if the Local Government are willing to utilize the existing survey party and bear the whole cost, he would raise no objection. He considers that the forest parties are practically handed over to Local Governments for employment as long as there is useful work for them.

Major P. J. Gordon.

cadastral maps and the eastern from forest maps, the whole being re-drawn on the 2″ scale and reduced to the 1″ by photography.

I also produce Forest Survey sheet 276 S. E.—4, surveyed in 1897-1899 and published in 1901 by the Survey of India. The cost of publication was paid for out of the Forest Survey Budget, and apportioned in the usual percentages of 30 per cent. to Topographical Surveys and 70 per cent. to Forests. The map can be bought by the public.

7. The accounts of the Forest Survey Branch are kept separate from those of the Survey of India, and are submitted by me to the Comptroller of India Treasuries for audit.

Forest survey parties.

8. I have, in addition to the Branch Office at Dehra Dun, four Forest Survey Parties under me. No. 17 Party working in the Bombay Presidency under Mr. B. G. Gilbert-Cooper, consists of three Provincial officers and 54 surveyors, draftsmen, computers, etc. No. 19 Party working in the Madras Presidency under Captain C. L. Robertson, C.M.G., R.E., consists of 6 Provincial officers and 60 surveyors, etc., No. 20 Party working in Burma under Captain A. Mears, I.A., consists of 4 Provincial officers and 57 surveyors, etc. No. 9 Party, of which I am the executive officer, is employed on the survey of forests throughout the Bengal Presidency. It is at present working in the North-West Frontier Province, Punjab, the Central Provinces, Bengal, Assam, and Burma. It consists of 4 Provincial Officers and 58 field surveyors, in addition to a number of others not on the regular establishment. At present two of the smaller camps are under native surveyors. The arrangement by which I have to act as executive officer of such a party as well as administrative officer of the Forest Survey Branch, is most unsatisfactory. I have not sufficient time for inspection, and find it difficult to do justice to my work either as administrative or executive officer.

I require another Imperial officer or selected Provincial officer either to hold charge of No. 9 Party or better still to act as my assistant, so as always to have one responsible officer at head-quarters. I am generally absent from head-quarters for two or three months in the field season and for six weeks during recess.

In Burma, I endeavour to keep the work of No. 20 Party as concentrated as possible, but it is difficult always to arrange this. The bulk of the party is at present employed in the Chindwin Valley, but there is also a camp at Thayetmyo and a few men doing revision work in Thaungyin, where the original survey was done under a native surveyor—not a Provincial officer—under the control of the Divisional Forest officer. The working-plans officer, on trying to make his working-plans, found the maps inaccurate, and the work has now to be done over again.

Like other forest survey parties No. 20 Party is doing all classes of survey, triangulation traverse, and detail survey.

Provincial officers employed on forest survey work.

9. The Provincial Officers in No. 20 Party are :—

Mr. P. F. Prunty	Extra Asst.	Supdt.,	3rd grade.
„ M. C. Petters	„	„	6th „
„ S. S. M. Fielding	Sub-Asst.	„	2nd „
„ J. H. Williams	„	„	2nd „
Munshi Amjad Ali	„	„	3rd „

Amjad Ali is a Mahommedan from Bengal and was promoted from the Subordinate service; he had been doing surveyor's work for nearly 22 years before he got his promotion. He has now passed his probationary period, and is as competent an assistant as many Europeans. He is capable of any work which does not require much originality. He is careful and accurate both in his professional work and his accounts. He is capable of doing the different kinds of survey himself from triangulation to detail survey. He can compute his observations and, although not a good draftsman, supervises his mapping carefully and well. He has adequate control over his men. He speaks English well, and gets on well with European officials. He received his promotion on my recommendation; before recommending him I tested him in independent work of all kinds and in charge of a small camp.

Promotions from the Subordinate to the Provincial Service are made under the orders of the Government of India.

I have not had a native officer who has entered the Department by competitive examination, directly under me.

Each of the Provincial officers has charge of a camp. The officer in charge of the triangulation and traverse work has the largest number of men under him. Amjad Ali has twelve surveyors and Mr. J. Williams, who has only five years' service, being the most junior officer in the party, has only eight.

Surveyors, draftsmen, and menials.

10. The pay of the surveyors in No. 20 Party varies from Rs. 15 to Rs. 115 per month, including Burma allowances. These men cannot all do detail survey or mapping, some are only trained in traversing and one or two in triangulation; during recess some of the traversers and triangulators are employed in computing.

We do employ draftsmen, and there are five in No. 20 Party. One is drawing as much as Rs. 60 per month after about 20 years' service. In addition to these, many of the field surveyors are employed on fair mapping during the recess.

Burmans make as good surveyors as natives of India, but are somewhat difficult to manage. In No. 20 Party there are 5 Burman surveyors who are grouped together in a small camp under the senior Burman surveyor. This camp works under the immediate supervision of the officer in charge, who inspects their work more rigorously and more often than that of the other camps under Provincial officers. They do not work satisfactorily under natives of India or Europeans who do not understand their language and temperaments. The Burmans are easy-going, and require considerable tact to manage; if hustled, they are inclined to fudge their work. It would not be difficult to get more Burmans if there were inspectors of their own nationality to place in charge of them.

The menial establishment is entirely composed of natives of India. We have some Burmese interpreters, about 20, I think, in No. 20 Party—about one for every three surveyors. They get from Rs. 15 to Rs. 20 a month.

In addition to No. 20 Party, we have two detachments of No. 9 Party working in Burma under Messrs. Veale, Extra Assistant Superintendent, 6th grade, and Kenny, Sub-Assistant Superintendent, 1st grade. It is proposed, however, to attach these detachments to No. 20. Party. There are no Burman surveyors in these detachments.

Cost of forest surveys in Burma.

11. The expenditure of No. 20 Party for 1903-04 was Rs. 1,55,697 for the financial year.

The cost of survey in Burma is much greater than in other parts of the country on account of—

(1) The cost of transporting the establishment to and from India. The men are paid full rates from the date of embarking at Calcutta for the district under survey; for the period spent on the journey there is no outturn of work.

(2) The cost of a large elephant establishment, which is required in order to keep the men supplied with provisions, and also for carriage of baggage in the forests. There are no cart roads or villages in the forest reserves.

(3) Burma allowances to the establishment.

(4) Increased rates of travelling allowance.

(5) The very intricate and difficult nature of the country, which permits of a very small outturn.

(6) The general unhealthiness of the forests.

(7) Reduction in the number of working days on account of fogs at certain seasons of the year.

12. Nos. 20 and 9 Parties both recess at Dehra Dun. Only those members of the Parties who are required for work in office are brought to Dehra. The remainder of the surveyors are sent on recess leave on a maximum of half-pay, but only really good men get the maximum allowance. All the menials are taken back to Calcutta and paid off there, with the exception of a small proportion of trained tindals and chainmen, who get Rs.2 or Rs. 3 a month as a retaining fee during the recess. Suitable menials are not obtainable in Burma at a reasonable cost; Burmese labour is much more expensive than imported labour.

It would probably be a saving if it were possible to recess in Burma, but it would affect the recruitment of surveyors and after six months in the forests a change to their native country does the men a great deal of good. No. 7 Party recesses at Mandalay, but its conditions are not similar to those of a forest party. Personally, if I were in charge of a Party working in Burma, I think I would prefer to recess at Maymyo, but it would be an unpopular measure both among the Provincial officers and the surveyors, both on account of the climate and the greater expense of living.*

The time spent in going to that part of Burma in which the forest survey work lies at present and returning to Dehra Dun is about a fortnight each way.†

13. We have no school for training surveyors in the Forest Survey Branch, but each party endeavours to train a sufficient number of men to supply the waste caused by death, etc.

Scale for forest survey work.

14. The standard scales for forest surveys throughout India is 4″ to a mile, but in some instances as in the less valuable forests in Berar, where good 1″ maps did not exist, the 2″ scale was adopted. If good 1″ maps had been available, probably they would have sufficed for forest purposes in this case. In Bombay, many of the more valuable teak forests, which are closely worked by the Forest Department, have been surveyed on the 8″ scale, and a number of "babul" forests in the Deccan, where the produce is sold in small blocks at a high price per acre, were surveyed on the 16″ scale. I do not think the Forest Department would be satisfied with maps on a smaller scale than 4″ to the mile for their more valuable forests. When working-plans are not required, and for general administrative purposes, 2″ and even 1″ scales would probably suffice. There is, however, some difference of opinion on the subject of the scale of forest

* Note.—Colonel Longe points out that living in Maymyo costs about twice as much as living in India. He has no figures to show the cost of transporting men from India and back, but they are being worked out in his office in Calcutta.

† Note.—Colonel Longe explains that the working season is limited by the climate, so that, even if the recess quarters were in Burma, the party could not take the field earlier or close work later than it does at present. Major Gordon agrees with this opinion.

Major P. J. Gordon.

maps among members of the Forest Department. Where it is necessary for the Forest officers to construct roads, in order to exploit the produce of their forests, accurate maps on not less than the 4″ scale are essential.

The Inspector General of Forests is at present considering the question of the scale of forest surveys in connection with the future programme of the Branch.

15. The question of the programme is a difficult one, as opinions regarding the requirements in the various Provinces often change with changes in the personnel. Then, again, forests which may be of comparatively little value today, owing to their inaccessibility, may, on the opening of new roads and railways, become of the greatest value at some future time.

Future programme of forest survey work.

The immediate requirements of Burma, with the present strength employed on forest surveys there, will be met in about 6 years' time. But here there is no finality, as large forest areas are being reserved every year, and in Arakan and Myitkyina, where there are undoubtedly most valuable forests, reservation has scarcely been commenced.

Forest surveys in the Central Provinces are completed with the exception of some 700 square miles in Berar, the survey of which is now in progress, and will probably be completed in 1907.

The present programme in Assam will probably be completed in 1908 and in Bengal in 1909. The Punjab and North-West Frontier Province will be completed, or nearly so, in 1905.

In the United Provinces nearly the whole forest area has been surveyed, but I understand that new areas are about to be reserved, and these will have to be surveyed.

No. 17 Party will complete its work in the Bombay Presidency in 1908.

There is quite six years' work for No. 19 Party in Madras and possibly more.

I hope to be able to give a more detailed programme of present requirements at Dehra Dun.

It may be mentioned here that we have in some cases done forest boundary surveys at the request of the Forest Department instead of detail surveys. I can instance two notable cases in Singhbhum and Belgaum, where these surveys proved totally inadequate for forest purposes, and the forests in question had to be surveyed afterwards in full detail.

Dehra Dun.
8th March 1905.

16. I now produce a note regarding the programme of Forest Surveys.

If Forest Surveys on the 4″ scale were stopped, it would be almost necessary to make No. 9 Party over to the Forest Department again. It would only be returning the party to the Department that created it. The party consists of Dehra Dun people largely, who would probably object to recessing in any other part of India. No. 9 Party is employed all over India from the Punjab to Burma—divided into small parties under Provincial officers or under native surveyors.

I think the survey of the Sunderbans forests might be put under Major Crichton, though he would probably think differently. Nor might the Government of Bengal agree. He has men trained for work in the Sunderbans, and has a steam-launch. Muhammadans are necessary, and I have few. The Sunderbans area is about 2,500 square miles. All the areas in my list are areas for which 4″ surveys have been asked for and sanctioned by the Government of India. The figures do not include nearly all the forests in Burma There are 2,500 square miles of other forests for which a smaller scale would probably suffice. A really good 2″ map could probably be enlarged so as to meet most Forest requirements, *i.e.*, a map made for reproduction, not for reduction.

The Local Governments will probably press for a 4″ survey of the forests in my note.

17. I also furnish a note on cost-rates and standards of work.

Note on the Forest Survey Programme.

At the end of the present field season the requirements of the Forest Department in regard to 4″ surveys will be approximately as follows:—

Province.	Area. Square miles.	Remarks.
Bombay	2,200	Including 300 square miles 8-inch survey. No. 17 Party will complete its work in Bombay in 1908.
Madras	3,500	Figures approximate only, but No. 19 Party will probably finish forest survey work in Madras in 1909 or 1910.
Assam	550	Nos. 9 and 20 Parties will probably complete the survey of these areas in 1910.
Bengal	3,200	
Berar	700	
Burma	5,050	
Total .	15,200	

The above areas do not probably represent all forests for which 4″ surveys will eventually be required, but they represent the immediate requirements of the Forest Department for working-plan purposes.

I am at present making enquiries regarding the possibility of surveying the Sunderbans forests, 2,500 square miles, by means of photography from a captive balloon. Should this prove feasible, the survey of that area would be a comparatively easy and inexpensive one and the work of Nos. 9 and 20 Parties would be reduced by one year.

After the survey of the areas noted above, large areas of new reserves and of existing reserves for which surveys have not been asked for at present will remain. I would suggest that No. 9 Party, which consists principally of surveyors and draftsmen who were taken over from the Forest Department on the amalgamation of the Forest Surveys with the Survey of India, should be placed at the disposal of the Forest Department as long as required for the survey of such forest areas as may not be included in the five years programme now being prepared. When such areas, however, fall in any part of a province in which 1″ or 2″ topographical surveys are in progress, they might be surveyed by the Survey of India Party employed thereon.

The retention of the Forest Survey Office at Dehra Dun with a staff of draftsmen, etc., for the upkeep of Forest Map Records and the preparation of special maps and second editions, would be necessary.

Note on cost rates, etc.

The present system of calculating cost rates of survey work is a most unsatisfactory one, as it does not enable one to form even an approximately accurate comparison of the cost of work in different parts of the country or even of the work done in the same district in two different years; the standard of the work or rather the amount of labour put into it, on which the standard greatly depends, is not taken into account. The present system consists of a division of the amount expended by the area surveyed. The number of plane table fixings in detail survey, and of stations of observations in the case of traversing and triangulation would afford a much truer test than mere area. In flat open country an accurate detail survey can be obtained by a fourth of the labour which has to be expended on an equal area of hilly jungle clad country, and similarly in the case of traversing and triangulation.

A party producing, say, 800 square miles of detail survey during the season may be one year under a Superintendent drawing Rs. 1,600 a month; in the following year the officer in charge may be an Assistant whose pay is Rs. 600. This difference would affect the cost rates to the extent of Rs. 15 a square mile; the same applies to camps, but the differences are not so large, and owing to there being several camps in a party, would probably be equalized when the cost rates for the party came to be calculated.

I would suggest that cost rates should be calculated and recorded in the following manner, and entered in the Annual Report on a suitable form.

Detail survey and mapping.

General charges per 1,000 plane table fixings Rs.	Total cost Rs.	Pay of Superintendent, cost of office establishment, conveyance to and from the field, etc.
Survey per 1,000 plane table fixings Rs.	,, Rs.	Pay, etc., of camp officer, surveyors, and their squads.
General rate per 100 fixings Rs. per square mile ,,	} Total cost Rs.	

for an area of —— square miles surveyed with an average of —— fixings per square mile.

The cost of traversing and triangulation would be reported on in a similar manner.

If the method suggested above were adopted, a fairly accurate estimate of the cost of the work and the amount of labour expended on it could be formed, and much unfair criticism would be avoided. At present there is too great a tendency to judge surveys by mere outturn, as expressed by the area, and to treat all surveys on the same scale as if they were produced in one manner and under similar conditions.

Major R. T. Crichton.

Major R. T. Crichton, I.A., Superintendent, Bengal Provincial Surveys.

[*Dinapore, 4th December 1904.*]

Examined as to the composition of a Survey Party, the Committee having on the 2nd December seen a camp and work in the field at Katihar.

1. I am Superintendent of Bengal Provincial Surveys, and am also in charge of No. 4 Party (Bengal). I am an officer on the list of the Survey of India, and am not seconded for my work in Bengal. The men of the Survey Department under me are also borne on the Survey list without being seconded. My work is done under the direction of the Deputy Surveyor General, but the programme is fixed by the Board of Revenue, Bengal. The Superintendent, Provincial Surveys, is responsible to the Survey of India that all his work is up to the professional standard.

2. There are three parties under me—

One (No. 4) in Behar.
One (No. 5) in Chota Nagpur.
One (No. 6) in Eastern Bengal.

I have also a large Drawing Office in Calcutta.

Two of the parties are under Imperial officers, and one is under a specially selected Extra Deputy Superintendent. Each party contains three camps, one traverse and two cadastral. Each camp is under a Provincial officer, who is supposed to be assisted by one or two subordinate Provincial officers. A traverse camp has one Provincial officer, and a cadastral camp two.

Each traverse camp has one supervisor and each cadastral camp two supervisors. These supervisors are temporary hands employed by me, because the Survey of India cannot supply enough Provincial officers.

3. A camp contains the following staff:—

A Supervisor or Sub-Assistant Superintendent (non-gazetted).
A Head Inspector on Rs. 40 per mensem.
About 10 Inspectors on Rs. 30 per mensem.

Each Inspector has 10 or 11 amins under him. The amins are paid by contract, which gives them about Rs. 16 per mensem. The contract rates vary in different districts. In Behar the rate is Rs. 2-2 per 100 acres for survey. All other items such as *khánapuri* in the field, area extraction, completion of records and statistics are also paid at contract rates.

All these men up to and including Head Inspectors are on the temporary non-pensionable list.

4. An *Inspector* has to check the plane table sheets by *partáls*, also check the *khánapuri* (preliminary record-writing) work and write out the *khewats* (record-of-holdings) himself.

The *Head Inspector* checks as above, and checks the Inspector's *partáls*.

The *Supervisor* or Sub-Assistant Superintendent is in charge of a circle, of which there are usually four in each camp. He tests the above *partáls*.

Inspectors and Head Inspectors do two linear miles of *partál* between them in a square mile of country; and Supervisors or Sub-Assistant Superintendents, and what are called independent *partáls*, cover an additional two linear miles of *partál* in a square mile.

For an independent *partál* the sheets are sent to office and locked up by the officer in charge, and then any one (an amin or other person) is sent to run a *partál* between given points. The field book of the independent *partál* is sent in—plotted in office—put on a trace, and compared with the original sheet.

5. Up to the Head Inspector all my men are natives. Inspectors are promoted from amins. In Bengal about three-fourths of the employés are local men, as they must know the local vernacular. There is no educational qualification required of men up to the grade of Inspector. The language qualification limits the employment of men outside the country in which their own language is spoken. Above the Head Inspectors no natives are at present employed. I do not like to employ natives above this grade. It does not answer. I have had at various times four natives in the post of Sub-Assistant Superintendent. Two were dismissed in about a year or two for fudging their work. A third rose to the rank of Extra Assistant Superintendent and would have had to be put in charge of a camp, but I asked the Surveyor General to remove him. He was a good Sub-Assistant, but was not fit to be in charge of a camp, where he would have had Europeans under him. He would not have worked his Europeans, and they would have taken liberties. He went to the Godavari Survey, where he failed in an independent charge. The fourth native had only one eye, a fact which I discovered myself, but I do not remember his subsequent history.

These four natives were educated men who had passed the examination for Provincial officers for entry to the Survey Department. I am not sure of their exact educational qualifications.

6. For Supervisors no particular educational standard is insisted on. There are a fair number of applications from Mussoorie schools. Some of the men have been up for the survey examination and have passed, but not obtained appointments in the Provincial Service, and others have failed in it. Others are intending to go up for the examination, but are unable

to remain at school in the meantime. A very few have not the necessary qualifications to be nominated for the examination. I satisfy myself about their character by reference to their schools.

As a rule, these Supervisors, though fit for cadastral work, are not fit for traverse work. On the whole, they are not equal to the Sub-Assistant Superintendents.

7. If I were asked to double my staff in two years, I could find men to recruit, but not unless I could offer them permanent pensionable employment.

There would be no difficulty in getting extra recruits qualified under the rules to get into the Provincial Service. I could get 20 such men a year. I could get any number of amins and Inspectors, quite up to double the present number.

Examined as to preparation of topographical from cadastral maps.

8. In districts like Behar—fully cultivated and flat, with no contours—I think that topographical maps, showing any details that may be wanted for any purpose, can be compiled from cadastral maps, if before we make the cadastral survey we are told exactly what details are required and what we are to pentagraph. We do not, for instance, at present show the relative heights of banks of streams and embankments, but we could easily show all this if we were asked to. But it is possible that such topographical detail might be required that I should require a superior class of Supervisor.

The details shown in the topographical maps reduced from the 4″ topographical map, are the same as those shown in a reduction from the 16″ map. In certain districts, part of a tract has been mapped on one scale and part on the other. The same details are shown on both scales, but the 16″ map shows field boundaries as well.

9. I think that in the whole of the Patna Division; the whole of the Bhagalpur Division, excluding the Sonthal Pargannas; the whole of the Rajshahi Division, excluding Darjeeling, Jalpaiguri, and Kuch Behar; the whole of the Dacca Division; the Orissa Division, excluding the Tributary Mahals; and the whole of the Presidency Division, excluding the country round Raniganj, satisfactory topographical maps can be prepared from cadastral maps.

In the Chota Nagpur districts, I do not think anything will be gained by utilizing the cadastral maps for topographical purposes. In this country the cadastral maps cover scattered patches of cultivation only. We do not pretend to survey everything, but only the cultivated area. The Sonthal Pargannas are being surveyed by the settlement establishment on our traverses. The settlement maps have been checked by us, and, when reduced to the 2″ scale, we found that they were good enough to be made the basis of plane table sheets. But the sheets would require full examination in the field by a topographical party and working up in topographical details. It might very probably be cheaper to do a topographical survey afresh. The Sonthal Pargannas settlement maps would require more checking than the Chota Nagpur ones.

Examined as to cost and outturn of revenue survey and publication of maps.

10. Each party is expected to do 1,600 to 1,800 square miles in the year. The total Bengal outturn of traverse, cadastral, and record work is roughly 5,000 square miles of each per annum. The actual costrates for the last year, 1903-04, are given below. The figures are taken from my annual report, which has not yet been published:—

	Survey. Rs.	Records. Rs.	
Purneah	64-9	36-6	per sq. mile.
Bhagalpur	56-6	26-1	
Backerganj	96-5	30-9	
Ranchi	57-8	35-4	
Midnapur	Rs. 170.		

Total outturn 1903-04.

Traverse survey	5,028	square miles.
Cadastral ,,	4,054	,,
Land Records	4,065	,,
Topography	463	,,

11. The following standard sheets from the recent cadastral survey have been published:—

Champaran except one sheet;
all Muzaffarpur;
all Saran.
Darbhanga,
Monghyr,
Bhagalpur,
} are in hand, and are advanced in the order they stand.

In the above districts the survey is finished.

The sheets of Puri, Balasore, and Cuttack surveyed in the Orissa Survey of 1894, have just been issued. The delay has been caused by the District officers having constantly changed the names of the villages.

In Chittagong the survey was completed in 1893, and three-fourths of the sheets have been published, the non-cadastrally surveyed portions being shown from old data. The delay was due to the necessity for referring for orders the question of how to fit in the old data, changes of village names and alterations (*badars*) made by the revenue officials.

12. When a cadastral map is finished, areas are extracted for six months (*i.e.*, during the hot weather). It is kept one season (*i.e.* the next cold weather) for the settlement corrections

Major R. T. Crichton.

(*badars*). There is no reason then why it should not be issued within one year. That is, a map should be ready for publication within two years. But we could save six months by allowing the pentagraphing to be done, while the map is in the survey camp for extraction of areas and correcting *badars*.

Calcutta, 8th December 1904.

13. I put in a statement showing the rate at which I am prepared to turn out standard sheets from cadastral material. I first endeavoured to make an estimate of the cost of compiling one sheet, and brought it out at about one rupee a square mile without the addition of charges for rent, supervision, etc. I found, however, that in the calculation the outturns of the best men and not an average, had been taken as the basis of the calculation. I have now taken a whole season's outturn as the basis of calculation, and have assumed general average rates of work, and included the share of supervision, etc.

Further evidence given after Committee had inspected the Bengal Drawing Office.

The rate comes to Rs. 2·2 per square mile. I am quite satisfied I could do the work at that rate. I would take a contract for it under the conditions assumed. Elsewhere than in Bengal supervision charges would be much higher, and I have estimated that the rate might be as high as Rs. 3·9 per square mile. One has to keep the men up to the mark to get the outturn assumed, and most of the men are now fairly experienced. We do some of this work on contract.

14. I consider that it would be misleading to take the outturn of a year and the expenditure thereon as a basis of calculation, because up to date the section has been employed largely in arrears work, of which it has been impossible to keep a separate account.

We could not have worked at these rates when we commenced. During the past two years, I think we have worked at the rates I give. I have satisfied myself that the averages of outturn assumed are genuine. I took them out myself.

Estimated cost of compiling in the Bengal Drawing Office Standard sheets of one season's cadastral outturn of the Bengal Survey Parties.

4,810 square miles = 9 standard sheets, from 9,620 sheets on the 16″ scale

	Rs.
Computing rectangular co-ordinates of corners of 36 quarter sections = 104 corners @ 15 a day = 7 days or, allowing for 2 origins, in some cases say 10 days	10
Projection—one man 10 days	10
Plotting—25 villages a day = 192 days or 8 months + 8 days @ Rs. 25	210
Pentagraphing — 14 sheets a day = 687 days = 30 months @ Rs. 20	600
Inking and examining reductions — 15 sheets a day = 641 days = 28 months @ Rs. 30	840
Transferring — 12 sheets a day = 800 days = 35 months @ Rs. 20	700
Inking village sites—15 a day = 320 days = 14 months @ Rs. 30	420
Typing — 25 village names a day = 192 days = 8½ months @ Rs. 25	210
Outlining — 18,972 square miles at 36 square miles a day = 527 days = 23 months @ Rs. 28	640
First examination — 1 Sub-Assistant Superintendent for 9 months =	1,800
Typing names of rivers, roads — 8 days per standard sheet = 72 days or 3 months @ Rs. 25	75
Borders and scales — 1 sheet in 2 days = 18 days @ Rs. 25	20
Headings and footnotes, — 12 days per standard sheet = 108 days = 3½ months @ Rs. 30	105
Area calculation — 4 days per sheet = 36 days = 1½ months @ Rs. 22	35
Final examination—1 Sub-Assistant Superintendent for 4½ months	900
3 Khalasis	288
Contingencies, for furniture, etc.	500
Total direct charge	7,363
Share of general section of Bengal Drawing Office at rate for financial year 1904-05, *i.e.* 35 per cent	2,577
	9,940
Share of Controlling office @ 5 per cent	500
TOTAL	10,440

or Rs. 2·2 per square mile.

15. The foregoing is an exceptional rate owing to—

(*a*) Large outturn;

(*b*) Records are in same office—saves invoicing and carriage between offices;

(*c*) Considerable saving in the supervision charge or share of general section of the Bengal Drawing Office, owing to the fact that the Bengal Drawing Office undertakes a lot of Provincial work, such as reproduction of village maps, etc., which bears the greater share of the cost of this section.

If (*c*) did not exist, then the estimate would read as follows:—

	Rs.
Total direct charge as before	7,363
1 Officer in charge	4,800
Clerical staff	600
2 Khalasis	200
Contingencies	500
Office rent	4,200
	17,663
Add—5 per cent. control	900
	18,563

or a rate of Rs. 3·9 per square mile.

Examined regarding the possibility of having topographical details entered on cadastral maps through the agency of the cadastral parties.

16. I think I stated in my previous evidence that my cadastral parties could show on their maps such topographical information as the heights of river or canal banks, depths of fords, etc. If any further information is required, I could arrange, in flat country, to put it in by my own surveyors. I do as much as I can during the cadastral survey, but it all depends upon what I am asked to do. But even after I have finished all that is necessary, I think it will be as well to send some one to put in the topographical details. Calcutta, 27th February 1905.

17. As to the additional information required by the military authorities (see para. 5 of Colonel Kelly's memorandum) on looking through Colonel Kelly's suggestions, I do not see anything that could not be put on the map during my cadastral survey, except levels, but there would be no levels in flat country. For supplementary survey, I should require a topographical surveyor to go over the ground to see that the cadastral surveyor had not omitted any matters of importance, such as, for instance, a road which might be a through route of communication, but which might be of little importance in the actual village under cadastral survey.

I am thinking of level country, such as we have in Behar. In such country we have no ravines. If we were dealing with country in which there were large tracts of waste in which ravines occur, it would certainly be better for a topographical surveyor to go and survey the details of ravines on a small scale, than for us to map them on the 16″ scale.

In any case, a small detachment would be able to carry on the work if any additional information was wanted. There are some tracts, such as hill tracts, which would require to be separately surveyed.

18. I have no experience of this class of work, and I do not think I could make myself responsible for putting in topographical details in the districts which have been cadastrally surveyed in the past, but if, as I understand, the proposal is that two or three topographical surveyors should go over the ground to enter up the topographical details in the 1,600 square miles which each party does in a field season, I think this work should not be more than I could manage.*

19. I have no information as to the incidence of the cost, etc., between the Provincial and Imperial Governments.

*NOTE.—Sir John Farquharson explained that his idea was that the surveyor putting in the small amount of additional topographical detail should do so on the one inch reduction of Major Crichton's cadastral maps, and not that all the topographical information should be put in at the time of the 16″ cadastral survey. By using the reduced sheets one topographical surveyor could, he thought, in one season, put in the extra information for the whole of the 1,600 square miles where the cadastral survey of a party had taken place during the previous season.

SECTION IV.

SELECTED EVIDENCE—PUBLIC WORKS DEPARTMENT OFFICERS AT THE GOVERNMENT OF INDIA HEAD-QUARTERS.

Mr. S. Preston.

Mr. S. Preston, C.I.E., A.M.I.C.E., Secretary to the Government of India, Public Works Department, Irrigation, Roads and Buildings and Telegraphs.

[*Calcutta, 9th December 1904.*]

Examined as to extra-departmental work sent for execution to the Survey of India.

1. The proof sheets of an Irrigation map of the United Provinces were under consideration when Mr. Preston arrived. He said, "the history of this map is that in 1898, I, as Chief Engineer, got out an Irrigation map showing the Canal system of the Punjab. Copies were sent to the Government of India. They thought it was a very useful map, and issued orders that every Province should prepare similar maps. The United Provinces compiled a map and the Survey Department has been working on it for two years. The proofs take so long to make that alterations in the canal system occur, necessitating fresh corrections and additions each time a proof is sent, so that the map may be up to date when issued. It has not yet been finished and published.

2. I produce a Punjab Irrigation map. This is a reproduction of the original map that I made in 1898, and which we asked the Survey Department to produce. It was made up in four sheets. They took two years to produce it. In accepting the final proof I believe I asked the department to retain the stones, as from time to time we should require to issue reprints corrected up to date.

In 1902 there were so many changes in the canals that the Punjab Government decided to reprint it and asked the Survey Department to produce a corrected map. The Survey Department undertook the job, but more than a year elapsed before a proof was received. There was some correspondence about the delay between the Chief Engineer, Punjab Irrigation, and the Surveyor General. The latter said that it would take at least a year more to give the proof. The Chief Engineer (Mr. Benton), irritated at this, sent a fresh tracing of the map to Roorkee similar to the one sent to the Survey Department. Roorkee took two months only over the job, and gave a map produced in zincography. The Survey Department objected to the job being sent to Roorkee after they had been working so long at it. It has finally been decided that the Survey Department should go on with the work, and finish the map it is at work at, but in the meantime the Punjab had got all it required much more quickly and at less cost from Roorkee. I am perfectly willing to admit that I may have been wrong in asking the Survey Department to lithograph the map in the first instance and to keep the stones, also that they should not have been asked to reproduce the corrected map by the lithographic process. But I and my successor did this in ignorance, thinking it must be easier to correct the existing stones than to make fresh ones, and I think the Survey Department is quite as much to blame for not informing the Chief Engineer how long it would take to lithograph the map, and that it could be produced by some other process much more quickly and cheaper. In this case we only want a general map with no very high degree of accuracy, in fact an index map to our irrigation system, which can be quickly produced by some cheap process. If it had been pointed out to the Punjab Irrigation officers that the map could be produced more quickly and cheaply by any other process than lithography, they would have been glad to have it produced in that way.*

3. I made a few enquiries last year about the extra-departmental work now sent to the Survey Office being done elsewhere. In the spring of this year I was nominated a member of the Committee whose place has been taken by the present Committee, and made a few enquiries in Calcutta as to whether some of the leading firms, such as Thacker, Spink & Co. and Newman & Co., could not undertake some of this extra-departmental work. Mr. Newman showed me his workshops, but he has no machinery, and could not take any of the work. Thacker, Spink has the nucleus of a reproduction plant on a fairly large scale. They, however, declined to increase it unless Government gave a guarantee of giving them a definite amount of work. They did not feel inclined to increase their plant on the off-chance of getting jobs from Government. I then wrote to the Principal, Thomason College at Roorkee,

* Note.—Mr. Pope explained that in 1902 he was asked first of all for copies of the old map. He sent these, and a large number of corrections were made on them. It is not the case that a tracing (such as went to Roorkee) was sent, which the Survey could have reproduced quickly.

Mr. Preston in answer to a question from Colonel Longe said that it was quite possible that the orders for this map were sent direct to the Head of the Photographic-Lithographic office. Colonel Longe explained that these orders did not come to the Surveyor General, but went direct to the Drawing and Photographic offices, and he therefore did not know what jobs were being undertaken by the Photographic and other offices under him. Sometimes if he knew, he would object to the work being undertaken at all, as indeed he himself had done in certain cases.

and the reply * I received I am willing to place at the disposal of the Committee. I found that Major Atkinson, the Principal of the Roorkee College, had no objection to an increase in the work of the reproduction establishment, and had no fear of its interfering with the educational work of the College.

* *Vide* note below.

4. My evidence in regard to the general utility of the Survey Department maps will be from a different point of view from that of the railway department. The railway requires simply to know the country on a line between the different points between which the railway is to run, and has no work outside its boundary fence. As evidence of the enormous amount of detail Canal Engineers have to go into, I show the map of the Chenab Canal and its distributaries. Even this does not show the village water-courses for which the Irrigation Department has now made itself responsible. But the map at any rate shows that we require to know the details of practically nearly every inch of the ground between the two rivers, in this case the Chenab and the Ravi. For this reason we require maps in much greater detail than the Railway Department does and on a larger scale. No map probably which the Survey Department could be expected to give us would be on a sufficiently large scale to meet our requirements, but of course the larger the scale from which we have to make our enlargements the more accurate our maps would be. My practical experience has been mainly in the Punjab.

Questioned as to topographical maps generally.

A reference to the index sheet of publication of the Survey of India maps shows that a very large portion of the Punjab is only published on the $\frac{1}{4}$″ scale. These we have to enlarge for our own purposes. Or we have to piece together, and then enlarge the $\frac{1}{2}$″ maps which are published for districts only. We should prefer 2″ maps to 1″ maps, but the 1″ map would be sufficient for our enlargements, if it is impracticable to give us the 2″ scale.

5. In order to show what we require, I have brought a 2″ map of a new project—the Upper Chenab Canal—which has just gone to the Secretary of State. The telegram reproduced in the margin shows how this was prepared. It shows the labour involved owing to the absence of good 1″ maps. It will be seen that on this map we have shown contours at very close intervals obtained by cross levels ; this of course we cannot expect from the Survey Department.

The 2″ Upper Chenab project maps prepared from field books and checked with skeleton Survey of India trijunction maps—village sites fixed by four off-sets or bearing—village boundaries procured from village maps reduced and checked by trijunction pillars.

The biggest scale we are likely to use for our projects is six inches to the mile, but we only require this scale for a very small area, so that the six-inch scale should be put out of count for general work. Two inches to the mile is the scale we would like the maps on. I have never, as far as I am aware, worked in a district of which the Survey Department has published 2″ maps. The $\frac{1}{4}$″ map with which we have to work in certain areas is very much out of date.

6. The next suggestion I have to make is that, whereas in the case of the Chenab Canal we have actually made a large number of channels which have entirely altered the face of the country, they have not been shown on the Atlas Sheets, and the result is that the existing maps are absolutely useless, and could not be placed in the hands of anybody—troops or district officers. Now it seems to me that when the Public Works Department can report the completion of important works (road, railway, or canal), a small Survey Party should go round and make a sufficient survey to bring the maps up to date. In the case of a road or railway this might be done immediately the work is finished, but in the case of canals, which are always developing and being extended, it might be done at the end of fixed periods, say, every five years. The map of the Punjab, as far as irrigation distributaries are concerned, is entirely out of date. These distributaries vary from 2 feet to 25 feet in width, and take out of canals or branches which are as wide as 250 feet. It is perfectly easy to show all such Government distributaries on the $\frac{1}{8}$″ and $\frac{1}{4}$″ maps.

NOTE.—The following are the main points in the letter, dated 26th March 1904, of the Principal of the Thomason College, Roorkee, referred to in paragraph 3 of Mr. Preston's evidence :—

I will be extremely pleased with, and will welcome, an enlargement of the Lithographic Department of the Press, and do not think that it will interfere at all with the educational functions of the College. I look on the matter in this light. The College is not only an Engineering College, but a Technical Institute whose function is to aid and develop any industry it can for the country. Lithographic draftsmen, pressmen, and photo-mechanical workers are almost impossible to obtain in this country outside the Survey of India, and are wanted and will be still more wanted as time goes on. These industries cannot be taught in the bazaar, and since I have been here I have tried in every way to push this Department, and to get a large number of apprentices to train. At present I have only 64.

At present our difficulty is we never know what work we will get. It is impossible to suddenly get a lot of temporary hands for a rush of work, and if work is slack for long, we have to discharge good men or send them to work elsewhere.

I should much like to see the Department enlarged, so that we could have a proper staff and a constant supply of work. It might of course mean certain new buildings and other things, but I would find room for them all right.

We try to work as far as possible by means of Native agency, which is of course cheaper than European agency and the training of which is the *raison d'être* of the Department. Mr. O'Neil is at present the only European in the Department, but even now he requires assistance, and if the Department was much enlarged he would require assistance.

The Applied Science Department, as it is called, which really means the Photo-Mechanical Department, is now combined with the Lithographic and Typographic Departments in the Press which is under my personal supervision. Before last year it worked as a private concern under the title of the "Photographic Sales Fund."

Mr. S. Preston.

7. I have on various occasions gone into the question whether our information could not be utilized for the Survey of India maps, but must admit that our mapping is not as accurate as the Survey of India wants, very largely because we have to enlarge from out-of-date small scale maps. Another reason is that we have not surveyed these tracts on scientific principles. There are no Survey Department bench marks, etc., from which we can work, and our practice has therefore been to lay out a main base line and from it to run cross lines at right angles at 1,000 or 1,100 feet intervals. This, for special reasons which need not be explained, serves our purpose, but prevents the information being laid on to maps surveyed scientifically.

8. Government maps have few levels as far as I am aware. They of course show heights of trigonometrical stations, but it would be of great advantage to have many more levels. We have taken levels at 550 feet intervals, connected with the Survey Department data throughout the Crown waste lands. In settled country we have generally cross sections at 1 mile intervals.

9. I want to point out that the conventional sign used for canals is not sufficiently distinctive. The railways are generally shown distinctly by cross hatched lines, but large canals 200 to 300 feet wide discharging sometimes 10,000 cubic feet of water are shown by a very slight line, and are hardly distinguishable from village roads. There should be special and prominent symbols showing canals at least for the inch maps, and, if possible, for maps on smaller scales.

10. In reply to the President's definite question I would say that the scale we require for irrigation purposes is 2″=1 mile, and next in order of suitability I put the 1″=1 mile. Anything below that would not be of much use to us. For general purposes we want the Province to a $\frac{1}{8}$″ scale, and for the general map of a project a $\frac{1}{4}$″ map would be invaluable. We would not care to go below that.

Patwari maps are largely used in the United Provinces for engineering purposes, scale 16″ to a mile. For instance, the Fatehpur branch of the Lower Ganges Canal was aligned entirely with the help of these maps.

Mr. C. W. Hodson.

Mr. C. W. Hodson, M.I.C.E., Officiating Secretary to the Government of India, Public Works Department, Railway Branch.

[Calcutta, 9th December 1904.]

Examined regarding certain specimens of extra-departmental work sent to the Photographic and Lithographic Office for execution.

1. The Railway map of India for 1904 produced by Mr. Pope (Assistant Surveyor-General, in charge Photographic and Lithographic Office) was sent to the Survey Department by the Public Works Department. I can quite understand that this is rather a heavy piece of work. I do not think that there is any other way in which we could show the corrections beyond entering them in red ink, as has been done. I do not know the history of this map, but all the changes shown could hardly have occurred in one year, though the previous map is dated 1903. I think it is for the Survey Department to decide how the alterations can be best carried out on the map. Looking at the revised map as prepared in the Drawing Office of the Survey of India, the draftsmen in my office are capable of doing the work actually done on the map, but not so neatly or so well as the Survey has done it. If our establishment were increased, we could possibly undertake to do such work ourselves next year. I think there were probably an exceptionally large number of corrections in this particular map. If there were only very few corrections to be made each year, it would be much the best thing for the Survey to keep up these corrections. I consider that the map, to be of any use, should be corrected every year. It ought not to be a very difficult matter for the Survey Office to do this once a year.

2. I think it is essential to have some Central Office where these diagrams* can be reproduced for railways. We do a lot of this sort of reproduction work ourselves. We have six presses constantly at work.

3. Another work which has been sent to the Survey of India is the production of the plates and woodcuts in Mr. Priestley's report on American Railways.† A large number of plates have been sent to Press. I do not know whether this work can be done anywhere else than in the Survey Offices.‡ This was a particularly difficult piece of work, as some of the plans and diagrams had to be inset in the body of the report, which was already in print. In the circumstances explained, it would have been better had the diagrams been collected together in plates separate from the letter press.

Examined regarding Survey of India topographical maps generally.

4. I have experience of Railway construction in Tirhoot, Central Provinces, Sind, and Baluchistan. For such work we use the ordinary published maps; the 1″ and $\frac{1}{4}$″ scale are the usual scales. We always use them for our railway work. I think they are always very helpful. The more details we can find, the better they suit our work. My experience dates back to about 30 years ago. I should like to have 1″ maps when I can get them. The only serious

* Note.—Mr. Pope also produced a large bundle of railway diagrams of rolling stock.

† Note.—Mr. Pope also produced some postal maps, but Mr. Hodson had no evidence to give about these.

‡ Note.—Mr. Preston, who has experience of such work, thinks it can probably be done at Roorkee.

Mr. C. W. Hodson.

defects would seem to be certain inaccuracies which are inevitable owing to the changes in the courses of rivers in alluvial districts. Old maps are altogether out in this respect. Villages in the course of years change their position and names, so that it is desirable that the maps should be corrected periodically. My experience has been that village boundaries are useful. The trijunction points of villages do not seem to change their positions, even if the villages do. I should certainly like the village boundaries to be shown on the maps wherever it is possible to do so. If the trijunctions were shown, it would perhaps be sufficient. There is some advantage in the boundary, but it need not be as accurate as the trijunction points.

5. We always have to make additional surveys ourselves for laying out a new railway because we have to put in many extra details, *e.g.*, ravines and spurs of hills, etc.

A fairly accurate map would save us a large amount of field work in a difficult country. For instance, if it showed that it was unnecessary or impossible to follow a particular route, we would not waste any time over it. As a rule, it is desirable that the nullahs at least should be shown correctly. The hill shading of spurs and saddles is necessarily sketched in, and is often misleading.

But even the existing Survey of India maps do save our making many surveys which we would otherwise have to make.

Examined as to suggestions for improving the maps.

6. One point about the Survey maps is that they show very few levels, and those that are shown are usually on the tops of hills. For road and railway work the levels that are most important are those of saddles or the obligatory points through which the railway goes. Anything that would show these levels would be useful, even if they were not very accurate.

7. I should of course like to have contour maps, but we cannot expect the Survey Department to execute them all over India, but only in special places. For instance, in the Simla hills the whole country was contoured at 100 feet distances, and the Chief Engineer of the new Kalka-Simla Railway was, I believe, able to align the whole route on the map without any special survey. I would suggest that the Survey should not only put in levels that are known accurately, but also approximate heights, though in a different type or colour, to show that they are only approximate. A good 1″ map is sufficient for our purposes, but of course we should like a 2″ map, if we could get it. It is in hilly country that the larger the scale of a map the better it is for our purposes.

8. We generally pay our surveyors from Rs. 50 to Rs. 200, and draftsmen from Rs. 30 to Rs. 100. We generally get surveyors from the different Engineering Colleges, *e.g.*, Roorkee. There is generally very great difficulty in getting good draftsmen anywhere in India. All that we generally get are mere tracers. There are no special places for educating draftsmen.

Mr. E. I. Shadbolt, M.I.C.E., Officiating Director of Railway Construction.

Mr. E. I. Shadbolt.

[*Calcutta, 9th December 1904.*]*

1. In Madras I had to lay out a railway line in the Madura district. The map I had to use was not a regular 1″ map, but only a local one prepared by the Madras Survey Department, in which the positions of watercourses and lagoons and all topographical features were very inaccurate. Madura was a plains district. I found the map very misleading.

2. In hilly country in Travancore we had a finished map prepared by the Government of India Survey of a very ancient date on the 1″ scale, and there the hill sketching was very inaccurate. In finding a possible line for the railway, the map indicated certain localities as suitable which were not really so. To verify this, we had to do a considerable amount of jungle cutting. It was only when the line had been laid out, and was under construction, and a good deal of clearing had been effected that we found places where great improvements might have been made, if the map had been accurate. Speaking from memory, I think the Travancore map was made in the fifties. But the Madura map was a very recent one.

3. In Sind I had to lay out a line towards Rajputana. The country is very flat and largely cut up by irrigation channels. If I laid out a line on the map, the intersections with the water channels did not fall on the right places. These were 1″ topographical maps, but they were very old. A new survey was, however, in progress.

4. My work would have been materially assisted by the provision of better maps, because we have to go by maps in laying out our trial lines. Accurate 1″ maps would be quite sufficient for our purposes.

5. In 1887 I was running a railway survey in Kathiawar, from Dhoraji to Porbandar. The 1″ map of the country was of recent date, and was very accurate and of great use to me.

Mr. F. R. Upcott, C.S.I., Chairman, Railway Board.

Mr. F. R. Upcott.

[*Letter dated 27th February 1905 to the Surveyor General of India.*]

In reply to your question whether a good topographical survey would not materially aid and tend to reduce expenditure in all preliminary operations in connection with Railway

* NOTE.—Mr. Shadbolt had heard Mr. Hodson's evidence, and confined himself to giving additional information arising out of his own experience.

Mr. F. R. Upcott. projects, I can assure you that your present maps are of the greatest value in any reconnaissance work in all varieties of country, but their value would be greatly increased if contoured, which is what I apprehend you mean, in writing of topographical surveys.

The distance apart of contours would naturally vary with the nature of the country and the scale of the map, and you are a better judge of what it may be possible for you to give than I am.

I do not know what contours you would suggest on a 1″=1 mile map in undulating country, or whether you could only furnish maps giving the heights of saddles (not the peaks) but in any case, it would save the Railway Engineer an enormous amount of time and money, if you could provide us with maps either contoured or with the heights of saddles marked thereon, and I support your proposal in the strongest way.

In reply to the last two questions relating to the use to us of your scientific instrument depôt, I find it is of the greatest possible use to the Railways of India, both State and Companies.

If we are to be deprived of the use of your depôt, the various Railways would have to provide them in their own workshops, and would have to introduce machinery and mechanics capable of dealing with delicate instruments, and this would involve a large expenditure, and be much more costly than the present system, because there would be no Central Depôt for the repair and issue of instruments; I, therefore, most strongly deprecate any idea of closing your depôt against us.

SECTION V.

SELECTED EVIDENCE—FOREST OFFICERS.

Mr. S. Eardley-Wilmot, Inspector General of Forests in India.

Mr. S. Eardley-Wilmot.

[*Dehra Dun, 24th March 1905.*]

1. Throughout India, the scale of survey for each individual forest should be considered on its own merits. In the majority of cases the 4-inch scale is unnecessarily large, provided that a skeleton map showing the forest boundaries in sufficient detail, and on a large enough scale to admit of the pillars being at any time relaid, is provided. This is specially the case for forests, the yield from which is of small value compared to the area. Under the above circumstances it is impossible to say on what areas in Burma the scale can be reduced from the 4-inch, but it is anticipated that not more than 20 per cent. will require such a large scale.

2. I agree generally to the principle that the forests should be surveyed in the ordinary course of the topographical programme, provided that arrangements are made to survey any special forest areas, when such a course is necessary in order to prevent delay in introducing the systematic working of the forests.

3. In the case of special surveys, I am not qualified to undertake any professional control of either the field work or the mapping of forest areas, but I am prepared to pay for a special staff of Forest Survey officers and surveyors, who would remain entirely under the control of the Surveyor-General.

4. I understand that if the new scheme is adopted, the post of Superintendent, Forest Surveys, will cease to exist. I do not object to this, but I consider it necessary to retain the Head-quarters Forest Survey map office, as at present, and the custody and issue of forest maps should remain as at present. In these circumstances it would appear preferable that the scope of the office should be extended to the preparation, custody and issue of the necessary forest maps, special as well as general, of the whole of India. In that case an Imperial officer would be required.

5. I am quite willing to agree to the cessation of 4-inch forest surveys in Burma, provided that 1-inch or 2-inch surveys are carried out over the areas affected without delay, and special forest surveys are undertaken in areas which, under the former programme, would have been undertaken, but cannot be included in the regular 1-inch programme within the time specified, and also that in these areas, where necessary for forest purposes, large scale maps are provided. It will be necessary at any rate to provide skeleton maps, showing forest boundaries in sufficient detail to have them relaid.

6. I consider it essential that the boundaries of forests over one square mile in area should be entered in the 1″ topographical maps.

Mr. T. B. Fry, Conservator of Forests, Central Circle, Bombay Presidency.

Mr. T. B. Fry.

[*Bombay, 27th January 1903.*]

1. I am the senior Conservator in the Bombay Presidency and am Superintendent of working plans, and in that way see the work of all the Circles. I imagine there is about four or five years' work left for forest surveys to do, but I cannot say anything definitely about this. More accurate information on this point can be afforded by the Superintendent, No. 17 Party, Bombay Forest Survey. Our programme is completely drawn up, and there are no more forests to be surveyed after the programme is finished.

Programme of Forest Surveys.

2. The teak forests in the Northern Circle and Central Circle, and in Colaba out of the Southern Circle, have been surveyed on the 8″ scale. The main part of Canara has been done on the 4″ scale. The question whether the 8″ scale was not too elaborate was discussed, but it was decided that it was necessary in teak forests, where working plans are in force, and the system of working is that known as "coppice with standards," because fellings are regulated by area, and they are generally of comparatively small extent from 40 to 80 acres. As far as I remember, this discussion took place about 14 years ago, and the Government of India left the matter for the Bombay Government to decide. It was actually settled to survey the babul *kurans* (reserves) in Poona on the 16″ scale, the teak forests on the 8″, and the rest of the forests on the 4″. The 8″ survey is still in progress, the 16″ is all finished. It has been decided to survey all the remaining forests, in Khandesh and nearly all of that in Satara on the 4″ scale. Portions of Nasik including Peint and the Balgan, Dindori and Kalvan talukas are to be done on the 8″; these areas contain teak, mostly small sized, but the Peint forests are capable of yielding fairly large timber.

Scales of Forest Surveys.

3. The 4″ scale is certainly necessary in the ordinary forests wherever working plans are to be introduced. The main object of having a large scale is to enable the compartments to be tested. The compartments are

Necessity for the 4″ scale.

Mr. T. B. Fry.

laid out by ordinary surveyors, and then are tested by the Forest or District Officers to see that the boundaries are correct, and no fraud has taken place. For this a large scale map is essential to enable the testing to be done quickly. Even with a 4″ map the testing is difficult. I speak from experience, as I had to do testing on 40-acre compartments in Thana.

An accurate 4″ map, with as much topographical detail as can be conveniently shown upon it, will serve in most cases for laying out forest roads serving as feeders to ordinary district roads. Such roads could not be laid out on a 2″ map.

There is no part of the forests in the Bombay Presidency where a 2″ scale would be sufficient. By this I mean no forests which are to be worked either in the way of exploiting material for commercial purposes, or for systematically creating forests which do not exist at present, or which are now in such a ruined state as to require methodical treatment in order to restore them. Our forests are divided up into forests proper, pasture, and fuel and fodder reserves. We do not want the pasture land measured on larger scales.

Value of the Bombay forests.

4. Last year there was, I believe, a profit of about 3 lakhs in the Presidency on the forests. Figures can be ascertained from the Review of Forest Administration of India by the Inspector General of Forests.

The Bombay teak forests are not so valuable as the Burma ones, and in Burma the Department can afford to make separate surveys for roads, etc., whereas in Bombay that would not pay; so we require a larger scale map than is sufficient for Burma. This is an opinion only, and I am not prepared to say that the Burma Forest Department may not at some future date ask for a large scale map of their forests; a map on the 4″ scale would probably be very useful there.

Mr. E. D. M. Hooper.

Mr. E. D. M. Hooper, Conservator, 1st Grade, Madras.

[*Dehra Dun, 15th March 1905.*]

1. As regards scale, I think that the 2-inch scale is sufficiently large except in special areas, such as the Nilambur Plantations of Malabar. The forest boundaries should be traversed by theodolite and available for reference at all times. Scrub areas falling within the Revenue Survey areas need not, as a rule, be surveyed by the Survey of India, as, for instance, in Bellary and Anantapur. If the maps are on the 2-inch scale, we can make sufficiently accurate enlargements for our purposes, provided we have the boundaries properly traversed.

2. I consider that greater continuity of policy as regards the survey programme should be aimed at. It should be made the subject of exhaustive consideration as a whole in each province in the first instance, and not circle by circle.

3. No confidence can be placed in the work of temporary surveyors detached from professional supervision. I can speak with experience of temporary surveyors for the last 14 years on this point. I consider that constant supervision in the field is absolutely necessary. I would not undertake to relieve the Survey of India of Forest Surveys, and carry them out under the supervision of Forest Officers. The Forest Department has not the officers available for such work, nor have they the special training required, and it would necessitate the constitution of a special branch.

4. As regards the old topographical survey of Ganjam and Orissa, this has proved most inaccurate, and there are lots of disputes. This work should all be re-done.

5. In my Circle,—the Central,—there only remain to be surveyed the Western hills of Nellore and Chingleput adjoining the already surveyed portion of Cuddapah and Kurnool. There would be no objection to their being surveyed on the 2-inch scale only. There are other areas in Trichinopoly that are down for survey, but should not be surveyed, as they are included in areas already mapped by the Revenue Survey.

6. I should like a certain number of the maps always printed on linen.

7. If 2-inch maps are provided, I should like to be able to get copies showing the topographical features without hills, as well as others with hills.

A point of great importance in Madras is that all tanks should be shown, even very small ones.

The Forest Boundary Surveys should be complete, showing clearly the limits of enclosed villages.

Mr. F. Beadon Bryant.

Mr. F. Beadon Bryant, Conservator of Forests, Southern Circle, Burma.

It is certainly not necessary to survey all reserved forests on the 4″ scale. It is only the better stocked forests requiring working plans, and detailed examination of the teak or other valuable trees they contain which need be so surveyed. I do not think there is any rule that all forests for which plans are required must be surveyed on the 4″ scale. It would generally be advisable, but here in Burma there are large areas poorly stocked where rough working plans based on area will suffice for very many years to come; and other areas for which no plans are wanted—and in such cases maps on the 1″ scale will answer all purposes.

As far as my Circle (Southern) is concerned, most of the valuable forest have been surveyed, and for what remains the 1″ scale will generally suffice.

SECTION VI.

LIST OF QUESTIONS REGARDING TOPOGRAPHICAL MAPS ISSUED BY THE COMMITTEE, PRELIMINARY TO THEIR ENQUIRIES, AND SELECTED ANSWERS.

SERIES I—FOR REPRESENTATIVES OF LOCAL GOVERNMENTS.

Points on which information is desired from officers representing the views of the Local Government, such as Members of the Board of Revenue or Secretaries or Directors of Land Records, etc.

NOTE.—Information is specially required as to 1" topographical maps, though the questions cover a somewhat wider range.

1. Have you any remarks to make on the general state of the survey maps of your province, or any suggestions to offer with special reference to—
   (1) their being up to date or otherwise;
   (2) their general suitability for administrative purposes;
   (3) difficulty in obtaining them or delay in their publication?

2. Has any inconvenience resulted from the absence of good topographical maps in any part of the province, or from their being obsolete or otherwise inaccurate?

3. What are found to be the most convenient classes of maps for administrative purposes? (See Nos. 5 and 6 in list of points on which information is required from administrative officers.)

4. Are any special maps prepared in your province for issue to local officers? If so, of what class and by what agency? Do you employ the Survey of India for any part of the work? Are there any facilities for reproduction of maps either in Government or private establishments in your province?

5. (*For those cases only in which it is customary to send special maps to the Survey of India for reproduction.*) Do you consider that in place of using the Survey of India office for the reproduction of any special maps required it would be of advantage to have such maps compiled, drawn, and printed under local supervision? Would such an arrangement necessitate the provision of extra establishment and plant? If such work were refused by the Survey of India, would much inconvenience be caused, and would there be much delay in making arrangements to have it done locally?

6. Where it is found necessary to issue maps, such as those referred to in question 4, is this done because the survey maps are not convenient for the purpose required, or because they are not to be had, or can only be had with difficulty, or are out of date?

7. Are there any arrangements for the regular report to the Survey of India of changes (such as new roads, railways, etc.) after the preparation of maps which should be shown in them? If so, describe the procedure.

8. What surveys—topographical and others—are at present in operation in your province?

9. What share has the Local Government in deciding the programme of work of the survey parties in the province and to what extent are the survey parties and drawing offices (if any) under its orders?

10. Is the relationship between the survey officers (if any) working in the province and the Local Government sufficiently close to ensure the employment of the survey parties in such manner as to meet, as far as possible, the wishes of the Local Government?

11. Can trained surveyors be obtained for special surveys in the province? If so, any information as to their recruitment, training, and remuneration, and as to the classes of men employed will be useful.

12. Have any large scale surveys of municipalities and towns been made? If so, by what agency and at whose cost?

FOR THOSE PROVINCES ONLY IN WHICH TOPOGRAPHICAL MAPS ARE PREPARED BY REDUCTION FROM CADASTRAL OR OTHER LARGE SCALE MAPS.

13. Have you had any opportunity of comparing topographical maps made by direct survey with those made by reduction from cadastral maps? If so, what is your opinion of their relative merits?

14. Are cadastral surveys in your province uniformly based on a traverse survey?

15. Are steps taken to maintain the traverse mark stones, and with what result?

16. Give for as many districts as possible that have recently been cadastrally surveyed the cost per square mile of the cadastral survey, mentioning whether the latter includes the

surveyor's salaries in all cases, and the extent to which free labour may be counted on for chaining and such work.

17. Have any district or other general maps been prepared by reduction of village maps not based on traverses? Has it been found possible to make such maps sufficiently accurate for revenue purposes?

18. To what extent and under what arrangement are officers of the Survey of India employed on cadastral work in your province? Are they confined entirely to survey or partly employed on record work? If their services are required for topographical work elsewhere, can they be replaced without detriment to the work of the Land Records Department?

SERIES II—FOR CIVIL OFFICERS.

Points on which information is required from Civil Administrative officers.

NOTE.—Information is specially required regarding 1" topographical maps, though the questions cover a wider range.

1. What Survey of India maps, if any, are in use by yourself or officers serving under you?

2. Specify the maps, if any, other than those of the Survey Department which you find it convenient to use either for your district as a whole or for smaller areas, such as tahsils and talukas, etc.

3. Are survey maps of the district or other area under your control regularly issued to you or officers subordinate to you on publication?

4. Where maps, such as those referred to in question 2 are used, is it because they are more convenient for your purpose than survey maps, or because the latter are not to be had, or can only be procured with difficulty or are out of date?

5. Describe the class or classes of maps that would best suit your requirements, giving the scale or scales.

6. Give some account of the information that should be shown in a map to make it most useful for your purposes. Is the insertion of village boundaries essential, and, if so, in what classes of maps? Is a map showing merely the names and boundaries of villages with such features as roads, rivers, and railways, and giving such information of administrative importance as the position of tahsil head-quarters and the like, more useful for all or any of your purposes than a map giving full topographical detail?

SERIES III—FOR PUBLIC AND MILITARY WORKS OFFICERS.

Points on which information is required from officers who may have to use the maps of the Survey of India for professional purposes—e.g., officers of the Public and Military Works and Railway Engineers.

NOTE.—Information is specially required with reference to 1" topographical maps, though the questions cover a somewhat wider range.

1. To what extent do you use maps of the Survey of India, and what class of these maps do you find most useful?

2. Do you find them of material assistance in your work?

3. If not, in what respects are they defective? Specify clearly whether the defects are owing to the maps not being up to date or to other causes.

4. Have you any suggestions to put forward as to improvements that would make the maps more useful for your purposes?

5. Have you had any occasion to make special surveys for your own purposes owing to non-existence of survey maps, or to their being out of date or otherwise defective?

6. When a special map is required, do you have it prepared and reproduced under your own orders, or do you send the rough information to the Survey of India to have the map worked up and reproduced?

7. Have you any establishment of your own, or are there any local establishments by which

(*a*) the drawing and
(*b*) the reproduction

of such work can be satisfactorily carried out?

8. What rates of pay do you give to surveyors required for special surveys, and whence do you recruit them? Any information as to the class of men employed and their training and as to the ease or difficulty of obtaining them will be useful.

9. Give similar information as to draftsmen, whether employed for mapping or other work.

10. Are Survey of India maps of the parts of the country you have been employed in readily obtainable? When you have a project to carry out, do you apply to the Survey of India for maps of the area affected?

11. Are you supplied with copies of survey maps of your district, etc., immediately on publication?

12. Have you ever had occasion, in order to render the maps more useful for your own purposes, to enter changes in them from actual survey, such as new roads, railways, canals? Have you reported these changes in any case to the Survey Department?

SERIES IV—FOR MILITARY OFFICERS.

Questions for General Officers Commanding Divisions and Brigades, and Colonels on the Staff.

1. What Survey of India maps of your command are in common use for military purposes?

2. Are they in all respects up to your requirements from a military point of view? If not, in what details do they fall short?

3. If tactical maps of any portions of your command are non-existent, give the degree and order of urgency in which you consider these various portions should be surveyed—on account of military considerations.

4. Having regard to the physical nature of the country comprised in your command, on what scale do you consider that any new survey should be conducted (and reproduced) to make efficient maps for tactical purposes?

5. Having regard to economy in the cost of reproduction, what are your views with regard to the number of colours in which these maps for tactical purposes should be reproduced?

6. Give details of information, you consider, should be depicted on maps generally regarding physical and artificial features to make them useful for (*a*) strategic, (*b*) tactical purposes.

7. In your own command which of the above information is of paramount importance?

8. In the event of your using maps not surveyed and reproduced by the Survey of India, describe them and criticize them from a military point of view.

Madras.

Reply received from the Board of Revenue, Madras, to the first series of questions.

[Received with letter No. 49, dated 9th January 1905, from Secretary to Madras Government.]

Q. 1.—The following are the one-inch topographical maps of the Madras Presidency published by the Survey of India :—

Series.	Sheet Nos. (old).	Years of publication of sheets.	Districts of the Madras Presidency to which the sheets relate.
Hyderabad Topographical Survey . .	11 to 18 . .	1875 to 1880 . .	Portions of Ganjam, Vizagapatam and Godavari.
Central Provinces Agency Topographical Survey.	1 to 29, 33, 35, 45, 47, 49, and 51 to 54.	1870 to 1880 . .	
Ganjam and Orissa Topographical Survey	48 to 53, 55 to 57, 72, 74, 76 to 81 and 101.	1871 to 1877 . .	
Madras Survey	150 to 152 . .	1892 to 1895 . .	Portions of Madura and Tinnevelly.

None of the above sheets appear to have been revised since the date of their publication. In the last mentioned three sheets, only about 600 square miles of the hill country were topographically surveyed by the Survey of India Department. For the remaining area, the one-inch taluk maps published by the Madras Survey Department were utilized by the Survey of India in compiling the topographical sheets.

The taluk and district maps issued by the Madras Survey Office are defective in some respects, particularly in regard to the correct delineation of roads. They also require to be brought up to date in many instances. The taluk maps prepared from the results of the cadastral survey are generally satisfactory, and fulfil all ordinary administrative requirements, and their usefulness would be increased, if they could be made to show drainage and watershed lines. The district maps based on the same data as the taluk maps are useful as route maps, but are wanting in clearness and accuracy.

Q. 2.—The village maps in ryotwari areas, though primarily intended for revenue purposes alone, contain many topographical details such as roads, rivers, canals, cart-tracks, village sites, tanks and the like. When these maps are not up to date, serious inconvenience is often felt in revenue administration. Maps of proprietary areas are also often required. It is hardly necessary to do more than to refer to the need of good topographical maps for forest and river conservancy purposes.

Q. 3.—The taluk and district maps prepared by the Madras Survey Department are very useful and convenient for administrative purposes.

Q. 4.—Besides the taluk maps on the ½-inch or 1-inch scale and the district maps on the ¼-inch scale which are issued to local officers on publication, miscellaneous maps of all descriptions are prepared on various scales for illustrating administration reports, etc., of every department of Government in the province.

With the exception of a few maps which are compiled by the Public Works and Irrigation Departments, compilation and reproduction of all maps are done at Madras by the Drawing and Photo-zincographic Office attached to the Madras Survey Department.

Q. 5.—No maps are sent from this Presidency to the Survey of India for reproduction.

Q. 6.—No.

Q. 7.—None as far as the Madras Survey Department is concerned.

Q. 8.—The following surveys are at present in progress by the Madras Survey Department :—

(1) Initial cadastral survey of tracts excluded from the cadastral survey of 1877, in the Gumsur taluk of the Ganjam District.

(2) Cadastral resurveys and revision surveys in the districts of Ganjam, Kurnool, Cuddapah, Nellore, Salem and Tinnevelly.

A forest party of the Survey of India is employed in surveying forest reserves in the districts of Ganjam, Godavari, Kurnool, Chingleput, Trichinopoly, Coimbatore and South Canara.

A detachment of the Survey of India is making a survey of the Godavari River.

Q. 9.—The Madras Survey Department is completely under the orders of the Local Government.

The Local Government also settles the programme of work of the Survey of India Party engaged in the survey of forest areas in the Presidency. The maps issued by the Survey of India branch are verified by the local Forest Officers before final publication.

Q. 10.—Please see reply to question 9.

Q. 11.—There is a College of Engineering in Madras where instruction is imparted in surveying. Passed students from this college are mostly employed in the Public Works Department and under District Boards. Some of the students joined the Madras Survey Department and received instructions for a few months in the methods adopted in cadastral surveys, but after a short time quitted the service on finding that the work was more arduous than they had expected.

Surveyors for cadastral surveys are recruited from among the natives of the districts under survey. They are, as a rule, started in the lowest grade, *viz.*, Field Surveyor, pay Rs. 10 to Rs. 15.

Q. 12.—The following Municipal towns have been surveyed by the Madras Survey Department, and the cost of the survey was borne by Government. The scale of the revenue maps showing the limits of properties, is 160, 80 or 40 inches to the mile according as the localities are crowded, less crowded or open. The manuscript maps on the above scales have been reduced by photography to half scale and published. Topographical maps on scales 20″ and 10″ to the mile are also published.

1. Bezwada.
2. Anantapur.
3. Conjeeveram.
4. Madras.
5. Tirupati.
6. Walajapet.
7. Vellore.
8. Gudiyattam.
9. Cuddalore.
10. Vaniyambadi.
11. Tirupattur.
12. Salem.
13. Tanjore.
14. Kumbakonam.
15. Mayavaram.
16. Mannargudi.
17. Negapatam.
18. Trichinopoly.
19. Srirangam.
20. Madura.
21. Dindigul.
22. Periakulam.
23. Palni.
24. Coimbatore.
25. Karur.
26. Erode.
27. Ootacamund.
28. Coonoor.
29. Palghat.
30. Calicut.
31. Cannanore.
32. Tellicherry.
33. Cochin.
34. Mangalore.

Q. 13.—There has been no such opportunity until now for any considerable area. The Banganapalle State, which was topographically surveyed in 1872, has recently been cadastrally surveyed.

A comparison of the two surveys will shortly be made.

Q. 14.—Yes.

Q. 15.—Yes; with satisfactory result.

Q. 16.—The districts which have been cadastrally surveyed are given in the following table, which also shows the cost of the surveys:—

District.	Total area for survey.	Date of commencement of survey.	Date of completion of survey.	Total cost.	Cost per square mile.	Remarks.
1	2	3	4	5	6	7
	Sq. miles.			Rs.	Rs	
Anantapur	4,538	1881	1894	7,70,645	170	Initial cadastral survey.
Bellary	5,374	1872	1891	9,86,554	184	
Tanjore	2,592	1884	1890	10,88,018	420	
Malabar	5,397	1871	1896	15,05,469	279	
South Canara	3,560	1888	1896	5,57,151	151	
Godavari	2,517	1892	1896	1,79,812	71	Cadastral resurvey.
Kistna	5,269	1892	1903	4,17,433	79	
Trichinopoly	2,733	1891	1895	1,20,660	44	
Salem (5 out of 9 taluks)	2,325	1893	1896	71,112	31	

The cost entered in column 5 above is inclusive of the salaries of surveyors. The cost of stones and of hired labour employed for chaining, etc., was, as a rule, advanced, in the first instance, by Government and subsequently recovered from landholders.

Q. 17.—No.

Q. 18.—Officers of the Survey of India are not employed on cadastral work in the Madras Presidency.

Mysore.

Answers given by the Mysore Durbar to the first series of questions.

Q. 1.—(1) The survey maps (topographical) are up to date; and can hardly be improved on for general purposes.

(2) They are most suitable for all administrative purposes, except for minute revenue purposes for which special revenue survey maps are issued by the Survey and Settlement Commissioner in Mysore.

(3) They are obtained direct from the Surveyor General's Office, Calcutta; free of cost under the terms of letter No. 756—395-92, dated 4th March 1893. These maps are not easily procurable locally: and I have frequently had to refer applicants to the Surveyor General's Office, Calcutta.

Q. 2.—No. Very few errors have been discovered; and, as a rule, these inaccuracies are mostly as to the areas of water spreads of tanks at weir level. In parts of the Sagar-Malnad (sheets Nos. 2 and 18) contouring is in part incomplete. The correct areas of tank spreads are obtainable from our local Revenue Survey Office.

Coorg.

Replies to the first series of questions from the Commissioner in Coorg.

Q. 1.—The topographical maps available are neither up to date nor suitable, and the stock of them is exhausted and cannot be replenished without reprinting. They were prepared nearly 30 years ago by the Madras Survey, and the method of printing adopted is such as to obscure details.

The cadastral maps, which are prepared by the local surveying establishment, are up to date, and on the whole suitable for the purpose of the land revenue administration. They do not meet requirements of the Public Works or the Forest Department.

Q. 2.—Inconvenience has resulted from the absence of good topographical maps, notably in connection with the Mysore-Tellicherry Railway Survey, the working out of irrigation schemes and the drawing up of forest working plans.

Letter No. 128 (5), dated Bangalore, the 21st January 1905, from the Secretary to the Chief Commissioner of Coorg.

I am directed to return with the necessary answers* the three lists of questions received with your letter No. 4—8, dated the 24th November 1904. A copy of the Commissioner's letter* No. 1835, dated the 12th January 1905, and of the Executive Engineer's letter No. 117,* dated the 10th January 1905, referred to therein is also enclosed.

2. The position as regards the existing maps of Coorg may be summarised as follows:—

(1) *Topographical maps.*—Coorg was topographically surveyed in 1872—1879 and a map of taluks was prepared on the scale of two inches to one mile. This map, of which copies have now run out, is quite accurate, but it is not up to date and needs revision. It is indifferently printed, the usefulness of the map being defeated by masses of shading, so that it is exceedingly difficult to trace with the eye the valleys and ridges in the more mountainous portions, while further details, such as the boundaries of coffee estates, the levels of plains and valleys and the heights of additional hills are desirable. The want of a good map has been felt on more than one occasion by the Public Works Department (*in re* Railway Survey and Irrigation projects) and the Forest Department (*in re* working plans).

(2) In 1902 Mr. Haller, Assistant Superintendent of Land Records, prepared a map of the whole district on the scale of 1 inch = 2 miles. It is based on the topographical taluk maps and the recent cadastral survey maps. It is a good map and indicates the main topographical features, but does not meet all the requirements of the Administration.

(3) *Cadastral survey maps.*—These were prepared by the local Surveying establishment in 1888—1893 on the scale of 8 inches = 1 mile, and are kept up to date, and while meeting the requirements of the land revenue administration are insufficient for the Public Works or the Forest Department. It is desirable that such maps should show roads and streams in continuity, the position of the chief hills, peaks and villages and hamlets where they occupy defined sites.

(4) The only other maps prepared recently are (1) a topographical map on the scale of 1 inch = 1 mile of the environs of Mercara, compiled last year at the request of the Officer Commanding the 71st Coorg Rifles, who for military purposes required something larger than the district map and clearer than the taluk map; and (2) large scale maps of the towns of Mercara and Virajpet prepared for the purposes of municipal assessments.

3. *Suggestions.*—The Commissioner recommends (i) a new district map on the scale of 1 inch = 1 mile divided into sections, say, one for each of the five taluks comprising the province; and (ii) enlargements on the scale 2 inches = 1 mile for each of the 19 *nads*. The

* Not printed.

Coorg.

former should show *nad* boundaries, and the latter village boundaries. Both should give all topographical etails, such as hill contours, the elevation of important peaks, the general level of different valleys and plateaus, streams, channels, nullahs, roads, cart-tracks and the principal bridle and foot-paths, fords, wet cultivation, coffee in blocks of 50 acres or more, and villages and hamlets in those cases in which they occupy defined sites. If possible, jungles should be indicated as well, but this may not be feasible in a country where climatic conditions allow of rapid changes in regard to the undergrowth such as *lantana*. Local officers wish to have contoured instead of shaded maps, and suggest that a proportion of the contour lines in the existing topographical taluk maps should be omitted. In these suggestions the Chief Commissioner concurs.

4. Specimen copies of the maps referred to in clauses (1), (2) and (3) of paragraph 2 and of the 1st map referred to in clause (4) are enclosed for information. I am to request that they may be kindly returned when done with.

Selections from replies received from officers in the Central Provinces to the first and second series of questions.

Central Provinces.

First Series—Question 1.

Mr. B. Parkes, Secretary to the Chief Commissioner in the Public Works Department.

(1) They are practically all out of date. Pending issue of fresh maps, they should be brought up to date as far as possible from information which is at once available, *e.g.*, what is supplied by the Public Works Department under Code I, 977.

(2) They are generally suitable, but the points referred to in the Central Provinces letter No. 6936, dated the 2nd November 1904, should be attended to carefully in order to improve their utility.

(3) Sometimes maps applied for are stated to be out of print and great difficulty is experienced in consequence. I may quote as an instance the 1″=1 mile maps of Bhandara, Jubbulpur, Narsinghpur and Saugor, which are out of print.

Question 2.

Mr. R. H. Craddock, I.C.S., C.S.I., Commissioner, Nagpur, dated 28th January 1905.

The existing maps are now obsolete; old roads, now fallen into disuse, figure as important while new roads are not shown. Boundaries between villages, forests, zamindaris are not shown or are shown incorrectly. In the Baihar tahsil of Balaghat and in Chanda there are numerous villages, of which the names are not shown, while names appear of villages that have long since disappeared. Alterations of district boundaries, some of which are of long standing, do not appear.

The errors or omissions of zamindari boundaries have resulted in many troublesome boundary disputes, the settlement of which has taken years and the deputation of many officers, and boundaries of this kind on topographical maps have proved most misleading.

The obsolete character of these maps as regards artificial features has caused great inconvenience to officers newly coming to a district, and the want of village boundaries has been most troublesome to persons seeking mineral concessions, and officers who have to deal with their applications, as without them it is impossible to define areas.

When one has gained some acquaintance with a district, the general inconveniences are less felt, but it is of course absurd that a map should have to be used subject to corrections, which are known only to the man with detailed local knowledge. For instance, a group of villages are situated on a plateau elevated above the general level of the country, but there is nothing in the map to show this, and one is quite unable to judge, until one goes there, whether the villages in question are lying on and among ranges of hills, or in a low hollow surrounded by hills, or (as they really are) on a perfectly level plateau. I have indicated in my answer to question 6 of the questions for district officers what details should be shown. So far as natural features (as distinct from changing artificial features) are shown on the maps, they are in most cases very accurate.

With new railways, roads, and irrigation works, constructed, in course of construction, or projected, considerable alterations have taken, or are taking place, and with many new villages founded or being founded in the districts of Balaghat and Chanda, there is little finality. What we require is a complete bringing up to date now, *plus* a periodical revision in respect to new features, which should not be a difficult matter, provided that a system exists of communicating to the Survey Department *each change as it occurs*. When the list of such changes in the Survey Office has amounted to an appreciable number, the necessary corrections should be made in the maps of the district to which they relate. All changes in district and tahsil boundaries, and important cases of land disforested, should be communicated as they are made.

Mr. L. S. Carey, I.C.S., Commissioner, Narbudda Division, dated 31st January 1905.

I have mentioned, in answering question 5 of the second set of questions, one serious inconvenience caused by the absence of a good trustworthy map in connection with applications for mining concessions in the Pench Valley Coal Field. I would also mention that

Central Provinces.

considerable inconvenience is experienced in the Harsud tahsil for want of a proper map. The ryotwari villages have all been carved out of jungle since the tract was surveyed. The whole face of the country is changed. The Survey of India Department has traversed the area, and could surely, with the aid of our 1 mile=16 inch patwari maps, evolve a very useful map.

Inconvenience is also felt owing to the names of many *malguzari* villages being omitted from the maps. When I came new to the Division, more time was taken up in fixing my tours than if I had had maps up to date. For instance, I had to call up a clerk or other subordinate with local knowledge, and mark in the road from Matkuli to Chhindwara, and those connecting Multai with Chhindwara, and the latter place with Narsinghpur. Several of my Deputy Commissioners mention this inconvenience which is naturally felt more by new comers than by those who have detailed local knowledge of their districts. The Deputy Commissioner of Chhindwara states that he often experiences inconvenience owing to the existing survey maps not showing the boundaries of various jagirs.

Mr. F. A. T. Phillips, I.C.S., Commissioner, Chhattisgarh Division, 25th March 1905.

I am not able to give any specific instance in which inconvenience has actually resulted in the Chhattisgarh Division in the past from the absence of good topographical maps. But the resources of the Division are now being developed, and there is little doubt that inconvenience will surely arise in the near future if the topographical maps are not soon brought up to date.

Question 3.

Mr. B. Parks, Secretary in the Public Works Department.

The most convenient are the 1″=1 mile maps for general administrative purposes. For special engineering purposes, *e.g.*, road and more particularly irrigation projects 4″=1 mile would be of the greatest value.

Mr. B. P. Standen, I.C.S., C.I.E., Commissioner of Settlements and Agriculture.

Unless village boundaries can be clearly shown in some way which shall prevent them from being confounded with roads or small streams, it would be better to omit them. Small streams often form the boundary between villages, so that it may be difficult to avoid confusion if village boundaries are to be shown. For some of the purposes for which a map showing village boundaries is useful, it is useful to employ a map showing village boundaries only (known as a *mujmili*) prepared in the Land Record Office from the sheets of the cadastral survey. Even if Revenue Survey maps existed for all areas, it would still be necessary to prepare these *mujmilis* because a number of copies of them are required for the officials of the Land Records and Settlement Department and for Famine Officers, etc., and to supply all these officials with expensive maps would be waste of money. It is certainly not so essential that village boundaries should be shown as that the map should give a clear idea of topographical details to the extent mentioned in my previous letter on this subject. At the same time it would sometimes be convenient to have village boundaries on the map.

Question 12.

Mr. R. H. Craddock, Commissioner, Nagpur.

The following extract from a letter from the Deputy Commissioner of Nagpur shows what maps exist of the towns of Nagpur and Kamptee :—

"Of Nagpur town the following maps appear to have been made—

(*a*) A 16″=1 mile map of 1865 of Nagpur City prepared by the Surveyor-General of India, being a Revenue Survey Map.

(*b*) A 16″=1 mile map of 1865-67 of Fort and Civil Station of Sitabaldi prepared by the Surveyor-General of India, being a Revenue Survey Map.

(*c*) Ferrotype plates of the Nagpur Drainage Survey in 1891 on a scale noted in the margin and prepared at the cost of the Municipality, and these are being checked for the purpose of Nazul Survey at Municipal cost.

Scale of large maps is 10 feet to one mile and that of small 24 inches to one mile.

"In Kamptee the following large scale maps of the town and cantonment are reported to have been made, *viz.* :—

(*a*) The largest map of the whole of the cantonment is signed by Mr. G. H. Cookes, Deputy Superintendent of Survey; it is dated 1890, and is on the scale 16″=1 mile.

(*b*) The largest map of the town or Saddar Bazaar is on the scale of 50 feet =1 inch; it is signed by the Deputy Assistant Adjutant General, Nagpur District, and bears the date 21st September 1890."

The Nagpur Survey of India maps are hopelessly obsolete and on much too small a scale. The Kamptee maps I have not seen. They probably serve cantonment purposes sufficiently well.

In some Municipal towns an endeavour has been made to obtain a cadastral survey on the scale 64″ to 1 mile, but the results are not very satisfactory. These have been having some

drainage surveys made by the Public Works Department. All these local maps have been made at Municipal expense. The main objects to be obtained in the larger Municipal towns are the proper survey of *nazul* land, and the detailed survey of roads, so as to check all future encroachments. The local maps are not sufficiently accurate for this purpose, and the drainage survey maps naturally show those details only which satisfy the purpose for which they are made. In one or two instances (Nagpur and Hinganghat) the Public Works Department have been asked to combine the survey of *nazul* land with the drainage survey, but I have not yet seen the results.

Mr. F. A. T. Phillips, Commissioner, Chhattisgarh Division.

Large scale surveys have been made in the three chief Municipal towns of the Division. In Raipur a drainage survey was made by the Public Works Department in 1891 and 1892 at a cost of Rs. 4,783, and a map was prepared on the scale of 10 feet to the mile. The cost appears to have been borne by Government. In Bilaspur also a drainage survey was made by the Public Works Department some five years ago, and a large scale map containing 96 sheets was prepared. I have not been able to ascertain the amount of the cost, which was borne by Government. In Sambalpur also a drainage survey was made by the Public Works Department some time ago, and a map, containing 68 sheets, was prepared on the scale of 120 inches to the mile. Two more surveys were subsequently made, one by the Public Works Department which prepared a map on the scale of 30 inches to a mile, and the other by the Land Records Staff which prepared a map on the scale of 32 inches to the mile. The cost of the last survey was borne by the Municipal Committee. The cost of the other two appears to have been borne by Government.

SECOND SERIES.

Mr. R. H. Craddock, Commissioner, Nagpur.

Q. 2.—The only maps, other than Survey of India ones, of which use is made, are the maps of the 16″ to a mile cadastral survey, and compilations prepared from those maps. The village maps are of course only useful for village interior details of cultivated land, but they are deficient in topographical details, especially in respect of blocks of forest. When a Revenue Survey map showing village boundaries exists, traces of these, are prepared for common use to illustrate tahsils and sub-divisions by the circles of revenue inspectors and patwaris, excise and police circles and the like. Such traces which are known as "*mujmilis*" contain no topographical details, and are merely used to show the collection and location of villages contained in particular sub-divisions for various administrative purposes. When no convenient map exists containing village boundaries, such *mujmilis* have to be prepared by reduction of cadastral maps, a work of some trouble and difficulty. In many cases, however, great errors in appropriate sub-division have occurred from too much trust being placed on such *mujmili* maps, with the result that physical features have been disregarded to the great detriment of work in the circle. The same want of maps, to combine village boundaries with topographical details, has caused many inappropriate boundaries between tahsils and districts.

Q. 3.—Except the new Forest maps, 4″ to the mile, which are regularly issued both to Deputy Commissioners and myself, I receive no maps except on indent. New issues are no doubt notified, but they sometimes escape notice; and it would be far better if copies of all new issues were supplied as a matter of course to the local officers and to Heads of Departments. As a matter of fact, however, new issues are mere reprints of older maps with some corrections which are not themselves complete. An endeavour was made in the time of Colonel Strahan to bring maps up to date with reference to cadastral maps. This method was very cumbrous and liable to errors and omissions, since it depended on their local detection by a staff over which there was little check. It sufficed fairly well to show the alignment of a new road, but for no other details, and it was not feasible in areas where the existing Survey of India maps contained no village boundaries. Hundreds of village traces were sent to the Survey of India Office, and there the matter ended. I believe that the experiment of bringing maps up to date by this method has been abandoned.

Q. 4.—In my answer to question 2, I have already referred to the use of *mujmilis*. *Mujmilis* will continue to be used to illustrate all proposals for small administrative circles, to illustrate proposed mineral concessions, and for all purposes in which extracts of maps are necessary to explain the text of revenue proposals. It is also convenient to supply minor officials with *mujmili* maps of their circles. It would be wasteful to cut up and use printed maps for these purposes; but it is essential that the map from which they are traced should contain village boundaries and boundaries of Government forests.

Q. 5.—After fully considering this question, I agree with Mr. Walker that for general use the scale of the Nagpur-Wardha Revenue Survey map, 1″=2 miles, is sufficiently large. For more minute work a map 1″=1 mile is most essential. It would fit in with the forest maps now being supplied. It is most useful for surveys of railways, roads and irrigation works, and for purposes of mineral concessions. As regards the former map, I had previously recommended a scale of 1″=1 mile, but on further consideration I think half this size will do. If brought up to date, the Nagpur-Wardha map would be an excellent one, and a tahsil tracing taken from it would make handy maps for the use of Tahsildars.

Central Provinces.

Q. 6.—The maps, 4″=1 mile, must show village and forest boundaries in addition to full topographical details. The maps, 1″=2 miles, for general use, should show besides these boundaries, *which are absolutely essential*, the following details:—

(1) All important rivers and streams, including important bridges and ferries.

(2) All wells.

(3) All tanks which can be shown on the scale.

(4) Village sites and hamlets of any size.

(5) Railways, roads, important cart tracks, telegraph lines away from railways.

(6) Railway stations.

(7) Tahsils and tahsil boundaries.

(8) Police station houses (as soon as effect has been given to the recommendations of the Police Commission).

Suggestions are made to include schools and dâk bungalows, weekly bazaars, etc., but there are a good many changes in the two former; and for the latter, lists of important villages could be procured from Deputy Commissioners, the names of which might be printed in larger type. Elevations of more important peaks might be shown, as suggested by some Deputy Commissioners.

Mr. L. S. Carey, Commissioner, Narbudda Division.

Q. 1.—There are the following maps in this office:—

(*a*) One set of topographical survey maps of Hoshangabad, Betul and Chhindwara. The maps relating to Hoshangabad were published in 1871, and those relating to the two other districts in 1870. The scale of these maps is 1 mile = 1 inch.

(*b*) Two sets of Revenue Survey maps, 1 mile = 1 inch, of each of the districts of this Division. In the case of Nimar and Chhindwara both sets are of the same year, *viz.*—Nimar 1874 and Chhindwara 1873. In the case of other districts, both sets do not belong to the same year—Hoshangabad, 1870 and 1895; Narsinghpur, 1866 and 1867; Betul, 1871 and 1899.

The second set of the Revenue Survey maps were supplied in 1903 for marking mineral concessions granted in the several districts. These maps are also on the scale 1 mile = 1 inch, except the later edition of the Narsinghpur map, the scale of which is ¼ inch = 1 mile.

(*c*) District maps, scale 4 miles = 1 inch in Book Form.

(*d*) Forest Survey maps. These are received on publication, and their scale is 1 mile = 4 inches.

Q. 2.—

(*i*) There are maps for each district, on the scale of 8 miles = 1 inch, which illustrate the district road schemes and famine programmes. These are prepared in the Public Works Department Secretariat, and contain very little detail, but are useful for the purpose for which they were designed.

(*ii*) Cadastral survey maps, 1 mile = 16 inches. These maps are the basis of the Land Record papers. They themselves are based on a traverse by the Survey of India Department.

Q. 3.—Forest Survey maps are supplied on publication. The maps of the Survey of India Department are only supplied on requisition.

Q. 4.—The maps referred to in the answer to question 2 are used, because their scale is more convenient. For the first purpose a small and handy map on thin paper is required to be pasted in the road scheme and famine programmes. For the second purpose a large scale map is required. To all intents and purposes, these cadastral maps are Survey of India maps, in which, however, interior details have been worked in by the cheaper agency of patwaris.

Q. 5.—For administrative purposes a revenue survey is always a desideratum. And this becomes a necessity when a coal field is discovered or other minerals are being exploited, and concessions over given tracts of country are sought. Care has to be taken to prevent over-lapping. It is therefore essential to define the exact limits of the land over which concessions are granted. Difficulties were recently experienced in marking the boundaries of the concessions sought by three separate firms in the Pench Valley Coal Fields of the Chhindwara District, owing to the indistinctness of certain village boundaries. In the case of some villages no boundaries at all were marked. The most useful map for administrative purposes is undoubtedly a topographical survey, scale 1 mile = 1 inch. It should be supplied in conveniently sized sheets. I think the present form of issue is quite good. On the assumption that Revenue Survey sheets will also be available on requisition, I quite accept the view enunciated in the closing clause of paragraph 3 of the Central Provinces Revenue Department letter No. 6936, dated the 2nd November 1904, to the address of the Secretary to the Government of India in the Revenue and Agriculture Department, that it would be most inadvisable to overload the topographical map with details of village boundaries. Where

villages are very small, as in the Mangeli tahsil of the Bilaspur District, a topographical map, which showed village boundaries, would have room for little else, and the map would be very confusing. Central Provinces.

The scale of 2 miles = 1 inch is a convenient one for some administrative purposes, *i.e.*, for marking out patwari circles, excise circles, etc. The scale is sufficiently large to exhibit village boundaries, whereas the 1 mile = 1 inch map is more cumbrous, and 4 miles = 1 inch is too small for most purposes. Mr. Fuller, on the close of the traverse survey of Chhattisgarh, had maps on the scale, 2 miles = 1 inch, prepared by the Survey of India Department for the *khalsa* area of the three districts of Raipur, Bilaspur and Sambalpur. These maps have, I believe, been found handy and useful. But a map on this scale would not be anything like so useful for general purposes as one on the 1 mile = 1 inch scale. If it were feasible then to supply maps on three scales to District Officers, I should recommend the issue of the following:—

(*i*) Topographical map, scale 1 mile = 1 inch.

(*ii*) Topographical map, scale 4 miles = 1 inch, in book form.

(*iii*) Revenue Survey map, scale 2 miles = 1 inch.

The last map would, I think, do well for illustrating mineral concessions, as well as for marking out administrative units and grouping villages for purposes of Census, Administration of Land Records, or Excise, the enumeration of vital statistics, etc. Such a map might, I think, be little more than what is known in these Provinces as a *mujmili*, *i.e.*, a skeleton of village boundaries, though its utility could be greatly enhanced if the principal natural features were exhibited, such as rivers and hills, and roads and railways were also marked. For the administrative purposes enumerated above, it is most desirable that the existing facilities for communication, and the obstacles to the same, should both be clearly indicated.

Q. 6.—Please see my answer to question 5 above. The topographical map, scale 1 mile = 1 inch, as recommended above, should be amplified in the manner suggested in paragraph 3 of the Secretariat letter No. 6936, dated the 2nd November 1904. I have no further suggestions to make.

The present form of the small scale topographical map, 4 miles = 1 inch, appears to me quite suitable. To overload it with detail would be to curtail its utility. All that is wanted is to bring it up to date.

Mr. F. A. T. Phillips, Commissioner, Chhattisgarh Division.

Q. 1.—Reference has been made to the Forest Survey maps by the Deputy Commissioner of Bilaspur only, though the Deputy Commissioner of Raipur has mentioned them in his answer to the second question. As these maps (which, by the way, are excellent) relate only to forests and show nothing but forests, probably any reference to them is not required. The Deputy Commissioner of Sambalpur has omitted mention of the large map of his district on the scale of one inch to the mile.

Q. 2.—Only the maps of the Survey of India are used in the Feudatory states. In the three British districts traces of the patwaris' maps are also used to a considerable extent.

Q. 3.—The answers given are somewhat conflicting. I believe that maps are regularly issued on publication to the administrative officers of the areas to which the maps relate. But for a very long time no Revenue Survey map has been published.

Q. 5.—The Deputy Commissioner of Bilaspur still thinks that a map on the scale of one inch to two miles is better than a map on the scale of one inch to one mile. In this opinion he is alone. It seems to me that the scale of the large map should be one inch to the mile. A smaller map on the scale of one inch to four miles is also very desirable for more general use, being more handy, but the amount of topographical detail that can be entered in it is necessarily limited.

Q. 6.—As to the information to be shown in a map, the answer for the Central Provinces generally has already been given in paragraph 3 of Central Provinces Revenue Secretariat letter No. 6936 of 2nd November 1904. I need only add that there seems to be a consensus of opinion that village boundaries need not be shown in the small scale maps, but that they should be shown, if possible, in the large scale maps.

Reply furnished by Mr. H. S. Lawrence, C.S., Director of Land Records and Agriculture, Bombay, to the first series of questions. Bombay.

[*Received with letter No. 430, dated 21st January 1905.*]

Q. 1.—The Bombay Revenue Survey maps are corrected up to date by the Land Records Department.

With regard to Survey of India maps—

(1) Very little detail is required to bring the 1-inch maps up to date.

Bombay.

(2) As Revenue Survey maps of each village have been prepared, the topographical sheets are not universally used for revenue administrative purposes. For irrigation schemes and military requirements more levels and contours are desirable.

(3) The Calcutta map office is frequently out of stock of Bombay Sheets.

Q. 2.—I am not aware of any inconvenience, as in this Presidency Bombay Revenue Survey maps are utilised.

Q. 3.—For District Officers on tour District maps on a scale of 2 inches to the mile are most convenient and such maps have been compiled by the Photozincographic Department. Maps of Talukas or Sub-divisions of Districts have been compiled from the Bombay Revenue Survey village maps. These show cart tracks as well as main roads and give information as to alienated villages, markets, etc., which is not always given on Topographical sheets.

Q. 4.—Village maps on the scale of 8 and 16 inches to the mile are issued to all local Revenue officers. These have been prepared by the Bombay Revenue Survey, and show the boundaries and demarcation marks of every survey number, but not all topographical details. Taluka maps are compiled from village maps. The officers of the Survey of India are not employed for any part of this work. The Photo-zincographic Department at Poona prepare large numbers of local maps and plans, *e.g.*, municipal water-works, irrigation schemes, forest surveys, etc., and reproduce all the village and Taluka maps drawn by the Bombay Survey Department.

Q. 5.—It would be a distinct advantage to have all Survey of India sheets relating to this Presidency reproduced by the local Photo-zincographic Department.

Q. 6.—See answer to question 4.

Q. 7.—The Land Records Department duly keep up the work of correction and alteration required in the Bombay Revenue Survey village maps by the construction of new roads or railway lines, etc., and copies of revised maps are produced by the Photo-zincographic Department.

Q. 8.—A Survey of India Party is employed on the survey of lands notified as forest under the Indian Forest Act.

Revenue surveys of alienated villages and of a tract of country in the Khandesh District, known as the Akrani Pargana, are in progress under the supervision of the Superintendent, Lands Records and Agriculture, C. D.

Q. 11.—Men trained in the late Bombay Revenue Survey have been employed as Circle Inspectors. These men have a knowledge of theodolite survey sufficient to carry out traverses, but have no experience of the use of the plane table or of levelling.

Q. 12.—Town and City surveys have been made by the agency of the Bombay Revenue Survey. The cost has usually been met by the local municipalities.

Reply received from Mr. H. F. Beale, Superintending Engineer for Irrigation on Special Duty, Bombay, to the third series of questions.

[*Dated the 19th January 1905.*]

Q. 1.—The only Survey of India maps we use are the 1 mile to 1 inch topographical maps and the 4 miles to 1 inch Atlas. Smaller scales, such as 8 miles to 1 inch, are inconvenient, except when dealing with a large part of the Presidency at one time.

The 4 miles to 1 inch scale is particularly suitable for a general index map for large projects; but the 1-inch topographical map is generally used for detailed index sheets, and all other purposes.

The topographical sheets are used for ascertaining the location of towns, villages, roads, nullahs and the conformation of the ground. From the hill shading or contour lines we can generally indicate likely dam sites; from the position, size and conformation of the catchment the probable supply of water can be ascertained. The probable line of canal can usually be roughly guessed at by reference to the contour shading, especially if aided as in the case of the Krishna Valley with very numerous clinometrical heights. Areas of command and catchment areas are measured off these maps in square miles and reduced if necessary to acres. The nullahs are usually very accurately marked, so are most of the roads and paths. Thus the general dimensions of the masonry works required for canal or road lines can readily be worked out. Of course the nature of the nullah beds and banks, and the depths of foundations have to be investigated on the spot.

Q. 2.—From No. 1 it will appear that the assistance given by the 1-inch maps is very considerable. Lengthy operations in the field to ascertain areas are avoided, these being measured by planimeter off the maps, and they are accepted as accurate.

As examples the following villages have been measured, and the areas compared with those given in the village registers :—

Name of village.	Area from village register.	Area by measurement off topographical sheet.
	Acres.	Acres.
Nirwi	4,990	4,947
Nhawre	10,746	10,630
Nimon	9,606	9,210
Mandavgaon	8,883	8,883
Inamgaon	5,338	5,126
Ghanegaon	3,280	3,155
Sirasgaon	8,545	7,987
Wadgaon	6,096	5,766

For the Index sheets it is possible, without surveys, to draw in the position of distributary outlets and the probable length and direction of the channels, as well as the limit of command when there are hillocks, long spurs, or ground much broken by nullahs. This saves much trouble, and prevents also the carrying out of a lot of unprofitable work. The advantage of numerous levels and contour lines is shown by the use I made of the maps when examining the Kolhapur State. By referring to the maps I could decide without any surveys that water could not be taken profitably from any part of the basin of the Krishna for use on the Gokak Canal.

But the maps could be improved somewhat.

Q. 3.—The defects of the Indian Atlas, 4 miles to 1 inch, is principally that it is out of date. All the names should be reprinted with the proper spelling. Then all the new works should be placed on the maps, and the relative importance of the towns be re-checked. Some of the sheets appear to be out of print. No. 41 containing the Belgaum and Dharwar District could not be obtained from Calcutta when I indented for it through the Photo-zincographic Office, Poona. Some of the sheets are divided into 4 parts. This makes them portable and very convenient for use.

The defects of the topographical sheets are as follows : —

(*a*) The maps are not up to date. I am not aware of what arrangements are made to place new features on the sheets, but would suggest that an annual or at most triennial return be submitted by the local Government of completed works, with plans carefully drawn on any convenient large scale, so that the new features may be correctly transferred to the sheets in Calcutta. The number of copies of maps to be printed should not be in excess of reasonable requirements, but if there is a large balance of maps in stock, the corrections could perhaps be printed on them in red or some colour, and these corrected maps could be issued at a somewhat lower price, say Rs. 1-4 instead of Rs. 1-12.

(*b*) There are sometimes, though very seldom, errors in names and boundaries. One of each has been pointed out to me, *viz.*, in sheet 329 in the top left-hand corner "Boblad" village should be "Shirbur." This village lies in H = Jamkhandi State, while on map No. 328 the continuation of this state is called Q = Aundh. The boundary is presumably wrongly marked.

(*c*) The contour lines are mostly given in a very satisfactory manner, but they have in some cases not been shown, and this gives a mistaken idea of those parts of the country. The most noticeable omission of this kind I can instance is on map 267, showing the Malsiras taluka, Sholapur. The contouring comes to an abrupt end at various places on this map, showing incomplete work.

(*d*) The levels of the ground are given in very numerous places in the Krishna valley, and in very few places in the Bhima Valley and others. There are apparently 5 kinds of levels on the sheets, *viz.*,—

(*i*) Great Trigonometrical Survey bench marks.—These are on a few main lines, generally following the Railways. Unless the objects on which the marks are made have been purposely moved, they can usually be found; and occasionally the books of spirit-levelled heights indicate changes in this respect.

(*ii*) Bench marks stated in feet only (and sometimes with one decimal). It is often difficult to find these on the ground. These, if readily found and distributed more freely, would be most useful records, as they would allow of a sufficiently close check on preliminary levelling, and enable work to be started from some near point. I believe that the bench marks stated in feet only are supposed to be correct within 1 foot.

(*iii*) Bench marks of the Public Works Department with two places of decimals. These could be added to whenever the maps are being corrected. They should be notified with the annual or triennial report suggested above.

Bombay.

(*iv*) Trigonometrical and topographical heights marked with a Δ and level in feet above mean sea level.

(*v*) Clinometrical heights marked with a ° and figure representing feet.

The last two are of no use for starting or checking lines of levels, but they are most useful for judging the conformation of the ground: and if work similar to that shown in the Krishna valley could be done for the other districts, the usefulness of these maps would be very much enhanced. But even if it be not carried out to this extent, it would be well to have lines of such levels on all important spurs and ridges, and in the lowest part of the valleys between them.

If it is not possible to have a description of the regular bench marks written on the maps, it might be printed at the foot, or issued as a leaflet with each sheet. As it is, there is often great difficulty in finding the bench marks, and the checks on new work cannot be made.

(*e*) The agricultural improvement should be brought up to date, all the masonry wells and the village tanks require to be marked and the vineyards, fruit gardens, orchards, etc., noted. Some of these, now shown on the maps, have disappeared in certain parts of the country, and they should be deleted. Corrections of this kind could be made every ten years.

(*f*) A rather serious defect is the absence of levels along rivers. The relative height of the bed and banks is frequently given, and when sudden drops occur, they are sometimes noted, but what is wanted is the actual bed level (approximately) of the rivers at a few miles interval. When there are frequent falls, it would probably be sufficient to give the level above and below each drop. The bed of the river might safely be taken at the summer water-level, in the Bombay Presidency proper.

(*g*) The next defect in connection with rivers is the omission to mark the limits of annual flooding. This is a feature of great importance on the Krishna, its tributaries and other rivers in the south. It affects the cultivation and the traffic, and therefore the construction of irrigation works and communications. Occasional levels should be given to fix the position of this outline.

(*h*) There is considerable confusion due to the new and old numbering of the sheets being retained. The index sheets help one, but they are not always at hand. I think all the new numbers should be printed over the others in red before issue, so as to avoid confusion.

Q. 4.—The answer to the last question overlaps this. The following remarks may, be added:—

(*i*) If the clinometrical heights are very unreliable, *viz.*, liable to errors of 5 feet or more, fewer and more exactly defined positions would do, but in any case it would be well to add a note on each sheet to explain what limit of error has been allowed.

(*ii*) I seem to remember some maps in which under P & H the population and number of houses of each place was recorded: this is often useful.

(*iii*) The levels along roads might be given at fairly long intervals, but it would be most useful to mark all long gradients steeper than 1 in 40, or some such figure.

(*iv*) A clear distinction should be made between Local Board and Public Works Department roads, the former are often so bad that the carts travel through the fields at the side. The two firm lines with burnt sienna lead one to the conclusion that ordinary wheeled traffic can get along without damage, and this should be a safe conclusion, because otherwise district tours may be upset and other difficulties occur.

(*v*) The edge of waste land and cultivation is sometimes shown. This is often a very useful demarcation. It might be put in on broad lines, so as to distinguish cultivated from barren spurs and hill tops.

The following additional suggestions have been made by officers reporting their views: —

(*vi*) The depth of wells might be marked, this would lead to a knowledge of the sub-soil water level.

(*vii*) It will not entail much labour to give the waterways of important masonry and iron bridges.

(*viii*) The high banks and deep cuttings of railways, roads and canals may be shown by distinctive shading, in some simple manner.

(*ix*) The paper used may be superior because the present paper will not bear the use of India rubber. The printing is in some cases indistinct and faint. It might be improved.

I do not support these five suggestions.

Q. 5.—Survey map No. 200 is apparently out of print. It is the one that contains the Bhatghar Reservoir (Lake Whitting). Fortunately I was able to borrow a copy from the Executive Engineer for Irrigation, Poona.

The only special survey I have made, which I think might be avoided in the future, is for the location of the annual river-flood line, where rivers overtop their banks by a wide margin.

This was done by eye, the villagers indicated on the ground the usual flood level, and it was sketched on to the village map.

The other surveys we have to make could not be avoided by any process of mapping.

Q. 6.—When I have to deal with areas for which I cannot get a map on the 4 miles to one inch scale, I have to prepare it in my office from the topographical sheets, reducing it by means of the pentagraph. I have not worked in any region of which no map existed.

Q. 7.—My establishment could no doubt produce a special map for our purpose if it were required, and the Photo-zincographic Office in Poona could reproduce it in a thoroughly satisfactory manner.

Q. 8.—My surveys are carried out by trained Engineers (Assistant and Executive Engineers) assisted by subordinates. The subordinates are mostly recruited from the College of Science, Poona, but a few are men who have been trained on works. On first appointment I gave inexperienced men the following pay :—

L. C. Es. (Bombay University) consolidated pay.	Per mensem. Rs.
1st class	125
2nd class	105
not classed	85
Sub-overseers (all alike)	60

For men with some previous experience I used to add from Rs. 5 to Rs. 25 to these figures. The salary of these men has risen since appointment in 1902 according to the quality of their work.

My senior Sub-Engineer has all along drawn Rs. 350 per mensem and travelling allowance in addition. He was trained by Mr. Whiting, formerly Chief Engineer for Irrigation.

The average salary for 7 Engineers and 1 Sub-Engineer in December was Rs. 444—

with travelling allowance extra for—
10 Upper Subordinates Rs. 169
26 Lower Subordinates Rs. 67½
} consolidated.

The L. C. E. men are trained as Engineers at the Poona College of Science, which is affiliated to the University of Bombay. They are as a rule excellent men for upper subordinate appointments.

The sub-overseers are trained at the same institution in the subordinate branch, and many of them are very good surveyors and draftsmen. It is easier to get the latter than the former. It is not easy to get L. C. Es. of the higher classes for less than Rs. 100 per mensem consolidated for temporary appointments. Among the 9 L. C. Es. I have appointed since 1901 there has only been one failure. There have been a goodly number of unsatisfactory men among the lower subordinates.

Q. 9.—The draftsmen I employ are engaged in tracing and sometimes reducing maps, in putting on the classification of soils from marks made on the village maps, in drawing and tracing designs for masonry works, and in plotting surveys, planimeter work, etc.

My present establishment is composed of—

1 Head draftsman on	Rs. 100
3 Draftsmen on	Rs. 50 to Rs. 75
9 Draftsmen on	Rs. 30 to Rs. 40
13	

Only 3 of the above men have passed the sub-overseer's examination at the College of Science, and one was trained there, but did not pass. From Rs. 30 to 40 is not profitable pay for these men. Many of them are very good draftsmen, and could expect from Rs. 50 upwards for such work, but surveying is more profitable. There is a fair supply of junior tracers and draftsmen from other sources.

Q. 10.—The Indian Atlas sheets and topographical sheets have, with the exceptions previously noted, been readily obtainable. I do not apply to the Survey of India for maps. I get them from the Photo-zincographic Office, Poona, on payment. Usually they are in stock, and are supplied very promptly, mounted as I require them. I have adopted this system in order to avoid delays.

Mr. Mawson, Executive Engineer, who had on certain occasions to apply to Calcutta through a superior officer, complains of delay in supply.

Q. 11.—No.

Q. 12.—The new features, *viz.*, railways, roads, tanks, canals, bungalows, etc., have to be entered, as already explained.

I have not reported any such changes. I am not aware of any orders on the subject, and the assumption has been that the local Government provides for the necessary communication being made from time to time.

Sind.

Reply received from Mr. J. W. P. Muir-Mackenzie, C.S., Commissioner in Sind, to the first series of questions.

[*Enclosure to Bombay Government letter No. 1266, dated 3rd March 1905.*]

Q. 1.—The topographical survey maps are unsuitable for general administrative purposes, because they do not correspond to administrative units, *viz.*, talukas and subdivisions.

Q. 2.—No great inconvenience has resulted. The cadastral maps sufficiently serve our purposes. But the compilation of a map which contained the information, now embodied separately in the topographical and revenue cadastral maps, would be a very great convenience.

Q. 3.—At present the most convenient are the maps of the Sind Revenue Survey, but they leave much to be desired in their lack of topographical detail. What is wanted is a map of subdivisions and talukas, showing the same amount of topographical detail as the Survey of India maps, and also the boundaries of *dehs*, and Public Works Department contours. I commend to the Committee Mr. Rieu's answers to questions 5 and 6 which will give all the information required.

Q. 4.—Yes, the cadastral maps of the Sind Revenue Survey, produced under the direction of the Superintendent, Land Records and Agriculture. There are maps for the District, the subdivision, the taluka and the village.

No.

Maps are sent to the Photo-zincographic Office at Poona for reproduction.

Q. 6.—Our revenue survey maps were prepared by separate agency before the Survey of India ever proposed to undertake cadastral work for the Bombay Government. The answer therefore is in the negative.

Q. 7.—None, as far as the Local Government is concerned. It is not known whether the officer in charge of the local party of the survey of India has instructions on this subject.

Q. 8.—A topographical survey by Survey Party No. 12 is in operation in Sind. The cadastral survey in each "*deh*" * is kept up to date by the "*tapadar*" or village accountant of the "*tapa*," that is the circle in which the *deh* is situated. In addition to this, large areas of waste land have to be broken up into small survey numbers. This work is done by parties of "*tapadars*" who are taken away from their *dehs* for this purpose.

* A deh is a revenue village, *i.e.*, a revenue unit comprising several hamlets or small villages. The boundaries of dehs only are noted in the cadastral maps. The villages or hamlets have no recognised boundaries.

Q. 9.—The survey party is not under the orders of the Commissioner, but is always ready to carry out any topographical work which he desires, *e.g.*, in 1889, they demarcated the boundary between Sind and Khairpur at his request, and in 1902 resurveyed the land at Jungshahi required for a Royal Artillery range.

Q. 10.—*Vide* answer to question 9.

Q. 11.—There is an agricultural school in the Province from which *tapadars* are recruited and in which the students are trained in ordinary cadastral survey operations during a course of two years. Other than these men, there are no trained surveyors available for special surveys in the Province. The old skilled hands of the Sind Survey Department were, on its abolition, absorbed into the Revenue Department. I imagine these men, who use only the cross-staff and chain, would be of no use to the Survey of India.

Q. 12.—Only of Karachi, Hyderabad and Sukkur by Colonel Laughton, R.E., of the Survey of India, at the cost of the Municipality concerned.

Q. 17.—Yes. Sufficiently accurate, but not sufficiently detailed.

Q. 18.—No officers of the Survey of India are employed on cadastral work in this Province.

Punjab.

Joint reply to the first series of questions received from the Settlement Commissioner, the Director of Land Records and Agriculture, and the Senior Secretary to the Financial Commissioner with a note by Sir Lewis Tupper, K.C.I.E., Financial Commissioner of the Punjab.

Q. 1 (1).—In the case of a number of districts in the Punjab the survey maps were made between 1850 and 1865, and no effective revision has been made since. To this category belongs—

1. *Gujranwala.*—Surveyed 1852—55. The latest map in the Financial Commissioner's Office is a copy corrected up to 1870. Since then the whole aspect of the south of the district has been changed by the introduction of canal irrigation and the southern boundary has been altered.

2. *Gujrat.*—Surveyed 1853—55. Apparently not revised since. A rough photozincographed reproduction made in 1879.

3. *Shahpur.*—Surveyed 1858-59 and 1863-65. Map republished 1875, apparently without revision. The present boundary of the district is not that shown in this map.

4. *Jhelum.*— } Surveyed 1851—59. Maps republished in 1899 on scale of 4 miles to
5. *Rawalpindi.*— } the inch. Maps in 8 large sheets of Jhelum and a large part of Rawalpindi have also been issued based on the surveys of 1851—59. There is a much later survey of the mountainous part of Rawalpindi. The 8 sheets referred to above show no village boundaries.

6. *Amritsar.*—Presumably surveyed in this period. The only map in Financial Commissioner's Office was issued by Survey Office "with corrections up to 1878," and bears the inscription "lithographed from an original supplied by the Commissioner, Amritsar Division."

7. *Sialkot.*—Presumably surveyed in this period. The map was published by the Surveyor-General in 1879 and purports to be "lithographed from an original supplied by the Deputy Commissioner of Sialkot."

8. *Gurdaspur.*—Surveyed (except hill portion) in 1862-63. Republished apparently without correction in 1884. The hill portion and Chak Andar have since been surveyed on a large scale; and the sheets are in the Financial Commissioner's Office.

9. *Lahore.*—Date of survey does not appear from map. The district map with village boundaries—scale 2 miles to the inch—shows the boundary on the Sutlej as fixed by a Punjab Government Notification issued in 1891.

10. *Muzaffargarh.*—Surveyed 1855—57. The map seems to have been published in 1863.

11. *Multan.*—Surveyed 1855—58. Map bears date 1861.

Except where the contrary is stated, these maps are on the scale of 2 miles to the inch.

All these districts except Rawalpindi have been cadastrally surveyed since the system for producing topographical maps in the Punjab described in the answer to question 13 was adopted in 1884,* and had it been carried out punctually we should now have modern maps of Nos. 1 to 4 and 6 to 9. The same plan was to be adopted in No. 5 Rawalpindi, the cadastral survey of which had been recently made in 1884. The state of things actually existing is that we have modern maps of none of them. The map of Lahore has, we understand, been completely revised, and one sheet of the new map was received in 1904. No. 18 Party is now engaged in making a topographical map of Muzaffargarh and Multan on the plan approved in 1884. The Survey Department can give full details as to the progress made in the case of other districts, where the work of revision has been taken in hand. The map of Jhang was revised on the 1884 plan, and a satisfactory map of the old estates produced. Even this, however, is incomplete, sheets for the whole of the Shorkot tahsil being wanting. But practically the huge area of waste has since been colonized, and if we studied the latest map of the old Jhang District for information about the new Lyallpur District, which has been carved out of it, we should find an almost unbroken expanse of jungle instead of a tract covered with hundreds of villages.

* Government of India, Revenue and Agricultural Department, No. 585—102-4, dated 8th October 1884.

As an illustration of the difficulty of obtaining suitable maps for district purposes, it may be remarked that in 1895 it was realised that Deputy Commissioners were often forced to rely in their work on incomplete or obsolete maps of their districts, a state of things which could hardly fail to cause serious inconvenience, and it was considered necessary that a special arrangement should be made for the periodical revision of all district maps, quite apart from the returns furnished from time to time for the information of the Surveyor-General. Deputy Commissioners were accordingly called upon in circular letter No. 6000, dated 5th November 1895, from the Senior Secretary to the Financial Commissioner (copy annexed), to report which map of their district was the best fitted for selection for the purposes of periodical revision. Deputy Commissioners accordingly sent up their maps for approval, and where suitable maps existed, corrected and brought them up to date after approval. This has been actually done, however, in the case of thirteen districts only. Again, all the maps approved, though the best available, are not really suitable, as they do not all show village boundaries, and in some cases the maps are on the scale of 4 miles=1", which is too small. In the remaining cases there were no maps available which could be immediately approved as standard maps. Maps of Rohtak, Ambala, Ferozepore and Ludhiana are in the course of preparation by the Surveyor-General, who is reducing the 1 mile=1 inch maps to 2 miles =1 inch and correcting them on data supplied by Deputy Commissioners. He has also been asked to prepare corrected maps of the Jhelum, Rawalpindi and Attock Districts. The correction of maps for Shahpur and Jhang has been deferred till the completion of settlement operations, while in the case of Kangra a new survey map is awaited. A map of Mianwali has recently been approved and sent to the Surveyor-General for publication. Under orders of the Punjab Government issued in 1904 the standard district maps will be decennially revised at the time of census, but where railways have been extended, canals made or other similar works executed, revision will take place every five years.

1 (2). In answering this question only the requirements of revenue officers have been considered, not those of officers of other departments (*e.g.*, Public Works and Forests). The topographical details shown in survey maps are quite enough for the requirements of *revenue* officers. In fact they are more than sufficient. We need village boundaries, but we do not want limits of waste and cultivation inside estates. Five years after the map is made these limits may have quite changed. Of course the Deputy Commissioner wants maps showing boundaries of thanas, zails, patwaris' circles, rest-houses, schools, and the like, but these he can add for himself. So far as district administration is concerned, the district and tahsil maps

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made by settlement officers (see answer to question 2) are sufficient except in hilly districts and it is easy to show on them local details—perhaps not of a very permanent character—omitted in survey maps. Survey maps of later date than those referred to under (1) ar generally on the scale of 1 mile to the inch. This scale is inconvenient for a district map because of the great size of the map. Once the sheets are pieced together all that can be done with it is to hang it up on a wall. To carry about with one the numerous separate sheets is troublesome, and they are very liable to be torn. The sheets can also be obtained each cut into 8 convenient sections and backed with cloth. These when folded up fit into a small portfolio. This is a great improvement on the large sheets. But the difficulty of having to piece the different portions of the map together, when one wants to consult it, is not surmounted. In all districts the details a revenue officer requires for a district map could be shown on the scale of 2 miles to the inch. This means the reduction of the district map to one-fourth of its present size and gives a map which one can carry about comfortably. Some Punjab districts (*e.g.*, Multan) are so large and contain so much waste that a scale of 4 miles to the inch is convenient for the district map.

1 (3). We do not know that there is any difficulty in obtaining survey maps after they have been published, but there appears to be often great delay in publication. On the latter point the Survey Department will doubtless itself furnish full information. Local officers should be furnished with printed lists showing exactly what maps of their districts or any parts of their districts are available. These lists should be brought up to date and re-issued triennially, if any change has occurred in the interval. In this way each local officer would be able to satisfy himself that he had in his office a complete set of maps relating to his charge.

Circular letter No. 6000, dated Lahore, 5th November 1895, from R. Sykes, Esq., Officiating Senior Secretary to the Financial Commissioner, Punjab, to all Deputy Commissioners in the Punjab.

It is believed that at present in most districts no regular system prevails to provide for the periodical correction of survey and other maps, so as to ensure the possession by each Deputy Commissioner of a complete and accurate map of his district. Under existing arrangements, whenever the revision of the map of the Punjab is taken in hand, each District Officer is called upon to furnish to this office for the information of the Surveyor-General at Calcutta, details of any changes which may be required in the map of his district, such as the addition of fresh names and the correction of those already shown as well as others which may become necessary owing to the alteration of boundaries, the extension of roads, and other causes of a like nature. Similar information is also supplied to the Surveyor-General as regards railways, canals, etc., through the particular department of Government primarily concerned. Topographical details required by the Survey Department are also shown by patwaris in the village maps prepared at Settlement, which are supplied to the Surveyor-General in accordance with the instructions contained in paragraph 44 of Revenue Circular No. 28. But, so far as is known, the information thus collected from various sources is not generally embodied in the maps currently used in the District Office, nor are copies of the map, when revised, ordinarily supplied to each district. It therefore follows that the Deputy Commissioner is forced to rely on an incomplete, or even inaccurate map in his work—a state of things which can hardly fail to cause serious inconvenience.

2. With a view to obviating the difficulties referred to at the end of the preceding paragraph, it has been suggested that some special arrangement should be made to provide for the periodical revision of all district maps. Any steps that may ultimately be taken in this direction will, however, be entirely distinct from the returns furnished from time to time under existing orders for the information of the Surveyor-General or to any other Government department. The object which it is now hoped to attain is merely that each Deputy Commissioner should be placed in possession of a map of his district on the most convenient scale, regularly brought up to date under his own personal supervision. For this purpose it would be necessary to show not only the changes in names, boundaries and roads, information regarding which is already supplied to Government from time to time by the District Officer, as stated in paragraph 1 of this Circular, but also any other improvements, *e.g.*, canal and railway extensions, which may be carried out under the orders of other departments of Government. It would be left to each Deputy Commissioner to obtain the additional information required on these points in any way he might select; and he would be entirely responsible for procuring it and for its accuracy when procured. A copy of the map, as corrected, would be sent up to Government at fixed intervals (probably every third year) though the Commissioner of the Division and the Financial Commissioner, who would have their own copies brought up to date before transmitting the original. On receipt of the original in the Secretariat office the necessary corrections would be enfaced upon the Secretariat copy, and the map would then be returned *direct* to the Deputy Commissioner concerned. For this purpose it would be necessary that each Deputy Commissioner should have in his possession at least two copies of the particular map selected for revision, and should have them both revised. By this means any inconvenience which might otherwise result from the absence of the map from the District Office would be avoided.

3. At the present time many maps exist for each district in the Punjab, and these vary considerably in size and the scale as well as in minuteness of detail. Some are ordinary maps of the country, while others have been prepared expressly to bring out special features. For the purposes of the periodical revision proposed in this Circular, however, it will be necessary to decide upon some one map for each district, and to procure additional copies of it, if necessary. It is believed that for ordinary purposes a map on the scale of 2 miles= 1 inch will be found most useful. Such maps are known to exist for the 11 districts marginally noted, and the scale is sufficiently large to readily admit of corrections and additions being clearly and accurately made, while the map itself is nevertheless not unwieldy or inconvenient to handle. But it is possible that a map on this scale may not exist for all districts, and it is not proposed that the procedure suggested in this Circular should involve any expense beyond the purchase of a few additional copies of maps already extant. I am therefore to request you to report at an early date through the Commissioner what the map of your district is on which you ordinarily rely in your work, and what map (whether the one ordinarily used by you

Lahore.	Shahpur.
Jhang.	Gujranwala.
Multan.	Kangra.
Ferozepore.	Hoshiarpur.
Gurdaspur.	Jullundur.

Muzaffargarh.

or some other) is, in your opinion, best fitted for selection for the purposes of periodical revision. It is left entirely to your discretion to select a map, having regard to local circumstances; and the remarks made above as to scale are not intended in any way to *restrict your choice*. At the same time it should be stated for information whether any map of your district at present exists on the scale of 2 miles=1 inch, and if so, full particulars regarding date of publication, etc., should be given. Should you select a map of a different scale, full particulars on the same points should be supplied regarding it, so that it may be readily identified in this office.

Q. 2. Inconvenience has undoubtedly resulted in some of the districts. It would have been much greater but for the fact that settlement officers have prepared and supplied to district officers district and tahsil maps on convenient scales. These maps are reductions of the cadastral village maps. In Multan, *e.g.*, Mr. Maclagan prepared maps of the district on the scales of 2 and 4 miles to the inch showing boundaries of estates, roads, railways, canals, camping grounds, bungalows, and village sites. The name of every estate is clearly printed in the larger map and of most of them in the smaller. He also prepared a skeleton map—scale 8 inches to a mile—in which the names of the villages and the village sites are omitted, but the boundaries are given. In the same way he supplied the Deputy Commissioner with English and vernacular tahsil maps, scale 1 and 2 miles to the inch. The maps were printed at the Mufid-i-Am Press, Lahore. The existing rules on the subject are contained in paragraphs 13-14 and 18 to 21 of Settlement Commissioner's Circular 16 (copy annexed), but as shown above the settlement officer can supply the Deputy Commissioner easily with even more than these rules prescribe. This remedy for obsolete survey maps is only available in districts recently settled, and it is not a satisfactory one in hilly districts or in districts honeycombed with ravines, like some of those in the north-west of the province.

Extract paragraphs 13-14 and 18 to 21 from Settlement Commissioner's Circular No. 16.

(IV).—Index Maps.

13. These should be prepared on mapping sheets, the square being sub-divided into the requisite number of smaller squares for the purpose. The scale to be adopted should, as a rule, be 240 karms of 5½ feet to the inch (4 inches to the mile), as this is the scale usually adopted in the Revenue Survey maps The reducing from the 40 karm field maps should be done by scale. This work is facilitated by scales with inches sub-divided into submultiples of 240. The Director of Land Records informs settlement officers of the name of the firm from which such scales can be procured. To test the work rapidly, the kanungos can be provided with double compasses of which one pair of arms measures a distance exactly six times that measured by the other pair. Such compasses can be made up in most large towns.

Scale and form.

The index map should show the same feature as those shown in the Revenue Survey maps of the villages and the signs will be those employed by that department, most of which are the same as in the 40 karm village maps. Each settlement officer will have to give his own instructions as to the points to be shown in these maps according to the character of the country under survey.

14. These index maps will be used as the basis for the tahsil and district maps about to be described. When done with, they should be attached to the mapping sheets of their respective villages, being laid each on the top of the bundle of sheets.

Final disposal.

(VII).—Tahsil or District (mujmili) Maps.

18. New topographical maps on the 1-inch scale are now under preparation by the Survey Department. Where fairly recent maps are available, these will be revised and brought up to date in the field: but more generally a small staff is sent to the district to reduce the *masawis* to the 2 inch scale, and a compilation of these reductions is then used as a basis for the preparation of a new topographical map, which is finally reduced by photography to the 1 inch scale.

As, however, the work is often postponed for some years, it will be convenient for the settlement officer to prepare for each tahsil or other convenient area a grouped (mujmili) map, on a scale of about 4 inches to a mile. This will be of use to local officers pending the preparation of the final topographical maps, and will be handed over as a guide to the Survey Department, when they commence work in the district.

19. The grouped map is made on tracing cloth, and is an exact reproduction of the index maps. It should for two reasons be started as soon as the index maps are available, and should not be deferred to the very end of the settlement, for (i) in piecing together the index maps errors in the boundaries are often brought to light, which are real errors of measurements, which require to be rectified by a further inspection of the ground, and (ii) there are differences in practice as regards the showing of roads, canal cuts, etc., in different patwaris' or kanungos' circles, and uniformity can only be secured by consulting the men who have actually made or supervised the measurement and who know the country intimately.

Not to be left to the end of settlement.

20. The map can most conveniently be prepared in separate sheets, each of the size of an ordinary village mapping sheet, but settlement officers can consult their own convenience in this respect. It will be best to make two copies of the grouped map. One of these (the original) would be in vernacular and an exact copy of the index maps. The other would be a copy in English for submission to the Survey Department. By having a list of the vernacular entries prepared with all the vowel points marked, the settlement officer can insure a uniform transliteration into English which will represent the actual pronunciation of the names, and by the help of the accumulated local knowledge of his staff, he will be able to avoid some of the mistakes which often disfigure our topographical maps.

Size and translation.

In districts where English Village Directories have been printed, the spelling of the maps should follow that of the directories. Where the latter are wrong, copies of them corrected by hand should accompany the grouped maps sent to the Survey Department.

(VIII).—Reduced Grouped Maps.

The preparation suggested.

21. It will generally take some time for the Survey Department to have a new topographical map of the district prepared. The settlement officer would, therefore, do well to have the vernacular copy of his grouped map reduced by pentagraph to a smaller scale (such as 1 inch or 2 inches to the mile) for district use, unless there is a fairly recent topographical map available.

Q. 3. Every district officer wants separate maps of the whole district and of each of his tahsils on single sheets. These should show roads, railways, telegraph lines, streams, canals, village sites and boundaries, and village names. For most Punjab district maps the scale of 2 miles to the inch is most convenient. In some large districts with much waste, as already noted, 4 miles to an inch is a better scale. In the same way the separate tahsil maps should be on the scales of 1 mile and 2 miles to the inch. English and vernacular editions should be issued, and it is very useful to have a number of tahsil maps printed on cloth. All classes of revenue officials from the kanungo upwards should have maps on which the limits of their charges are marked. If the Survey Department supplied the English maps, the vernacular editions could easily be prepared locally. It has been suggested that each Deputy Commissioner and Commissioner might also be supplied with an atlas showing all the survey sheets of his charge on such scales as he found convenient. This seems to be a valuable suggestion. The various details which are useful to a local officer, *e.g.*, schools, post offices, zail boundaries, boundaries of patwaris circles, could be filled in in his own office. It used to be the custom for a settlement officer to leave behind him an atlas of this sort, and it was a very useful practice.

Q. 4.—The following special maps are issued by the Director of Land Records:—

(*a*) $\frac{1}{4}$″ district maps showing village, tahsil, and district boundaries, railways, main rivers, canals, roads and other prominent features. A few of the more important places are marked.

(*b*) $\frac{1}{8}$″ district maps as above, but without village boundaries.

These are practically skeleton maps. They are of use in illustrating new schemes and reports. They can also be bound conveniently into district statistical atlases. They are reduced from the published sheets of the Survey Department. The Deputy Commissioner makes such corrections as are necessary in the maps, and notes the details which he thinks should be inserted.

Subsidiary to (*a*) a limited number of $\frac{1}{4}$″ maps are printed with the villages numbered, a key sheet being added with alphabetical lists of villages in English and vernacular.

These maps are prepared in the Surveyor-General's Office, Calcutta.

Besides the $\frac{1}{4}$″ and $\frac{1}{8}$″ skeleton maps, a number of district maps on various scales are prepared by reduction from the patwari village maps and these are very commonly used by Deputy Commissioners in their ordinary work. They are printed locally.

The skeleton maps could be reproduced by private establishments in the province in the same way as reduced patwari village maps.

Q. 5.—In September 1901 an order was sent to the Surveyor-General's Office for new skeleton maps ($\frac{1}{4}$″ and $\frac{1}{8}$″) for 8 districts. There has been serious delay in completing this order, and half the maps are still to be delivered. This has naturally caused considerable inconvenience, not only because the maps are wanted for use, but because the budget provision for payment has lapsed on two occasions.

The Survey of India Office have apparently no time for this work, and it would be done much more quickly by a local firm. Arrangements could be made without any appreciable delay. No extra establishment or plant would be required. The workmanship would not be up to the standard of the Surveyor-General's Office, but it would be sufficiently good for the purposes for which these maps are intended.

Q. 6.—Revenue maps, reduced from the patwari village maps, are in demand, because they are in most cases more up to date than the survey maps. They ordinarily give all the information that a district officer requires. They have an advantage over the survey maps which are in sheets by districts, in that they are prepared by tahsils as well as by districts.

Q. 7.—Paragraphs 1-3 of Revenue Circular No. 50 provide for the report of changes of territorial jurisdiction to the Surveyor-General. In 1895 the Revenue and Agricultural Department of the Government of India issued a Circular No. $\frac{7}{8}\frac{7}{9}$, dated 6th May, suggesting that means should be devised for correcting the topographical maps of the Survey of India whenever local surveys (such as those made in the Punjab when a district is brought under settlement) disclosed changes in physical features or changes due to the construction of new roads, railways, canals, etc. After consultation with the Surveyor-General the orders quoted in paragraph 257 of the Settlement Manual were issued. These are as follows:—

"All those sheets in which new roads, railways, canals, villages, dâk bungalows, etc., etc., appear or old villages have disappeared, should be sent to the Assistant Surveyor-General in charge of the Drawing Office, Calcutta, together with the one-inch standard sheet or sheets in which the patwaris' maps are situated and have been marked off for facility of reference. Settlement officers acting under these instructions should communicate with the Surveyor-General or Assistant Surveyor-General through the Director of Land Records.

These orders embodied a practical scheme for periodically correcting survey maps, if for sheets, or "*masawis*," we substitute the index village maps on the scale of 4 inches to the mile referred to in the extract from Settlement Commissioner's Circular No. 16 appended to answer to Question 2. The plan of sending copies of the index maps of villages in which changes had occurred was continued for some years. In 1901, however, the Survey Department intimated in a letter No. $\frac{1047 \text{ E.}}{\text{D.}}$, dated 23rd August 1901, that it should be discontinued, as another scheme was in contemplation. A copy of the letter* is annexed for convenience of reference.

*No. $\frac{1047 \text{ E.}}{\text{D.}}$, dated Calcutta, 23rd August 1901.

From—The Assistant Surveyor-General, in charge Drawing Office,
To—The Director of Land Records and Agriculture, Punjab.

I have the honour to intimate that 4″ traces from the recent Settlement Survey plans have been received from the Settlement Officer, Multan, in view of the pending revision of the Punjab Standard Sheets of this Department. This work will not be undertaken by this office, but by a Drawing Office to be subsequently formed in the Punjab to be attached, it is believed, to No. 18 Survey Party and until arrangements are finally made, I would request the favour of your directing that all such traces are to be retained with the Settlement authorities. Information will be sent you when work on these can be commenced. The traces received will, in the meantime, be stored here. Should, however, the settlement officers not be able to retain these traces, they may be sent to the Officer in charge No. 18 Party, Simla, who will keep them until orders are received to commence work.

Q. 8.—The following cadastral surveys by the patwari agency are in progress or have recently been finished—

1. Jhang.
2. Gujranwala—tahsils Hafizabad and Khangah Dogran.
3. Mianwali.
4. Gurgaon.
5. Karnal.
6. Rawalpindi.
7. Chenab Colony.
8. Jhelum Colony.

Districts in the North-West Frontier Province have been excluded from the list.

In the first three districts a complete re-survey on the square system is being made. In Gurgaon and Rawalpindi the work is mainly confined to the correction of the village maps prepared by triangulation at the last settlements. At Mr. (now Sir Denzil) Ibbetson's Settlement of part of Karnal the village maps of tahsil Panipat and Pargana Karnal were made by triangulation. Pargana Karnal will be completely re-surveyed on the square system; in Panipat the old maps will, with few exceptions, be simply corrected and brought up to date. The rest of the district was measured in 1882-1887 on the square system, and the mapping at the present settlement will be confined as much as possible to correction of existing maps. When new maps are required, they are made on the square system unless the physical features are such as to make the laying down of accurate squares impossible.

Where fluctuating boundaries exist in riverain villages, as was very common on several of the great rivers of the Punjab, fixed boundaries can be laid down under the Punjab Riverain Boundaries Act of 1899. The work is now nearly finished. The sheets showing the new boundaries are made over to the officer in charge of No. 18 Party to enable him to correct the topographical maps.

The single survey party employed in the Punjab is now engaged in preparing new topographical maps of Multan and Muzaffargarh with the help of the cadastral village maps prepared at last settlement (see answer to question 13) and in the correction of the topographical maps of the riverain tracts.

Q. 9.—The Local Government is consulted regarding the annual programme, and sends it to the Financial Commissioner for advice. The Financial Commissioner in turn consults the Settlement Commissioner. The plan is as good a one as is possible while the Survey Department is organized as at present. The single survey party employed is not under the orders of the Local Government. But the present officer in charge and the Settlement Commissioner are in frequent communication.

Q. 10.—Much would depend on the character of the officer in charge of the Survey party. At present the relations are quite satisfactory. But the programme is perforce a very meagre one. What would suit local requirements would of course be a Deputy Surveyor-General (with a drawing office) at Lahore and several survey parties working under his orders in the Punjab and the North-West Frontier Province. At present survey work in the province is much in arrears [see answer to question 1 (1)].

Q. 11.—The Revenue Department has no trained surveyors accustomed to the use of the theodolite. The Public Works Department will supply information as to the trained surveyors which it has in its pay.

Q. 12.—A map of Murree was prepared by the Survey Department in 1876, on the scale of 132 feet to the inch. It has been brought up to date during the present settlement of the Rawalpindi District.

The Station of Simla has been recently surveyed by the Survey Department on the scale of 50 feet to the inch, but copies of the maps have not yet been received.

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A map of the town of Lyallpur has been made by the Colonization Officer on the scale of 60 feet to the inch. He has also prepared similar maps of Gojra, Sangla and Chiniot Road Shahkot. A plan of Rewari City in the Gurgaon District on the scale of 100 feet to the inch was, according to the report of the Deputy Commissioner in answer to question B (1), published by the Survey Department in 1895 and a plan of the environs of Rewari on the 24″=1 scale of mile in 1894, but they are not to be found in the Financial Commissioner's Office.

Plans of all the head-quarter civil stations in the Punjab were prepared by the Public Works Department from 1891—1896 on the scale of 10 inches to the mile, with the exception of Simla, which is on the scale of 6 inches to the mile. The same department has also prepared similar maps of Murree and Sirsa. These maps were actually zincographed or lithographed and published by the Survey Department.

Q. 13.—The plan by which new topographical maps are made in the Punjab by the Survey Department is that described in paragraph 18 of Settlement Commissioner's Circular No. 16, which has been reproduced in the answer to question 2. That plan was devised in 1884 by the late Colonel Wace in consultation with the Survey Department, and is embodied in a Joint Memorandum by a Surveyor-General and Colonel Wace which will be found in the selections from the records of the office of the Financial Commissioner, No. 26. It was part of that plan that a very simple traverse should be made by the Survey Department *before* the cadastral maps on the square system were made. But in practice what has happened has been that settlement officers have made their maps on the square system without the advantage of checking them by a scientific traverse, which has *followed* the cadastral survey in order to satisfy the Survey Department as to the general accuracy of the village maps. Survey maps on this system have been prepared and published for the Thanesar Tahsil of Karnal, Ambala, Ludhiana, Hoshiarpur, Jullundur, Ferozepore, Jhang (part) and Montgomery. The field work in Lahore is believed to be complete. Only one sheet has appeared.* No sheets of the Amritsar District have appeared. It is not known exactly how much of the work in that district has been finished. Work is proceeding in Multan and Muzaffargarh. The arrears are very heavy [see answer to question 1 (1)]. The Ambala map is an excellent one, and there is no reason to suppose that the others are not perfectly satisfactory. Ambala is only mentioned specially because part of the district was cadastrally surveyed by the present Settlement Commissioner. There is no reason to suppose that the plan described above produces in districts which are neither hilly nor seamed with ravines maps inferior to those made by direct survey.

Q. 14.—No. The only district in which the survey is based on a scientific traverse is Hissar (except the Sirsa Tahsil). The plan is described in the 21st paragraph of Mr. Anderson's Settlement Report (copy annexed). It was given up as too expensive and as unnecessary where the cadastral survey was based on squares (paragraphs 3 and 4 of Joint Memorandum referred to in answer to last question).

Extract paragraph 21 from the Revised Settlement Report of the Hissar District for the years 1887—92.

Field measurements.

The field measurements were not made in this district on the square system which is now generally adopted. In anticipation of the settlement, a revenue survey was made by the Survey Department of India, and with the object of making easy the subsequent field survey, a new feature was introduced as an experiment. This experiment has proved a success, so far as the remeasurement for assessment purposes is concerned, but the advantages of the experiment recur at each attestation of the measurement, and even at each petty survey; and for future use a record is necessary of what was done. The experiment was thus described by Colonel Wace in a letter intimating the commencement of the survey in 1882 —

"In every village a number of permanent stations (*chandas*) in addition to the trijunction pillars are being marked by blocks of concrete, 18 inches long by 6 inches square. These stations (*chandas*) are so arranged that there shall not be more than half a mile between any two pairs of stations. The position of each station will be observed by the theodolite and recorded in the terms of the universal theorem. The result of this will be that when the field survey is to be commenced, an accurate plot of the village (on whatever scale may be required) showing every survey station will be placed in the patwaris' hands, and he will be able to commence at once with the field survey. It is an essential part of the scheme that these stations shall be permanently preserved, so that the patwari shall be able accurately to renew and fit into his field map any portions of that map which for any reason may need survey, thereby avoiding unnecessary re-measurements of the whole village subsequent to settlement."

The survey was finished in the beginning of 1884; and before settlement operations had commenced all the skeleton plots, on 4,597 sheets, were received. The sheets were plotted on 40 and 80 *kadam* scales, but in fixing these scales more attention was paid to the size of villages than to the size of fields. The Financial Commissioner approved of our using scales of 60 and 120 *kadams* to the inch as more suitable to the existing state of cultivation. Only one copy of the plotted sheets was received, and this, even if otherwise suitable, could not be put into the patwaris' hands. There were many objections to giving them the skeleton plots, and the maps have been prepared on ordinary mapping sheets, upon which the traverse points had been marked on the scale on which the village was to be measured. The skeleton plots received from the Survey Department along with 5 volumes of Traverse Data, and one volume with Alphabetical and Area Index of the skeleton plots of the whole tract, are now in the office, and may be used not only for renewing any map, but for replacing on the ground any *chanda* which may get lost. The positions of the points were marked by concrete blocks embedded in the ground; no difficulty was felt in finding them, and as they are now marked on the patwaris' maps and are shown in the Field Inspection Register under the field in which they are situated they will receive almost as much attention as trijunction pillars.

* Since this was written two more sheets have been received.

Q. 15.—According to the Punjab system the only traverse stations required are the masonry platforms erected where the boundaries of three estates meet (see paragraph 6 of Joint Memorandum referred to in answer to question 13). Land Revenue Rule 44 provides— Punjab.

In field inspection registers there shall be a red ink entry (without number) for every pakka survey mark or trijunction pillar, following the survey field in which the mark is placed, or which it adjoins, and in his field inspections the patwari shall ascertain that the mark exists, and is in good repair.

These trijunction platforms are repaired at each resettlement, and ought to be kept in repair by Deputy Commissioners in the intervals between settlements. But even, if the duty is neglected by Deputy Commissioners, no great harm is done, for except in lands subject to river action there is little chance of a survey mark 3 feet square of the kind described in Land Revenue Rule 195 disappearing.

Q. 16.—The cost per square mile of the survey work done during the year is reported annually for each district under Settlement. Formerly it was shown in Statement XXXIII B appended to the annual Land Revenue Report. The instructions for making the calculation are given on the back of the form in Revenue Circular 61 as quoted below:—

(*a*) No part of the pay of the District Patwaris will be charged to cost of survey.

(*b*) One-half of the pay of the permanent establishment entered in column 4 for the part of the year during which survey work is going on, will be charged.

(*c*) The whole pay for the part of the year during which survey operations are going on, will be charged for all members of the temporary establishment entertained specially to carry out or supervise survey work.

(*d*) In order to calculate what part of the year is devoted to survey work, take the total number of patwaris and make a rough calculation how many were employed in survey for 5, 5½, 6, 7 months, and so on; no fraction of a month less than half should be recognized. If there are 110 patwaris, and on a rough calculation 30 were employed on survey work for 5 months . = 150
40 were employed on survey work for 6 months . . . . . = 240
40 were employed on survey work for 7 months . . . . . = 280
the fraction of the year devoted to survey work is $\frac{670}{1320}$ or $\frac{67}{132}$ and the fraction to be entered in column 3, opposite heads 1 to 7 in column 4, will be $\frac{67}{264}$; opposite head 8, $\frac{67}{132}$ will be entered.

(*e*) The whole cost of implements and stationery purchased for the purposes of the survey will be charged. For example, the cost of paper bought for mapping or field-books will be charged but not the cost of paper used for khataunies.

For the last 3 years the cost has been shown in Statement III annexed to the Annual Report of the Settlement Department. It of course varies with the character of the district (flat or hilly) and with the stage settlement operations have reached. Early in a settlement, when the establishment is not fully trained, it will naturally be heavy. We fear the returns made are unreliable. It is of course very difficult to say what part of the gross expenditure on a settlement really represents cost of survey, and in new settlements we avoid complete re-survey wherever possible. In 1899 the average cost, as reported in the Land Revenue Report for the 5 districts of Multan, Jhelum, Hazara, Dera Ismail Khan, and Muzaffargarh was Rs. 15 per square mile. The amount varied from Rs. 8 in the plain district of Multan, in which the settlement was near its close, to Rs. 77 in the hill district of Hazara, where it was beginning. Next year the cost in the 4 settlements of Sirsa-Fazilka, Hazara, Kohat, and Dera Ismail Khan, as entered in Statement XXXIII B, averaged Rs. 42 per square mile; that in the first being shown as Rs.1,269! The following table gives the figures as shown in Statement III of the Annual Settlement Reports for the years ending September 1902, 1903, 1904:—

District.	1902.	1903.	1904.
Sirsa-Fazilka	32	...	...
Jhang	74	73	104
Hafizabad	...	99	88
Rawalpindi	...	55	57
Attock	97	61	...
Hazara	185	135	63
Kohat	42	72	...
Dera Ismail Khan	62	...	...
Mianwali	...	...	208
Gurgaon	...	...	111

Punjab.

Hitherto the land-owners in the Punjab have paid the chainmen, but under recent orders their pay will be charged to the State.

Government of India, Revenue and Agricultural Department, No. 939—138-2, dated 7th July 1904.

Q. 17.—It is not understood whether this question refers—

(*a*) to maps made by the Survey Department on the system described in the answer to question 13, or

(*b*) to maps made without the aid of the Survey Department.

If the former, the reply will be found in answer to question 13; if the latter, in answer to question 2.

Q. 18.—No officers of the Survey Department are employed on cadastral work.

Note by the Honourable Sir Lewis Tupper, K.C.I.E., Financial Commissioner, Punjab, on the questions put by the Survey Committee, dated 12th March 1905.

I concur generally in the joint report signed by Messrs. Douie, Rencuf and Leslie Jones and have not much to add to it. Practically these officers have acted as a Committee under my instructions for the supply of the information required. I gave them oral instructions in the first instance, and when their work was nearly complete I met them again, and we read over and discussed the draft of the joint report, as it then stood. The draft has since been supplemented and amended for the most part as arranged at that meeting.

2. The situation in the Punjab is not very satisfactory. Within my recollection the face of the country has undergone great and rapid change owing chiefly to the extension of railways and the vast spread of irrigation. In 1884 Colonel De Prée and Colonel Wace framed an excellent scheme for utilizing the patwari surveys for topographical purposes and it is still acted on. But the work of the Settlement Department has greatly outstripped that of the Survey Department, and the supply of topographical maps is much in arrears. I do not know how this affects the Military Department—see what Mr. Kitchin says of Rawalpindi "which is the constant scene of military manœuvres", but where "no reliable military maps exist with the help of which an officer could lead troops accompanied by the guns and baggage with certainty from one point to any other point across country." Up-to-date topography for military purposes is perhaps more necessary in the Punjab than in any other Province except the North-West Frontier Province. This applies with special force to the old Rawalpindi Division, yet our joint report states that of Gujranwala, Gujrat, Shahpur, Jhelum and Rawalpindi we have as yet no modern maps.

3. For revenue and general administrative purposes we have not been able to wait for the maps of the Survey Department. In various ways we have supplied ourselves with what we require for our every day purposes. The Settlement Officers, the Colonization Officers, the Irrigation Department —all give us maps. I have found the maps of the Irrigation Department more useful for my purposes than any others; except of course the Settlement Officers' maps attached to Assessment Reports when such reports are under review.

4. If topography is up to military requirements, we may be practically certain that it will be up to and beyond the requirements of the civil administration except as regards levels in the plains—a matter that the Irrigation Department will attend to as vital to its success.

5. Mr. Kitchin touches an important point where he says that it is essential (in topographical maps) to adopt a uniform method of spelling. "An officer," he says, "may easily lose his way by inquiring for some place under some name by which no one recognises it."

6. Although, as already said, I concur generally in the joint report, there is a passage* in it marked 1 (3), which does not meet my views. I invite attention to Major Barton's remark that "Tahsil maps are frequently needed by all classes of officers, Civil and Military, on tour, Recruiting Officers, etc., who frequently apply for them, but I have none to furnish." In my opinion it should be authoritatively prescribed as a part of the duty of a Deputy Commissioner to see that his office is supplied with all of the maps published by the Survey Department which relate to his district or any part of it. I quite agree that he should have triennial lists, but I did not see the final draft of the joint report and it does not adequately express my view of the duty of the Deputy Commissioner in the matter. Moreover, I think the office of every Deputy Commissioner should be a depôt for Survey Department maps of the district or any part of it from which officers of other Departments could obtain such maps on official application and from which such maps should be supplied on payment to such other persons as the Deputy Commissioner might approve.

* Page 164.

Reply received from the Board of Revenue, United Provinces of Agra and Oudh, to the first series of questions. United Provinces.

Honourable Mr. J. Hooper, C.S.I., Member, Board of Revenue.

Q. 1.—As regards the first part of this question, the Board would accept Captain Coldstream's classification of the survey maps, *viz.*,—

(*a*) Maps for Allahabad, Cawnpore and Fatehpur are in course of preparation on the basis of a new topographical survey.

(*b*) For about half the province there are maps that "require nothing more than a revision survey." These are chiefly for the districts of the Meerut Division (topographical survey, 1877—84), and parts of the Agra, Allahabad, Benares and Gorakhpur Divisions (compiled from professional cadastral surveys 1871—1891).

(*c*) Preliminary sheets for about one-fourth of the province compiled from cadastral surveys since 1894. These may be placed in the category of maps requiring "a supplementary survey."

(*d*) Old maps—(about one-fifth of the province)—Survey 25—45 years old. These include the whole of Oudh (except Kheri, Bahraich and Gonda), Bijnor and Budaon. The maps in this class may be regarded as really obsolete.

For Etawah there are no 1-inch maps.

(2) They would be more suitable if they were published by districts instead of in sheets and for a district map the 1-inch scale is inconveniently large.

(3) There is a great delay in publication. For instance, the maps of the following districts, of which the surveys were completed between 1897 and 1902, have not been published yet, thereby delaying the preparation of the revised edition of tahsili maps which are compiled from the Survey sheets printed on the scale of 1 inch = 1 mile :—

	Survey completed in	
Bareilly	1899	
Shahjahanpur	1898	
Lalitpur	1897	
Meerut	1897	No sheets published by the Survey Office yet.
Bahraich	1898	
Kheri	1899	
Bijnor (part of)	1898	
Pilibhit	1900	
Gonda	1901	
Farrukhabad	1901	
Etah	1902	

The cause of the delay is that the Survey of India do not publish maps on the 1 inch scale until the details for a complete standard sheet are available.

Q. 2.—It is no doubt an advantage to have good topographical maps, but I cannot say that any serious administrative inconvenience has resulted where they are not available. For revenue administration the first requisite is village maps. With these and a combined map showing the communications and the important natural features, such as rivers, hills and so on, full topographical detail is not required.

Q. 3.—This question has to be considered with reference to the needs of administrative officers of different grades.

I.—A provincial map is required by the Heads of Departments. The Commissioner of Excise has complained that there is no map of the Provinces less than 20 years old.

II.—Divisional maps are useful for Commissioners and the Board. These were compiled by the Public Works Department.

III.—District maps. There are maps on the scale of (*a*) 2 miles to the inch, and (*b*) 4 miles to the inch.

(*a*) The first used to be prepared by the Board at an average cost of Rs. 587-3-8 per map for preparation, and Rs. 168-0-8 for printing at the Surveyor-General's office by photo-zincography, or Rs. 755-4-4 per district. Two hundred copies of each map were printed. But in 1887 the Survey Department undertook the completion of the series by the publication of 13 maps which were then outstanding. These maps were to cost Rs. 8,450 or Rs. 650 each, and were to be completed apparently within three years, as the money was to be provided in that time. By the end of 1894 eleven maps had been published at a cost of Rs. 18,450 : the remaining two maps were published in 1896-97. The excess in the cost was attributed by the Deputy Surveyor-General to delays in district offices in bringing the maps up to date.

No district maps are at present under preparation, pending receipt of the standard sheets of the Survey of India of districts surveyed since 1894, nor has the question, whether a new series may be necessary, been considered.

(*b*) The 4 miles to the inch maps are those referred to by Colonel Gore at page 15 of his printed note. They are prepared to show topographical facts connected with district administration, for which purpose the Board thought they would be more convenient than the large maps on the scale of 2 miles to the inch. They merely show tahsil, pargana and thana boundaries, rivers, canals, tals and jhils large enough to show on the scale adopted, railways,

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roads, large towns, villages with population of over 2,000, or in which tahsils, thanas, post offices, rest-houses, schools, or excise shops exist. The details required for the compilation of these maps are entered by district officers on tahsili maps: these are sent to the Rurki Press, where by reduction and omission of superfluous detail the District map is compiled.

Maps of this kind are now prepared in the Naini Tal Drawing Office from new standard sheets on their publication, and are printed and published by the Survey of India. Captain Coldstream sees no advantage in maps of this kind, and the Board agree with him. The scale is too small for the maps to be of much practical use. For the District Officer the most useful and handy maps are those on the scale of 2 miles to the inch described under (*a*), giving the names and boundaries of villages, parganas and tahsils, with the more important topographical details.

IV.—Tahsili maps on the scale of 1 mile to the inch with the names in English and Vernacular. These are required for the use of the tahsil officials, many of whom do not understand English. In the case of Shahjahanpur these maps have been pieced together from the Survey sheets, and the Urdu names have been added in the Drawing Office. It is more economical than the method of compiling the maps afresh, but the standard sheets show too many insignificant details, such as small plots of waste, isolated trees, small topes, which have to be erased to provide sufficient space for the entry of the Urdu names of villages. There are 5 statements giving details of population, fairs, etc., printed on each tahsili map, which information the Survey Office maps do not provide. These are not required and might be omitted.

Q. 4.—The tahsili maps above referred to are so prepared. Up to 1896, when the publication of the 1st edition of tahsili maps of the Province was completed, the Government Press lithographed the maps prepared in the Board's Office.

In December 1896, the Board suggested that a revised series of tahsili maps should be prepared and published at the Rurki Press, and this suggestion was approved by Government (Government Proceedings for April 1897).

The second edition of the tahsili maps, commenced in 1897, is being compiled. The procedure has varied. The original suggestion (paragraph 7, Board's No. 3580, of 26th December 1896 in Proceedings for April 1897) was that the Press should provide, by photo-zincography from the Survey of India map of the district, a proof map with unnecessary detail omitted; the Collector was to note the alterations to be made and the Vernacular names to be added; and these alterations and additions were to be made on the stone or plate from which the original proof had been printed. The second proof was then to be examined in the Board's Office and returned for final printing. Later, the procedure was for the Board to send the Press a printed copy of the latest map of a tahsil corrected up to date from the latest survey and information received from the Collector. This was photo-zincographed from a tracing made at the Press (Colonel Gore's printed report, page 15), and returned to the Board for examination and necessary correction. This procedure was open to serious objection:—

(*a*) A fair copy not being supplied to Press, they had to make a copy for themselves, and this was often full of mistakes.

(*b*) Great delay resulted, and while the map was under preparation, further changes occurred.

(*c*) All these changes as well as corrections had to be made on a plate, which is evidently a very slow and tedious process.

The Saidpur (Ghazipur) map may be referred to. This was sent to Press in 1898, and the first proof was received last June. But in 1901 the Press wanted some corrections made in the original, and though these appear to have been carried out promptly in the Board's Office, they no doubt delayed the map.

A different system has now been introduced. A printed copy of the latest survey sheet or map is sent to the District Officer for correction or note as to what corrections are necessary. A similar copy of the map is then corrected in the Board's office, from which a tracing is made of the tahsil for which a map is required. This is a fair map, and can easily be reproduced by photo-zincography. The method is much more satisfactory, and only one proof will be required if the printing of the map is clear.

(2) In addition to the tahsili maps there are the 4 miles to the inch district maps referred to in the previous question. There are also the $\frac{1}{8}''$ district maps referred to by Colonel Gore, which are prepared for the Provincial Gazetteer.

(3) There is an index map prepared for the Excise Report. Originally four maps used to be made, but the Government of India observed (G. G. O. No. 1643 Ex., dated 25th March 1901) that they might be discontinued in ordinary years. The Excise Commissioner however, thought it necessary to have at least one map prepared.

(4) There are also the divisional maps on the scale of 4 miles to the inch drawn by the Public Works Department and printed at Calcutta.

(5) So far as the Board are aware there are no private presses in the Province that could undertake to print maps. The Rurki Press is used. Since 1897 the Government Press has done no printing for the Board's Office. It still lithographs from originals supplied by Settlement, Opium, Police and other Departments, but it is not equipped to take up fine work, photo-lithography, and so on.

Q. 5.—This question does not concern these Provinces, as the only maps now sent for reproduction are the Public Works Department Divisional maps, and the ¼-inch District maps prepared in the Naini Tal Drawing Office.

Q. 6.—The reason why the tahsili maps are prepared locally is that the names have to be printed in vernacular, and the Survey of India, I understand, were unable to undertake this.

Q. 7.—The answer to this question must be in the negative. Inter-provincial territorial changes are notified in the Gazette, and so are changes between districts, but this information cannot always be sufficient to enable the survey to correct their maps. The Public Works Department are required by paragraph 667 of their Manual to supply information of changes in canals, roads, etc.

With reference to this question, which is a very important one, the Board would invite attention to a suggestion made by the Director, Mr. Moreland. It is that the Survey Department should indicate what changes in topographical features require record, and that these changes should be recorded as they occur by the staff of the Land Records Department. This suggestion was approved by the Government (page 135, Proceedings September 1904). An arrangement of this kind would, it is believed, go far to solve the difficulty of keeping topographical maps up to date.

As to utilization of the Land Records staff, please see Mr. Moreland's note. His suggestion was recommended by the Board and approved by Government (page 135, Proceedings September 1904).

Q. 8.—The surveys in progress are—

(1) topographical survey of Cawnpore and portions of adjacent districts included in the Cawnpore sheets;

(2) some topographical work in small scattered areas in Meerut, Sitapur, Bahraich and Kheri;

(3) traverse survey for cadastral purposes in the Ganges alluvial tract of Moradabad;

(4) cadastral operations, partly resurvey and partly map correction in tahsils Amroha, Sambhal and Hasanpur, District Moradabad;

(5) map correction in tahsils Baberu and Kamasin, District Banda, and tahsils Rath, Jalalpur and Muskara, District Hamirpur;

(6) town surveys in Cawnpore, Moradabad, Amroha, Hasanpur and Bachhraon;

(7) surveys of the boundaries of first class roads in 11 districts.

Q. 9.—This Government is consulted as regards topographical surveys. The Government considers chiefly the requirements of the revenue administration, but sometimes, as in the case of Cawnpore, expresses an opinion as to the necessity of a topographical survey. The Local Government is not concerned with the carrying out of the survey or with the staff.

The programme of provincial surveys goes through the Board to Government, and the entire control is Provincial.

The drawing office is under the control of the Surveyor-General.

Q. 10.—Certainly.

Q. 11.—I can give no definite information on this point, as our surveys are now carried out by patwaris. But the Survey Officers appear to have no difficulty in finding surveyors when they want them for cadastral surveys. It has been necessary in fact in some cases to discourage the employment of amins as substitutes for patwaris.

Q. 12.—Several Municipalities and towns, namely, Fyzabad, Cawnpore, Allahabad, Muttra, Moradabad, Amroha, Dhanaura and Bachhraon (3 towns in the Moradabad district), Aligarh (Civil Station), Koel (Aligarh), Hathras, Sikandra Rao, Atrauli, Kosi and Ajudhia, have been surveyed on scales varying from 16″ to 64″ to the mile under the supervision of the Superintendent, Provincial Surveys, and the cost has been met by the Municipalities concerned.

Q. 13.—This is a professional matter. Captain Coldstream instances Lalitpur. As the Director says, the defects related chiefly to hills and undulations, and where these are absent (as in the greater part of the provinces), there appears to be no reason why the reduced maps should not be satisfactory. The Board's Junior Secretary, Mr. Freeman, a survey officer of much experience, says in all districts where he has been employed, topographical maps have been prepared solely from cadastral maps, and where the latter show all details, as in Banda, Mirzapur, Gorakhpur, Jhansi and Meerut no supplementary survey is necessary to make them suitable for topographical maps: indeed he thinks they are better and more accurate than original topographical surveys. The Meerut maps have been criticised (page 4 of the Preliminary Report), but it is not clear what the omissions were. If the Junior Member may venture an opinion, he would say that the sheets prepared from a cadastral survey, such as that of Jhansi, for instance, are excellent topographical maps.

Q. 14.—Yes.

Q. 15.—Section 29 of the Land Revenue Act (III of 1901), and Circular No. 17-VII of the Circulars of the Board of Revenue provide for the preservation of all boundary marks, and

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as traverse mark stones are usually fixed on the boundary of a field, mahal, or village; they are practically boundary marks, and are maintained in this way. As regards the results, in Banda and Hamirpur the great majority of the traverse marks have been found *in situ*, and this has greatly facilitated the present cadastral survey.

Q. 16.—The following list shows what districts have been cadastrally surveyed by the Provincial Surveys since 1894. The cost rates are those supplied by the Director of Land Records.

The rates do not include the salaries of the surveyors who surveyed the country, as patwaris have been trained and have surveyed their own circles. Where ravines, large rivers, or any other difficult physical features exist, patwaris have been assisted by amins whose pay has been included in the rates quoted. Usually 3 to 4 coolies are provided for each patwari by the zamindars for the carriage of plane-tables, flags, chains, etc., at the time of survey. The cost of these is met by the zamindars. One chainman is provided for each patwari, and two to each Inspector and Parlaller, in addition to the khalasis engaged for the Survey and Assistant Survey Officer and for office requirements at the expense of Government.

District.	Cost rate excluding head-quarters charges.	Approximate cost rate including head-quarters charges.	Remarks.
	Per square mile.	Per square mile.	
Meerut	28	31	Survey Officer's pay and allowances not included.
Jhansi (Lalitpur only)	63	70	Includes pay of Survey Officer.
Bahraich Sitapur	58	63	Ditto ditto.
Kheri	68	75	Ditto ditto.
Shahjahanpur	55	59	Ditto ditto.
Bareilly	76	84	Includes cost of preliminary operations in Aligarh.
Bijnor (4 parganas only)	57	70	Includes pay of Survey Officer.
Naini Tal	445	523	Ditto ditto.
Pilibhit	76	86	Ditto ditto.
Gonda	70	78	Ditto ditto.
Farukhabad	68	80	Ditto ditto.
Etah	61	71	Ditto ditto.
Jalaun	80	91	Ditto ditto.
Mainpuri	92	105	Ditto ditto.
Azamgarh	56	70	Ditto ditto.

Q. 17.—Of the first edition of the 48 District maps of the United Provinces published between 1873 and 1897 on the scale of 2 miles = 1 inch, the following are the particulars as to preparation:—

Eight maps were prepared in the Office of the Board of Revenue from the 1″ survey sheets.

Thirteen were prepared between 1888 and 1897 in the Surveyor-General's Office, Calcutta.

Twelve comprising all the Oudh districts were prepared in the Director of Land Records Office, Lucknow. These were prepared from the tahsili maps (scale 1″ = 1 mile,—called Pargana maps in former days) compiled by the Survey Department, from the revenue surveys made on the scale of 4″ = 1 mile and corrected up to date of publication from the latest settlement surveys.

Eight maps, namely, those of Dehra Dun, Muzaffarnagar, Meerut, Bulandshahr Shahjahanpur, Farrukhabad, Jalaun and Azamgarh, were based on Revenue Surveys made between 1832 and 1856 corrected up to date from the most recent settlement surveys, and 7 maps, namely those of Saharanpur, Aligarh, Mainpuri, Etawah, Allahabad, Fatehpur and Cawnpore, were compiled from settlement maps.

The tahsili maps were compiled similarly. The maps are sufficiently accurate for purposes of Revenue administration, though they cannot be described as good topographical maps. The second edition of tahsili maps which is in course of preparation is being compiled from the Survey standard sheets corrected up to date by District Officers.

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Q. 18.—(1) Officers of the Survey of India are placed on deputation and their services lent to the Local Government for employment on cadastral work, namely,—

	Pay.	*Local Allowance.*	*Total.*		
	Rs.	Rs.	Rs.		
Captain W. M. Coldstream, R.E., Deputy Superintendent, Survey of India . .	1,140	100	1,240	The pay of these 7 officers is met from Provincial Funds, and is debited to the Land Records Department.	
Mr. L. F. Berkeley, Extra Assistant Superintendent, 3rd grade	450	100	550		
Mr. P. C. Smart, Extra Assistant Superintendent, 3rd grade	450	100	550		
Mr. F. B. Powell, Extra Assistant Superintendent, 5th grade	350	100	450		
Mr. J. H. Murphy, Extra Assistant Superintendent, 5th grade	350	50	400		
Babu N. Chatarji, Extra Assistant Superintendent, 6th grade	300	50	350		
Mr. C. L. Littlewood, Sub-Assistant Superintendent, 1st grade	210	50	260		
Mr. F. S. Bell, Extra Assistant Superintendent, 5th grade	350	50	400	Employed on traverse work.	The pay of these officers is met from Imperial Funds.
Mr. J. M. Kennedy, Extra Assistant Superintendent, 3rd grade	450	...	450	Employed in the Drawing Office at Naini Tal.	
Mr. W. C. Price, retired Extra Deputy Superintendent	Pay allowed exclusive of pension.		300		

(2) They are partly employed on record work where the survey is accompanied by a revision of records.

(3) As regards the surveys now in progress, the Survey officers could be replaced by Deputy Collectors, after these had been put through a course of training, and this arrangement has been proposed by the Board. The Board are not prepared to say that the work would be as satisfactory as at present.

Reply received from the Bengal Government to the first series of questions, prepared after consultation with the Board of Revenue, the Director of Land Records and the Superintendent of Provincial Surveys. Bengal.

[*Dated the 11th January 1905.*]

Q. 1.—With reference to this and Question 2, attention is invited to the letter of this Government, No. 2258 T.—R., dated the 22nd September 1904, to the Government of India, Revenue and Agriculture Department, and its enclosures.

(1) The 1-inch standard maps are generally out of date, as they were mostly compiled from the Revenue Survey maps of 50 years ago. Modern standard maps have been compiled from the recent cadastral surveys of the Chittagong, Cuttack, Puri, Balasore, Muzaffarpur, Saran, Champaran and Darbhanga districts, and will shortly be compiled for North Monghyr, North Bhagalpur, and Backergunge.

(2) The manner in which the present maps, even in their present state, can be turned to practical use for administrative purposes is set forth by the Honourable Mr. Hare (1) in his "Note on the uses to which settlement records can be put by Executive Officers," to be found in Appendix Q, pages clxx to clxxiv, of the Board's Survey and Settlement Manual, 1900, (2) in a note written by him and dated the 12th December 1904, a copy of which is hereto annexed, and (3) in his evidence before the Indian Survey Committee. It is impossible for any map to remain accurate in respect of rivers, where these are large, and are continually changing their courses.

(3) (*a*) The Faridpur and Noakhali district maps are out of print.

(*b*) There is great delay in publishing the new standard sheets compiled from recent cadastral surveys; and, in the case of Orissa and of Chittagong, the delay has been very marked.

Q. 2.—(*a*) Please see the first part of the reply to Question No. 1.

(*b*) It is only necessary to remark that, inasmuch as the whole system of land records depends on the *mauzawar* arrangement, it is essential to show on the map the original Revenue Survey *mauzas*, even where it is expedient to add the names of new hamlets and important places. These *mauzas* can always be identified on the spot by reference to land-holders or their agents. The local names of course often change owing to various causes; and the labouring and trading classes frequently know a village, not by its survey name, but by what is called its "*mufassal*" name or by the name of some bazaar.

Q. 3.—The 1″=1 mile maps showing village boundaries and the 1″=4 miles district maps are generally found suitable; but in tracts irrigated by canals there have been demands for maps on the scale of 2″=1 mile. (*Vide* also the answer to the next question.)

Bengal.

Q. 4.—(*a*) Yes, thana (or *mujmili*) maps which are compiled from the standard maps prepared upon the basis of the recent cadastral survey, and which are referred to in paragraphs 6 to 11 of Mr. Hare's note on the uses of settlement records, to be found in Appendix Q, pages clxx to clxxiv of the Board's Survey and Settlement Manual, 1900. Each map shows a single thana, and gives the name and boundaries of each village, the serial number of the village in the thana as given in the settlement record, and only a few important topographical items, such as main roads and rivers. These maps are prepared in the Bengal Drawing Office under the supervision of the Superintendent of Provincial Surveys, Bengal. They are prepared on the 1″ = 1 mile scale.

(*b*) The most useful map for general administrative purposes would, however, be a *mujmili* map of each thana on a scale of *2″ = 1 mile*. This map should show village boundaries, the serial number of each village, important roads, rivers, ferries, markets, police-stations and outposts, registration offices, village sites, canals and railways. For each map an index list should be prepared giving serial numbers of villages and village names and the number of the head rural policeman's circle within which each village is included. Each Department should receive a copy of the maps and lists and mark upon the maps for its own use such additional information as it requires, *e.g.*, the Excise and Education Department would insert shops and schools, and the District Board roads, etc., etc.

There are no facilities for the reproduction of maps either in Government or private establishments in the Province as far as this Government is aware.

Q. 5.—No change whatever is required in the present system, except that the Bengal Drawing Office should be further developed. Proposals to that effect have been made, and sanction has recently been given to an arrangement for the adequate housing of the Bengal Drawing Office and for considerable additions to the plant.

Q. 6.—As stated with reference to Question 1 (1), the 1-inch standard maps are generally obsolete. Moreover, these maps are not handy, because the district is mapped on a number of sheets which do not coincide with any specified local areas. On the other hand, the thana (or *mujmili*) maps, referred to in the answer to Question 4, are very convenient because they each represent a single thana. They are also very useful, because they give certain administrative details with only the more important topographical details.

Q. 7.—Draft maps are sent by the Surveyor-General to District Officers every year. The latter cause the District Engineers to mark on the draft maps any additions to railways, canals and main roads, or any striking changes in the course of rivers; and the Survey of India correct their maps on the basis of the information so received.

Q. 8.—(1) The cadastral survey of the districts of Purnea, Bhagalpur, Backergunge and Ranchi is now in progress, while that of the district of Faridpur is about to be taken in hand. A topographical survey, on the 4″ = 1 mile scale, of the uncultivated portions of the Backergunge Sunderbans is in hand; while a similar survey will shortly be commenced in respect of the Sunderbans tract of the 24-Parganas. *Diara* tracts belonging to districts under survey and to adjoining districts are being surveyed topographically.

(2) Among minor operations may be mentioned the cadastral survey of the Kharsawan and Saraikela Political States in the Chota Nagpur Division, that of the Majnamutha, Jalamutha and other estates in the district of Midnapore, and the detail survey of the added area of the Calcutta Municipality.

Q. 9.—(*a*) The programme of the work to be done in Bengal is determined entirely by the Local Government, subject to the approval of the Government of India.

(*b*) The Bengal Survey Department and the Bengal Drawing Office, though manned by officers of the Survey of India, constitute practically a Provincial Department, except in regard to purely professional matters. The Provincial Superintendent of Surveys is responsible to the Surveyor-General that the survey work in the Province is up to professional standard.

Q. 10.—Yes.

Q. 11.—Trained surveyors can be obtained from the Dacca and Cuttack Survey Schools and the Bihar School of Engineering; but they are only qualified for small posts carrying Rs. 20 or Rs. 25 a month.

Q. 12.—The following Municipalities have been surveyed on scales varying from 16″ = 1 mile to 64″ = 1 mile, generally the latter:—

Chittagong Cuttack Balasore Jajpur Kendrapara Muzaffarpur Hajipur Lalganj Sitamarhi Bettiah Chapra Darbhanga Samastipur Madhubani Roserah (only topographically on 16″ = 1 mile) Bhagalpur Monghyr	By the Survey Department, the cost being met entirely from Municipal funds.

Burdwan, Dacca, Patna, Kotchandpur, Tittaghur, Siwan, Revilganj, Motihari	By private surveyors, at the expense of the Municipal Commissioners, except in the case of Dacca, where Government made a contribution of Rs. 5,000.

The Calcutta Municipality has also been surveyed by the Survey Department; and the added area of that Municipality is now being surveyed by a detachment under the supervision of the Superintendent of Provincial Surveys, on the scale of 50 feet=1 inch. The survey of the old area of the Calcutta Municipality was paid for partly by Government and partly by the Corporation, and the added area is being similarly dealt with.

Note.—There has been considerable difficulty in finding trained surveyors for dealing with the surveys of the Municipalities; and the survey of the added area of Calcutta has had to be entrusted to two retired officers of the Survey of India.

Q. 13.—No, because there are no topographical maps made by direct survey in respect of the areas which have been surveyed cadastrally. In flat and fully cultivated tracts where, of necessity, every item is surveyed in the course of the cadastral survey, it would be possible to compile satisfactory topographical maps by reduction. In hilly tracts, where there is a considerable amount of waste lands, a topographical survey is necessary. For instance, in tracts like Chota Nagpur nothing would probably be gained for topographical purposes by utilizing any of the work of the cadastral survey parties except their traverse stations.

Q. 14.—Yes, except in tracts dealt with by non-professional agency, in the case of which no regular traverse survey is practicable. The estates surveyed non-professionally are numerous and vary considerably in size; and there is no means of co-ordinating them either by locality or importance. They have to be dealt with either in order to obviate loss of revenue, or because the landlords or tenants concerned demand and pay for a survey, or because settlement and survey proceedings become necessary as a means of averting agrarian disturbances.

Q. 15.—Steps are taken in accordance with the procedure laid down in Appendix T to the Board's Survey and Settlement Manual, 1900; but the work has only recently been commenced, and it is too early yet to judge whether the results will be successful.

Q. 16.—The cost rates are given below. They include in all cases not only the salaries of surveyors, but also all supervision charges and a 4 *per cent.* charge for instruments:—

District.	Cost per square mile. Traverse.			Cost per square mile. Cadastral survey, including record-writing.		
	Rs.	*a.*	*p.*	*Rs.*	*a.*	*p.*
Chittagong	213	0	0*			
Cuttack, Puri and Balasore	181	0	0*			
Muzaffarpur	162	15	0*			
Champaran	142	12	7*			
Saran				177	6	3
Darbhanga				201	13	2

Measures of economy have, however, recently been adopted, and the latest cost rates, for the season 1903-04, are —

District.	Cost per square mile of cadastral survey including record-writing.		
	Rs.	*a.*	*p.*
Bhagalpur	82	11	2
Purnea	101	8	0
Packergunge	127	6	5
Ranchi	93	9	2

No free labour is obtainable anywhere, except in the district of Ranchi.

Q. 17.—None, as far as is known.

Q. 18.—(*a*) At present the following officers of the Survey of India are employed on survey work in Bengal:—

1 Imperial officer as Superintendent of Provincial Surveys.

2 Imperial officers in charge of parties.

1 Provincial officer in charge of a party.

22 Provincial officers as assistants.

(*b*) These officers are partly employed on record work, the initial records being written in the field by the Survey Department.

(*c*) It is the very decided opinion of this Government that the number of officers of the Survey of India now actually employed in Bengal is the minimum which is required for accurate and satisfactory work, and that it would be quite impossible to replace these officers by local

* Separate figures for cadastral survey are not available.

Bengal. men. Settlement officers are fully occupied in settlement work; and moreover it would be impracticable to train such officers as a general measure as fully equipped and efficient professional surveyors competent to take charge of survey parties. The case of the Sonthal Parganas, where good results have been secured by the Settlement Officer, is quite exceptional, special efforts having been made to retain the same officer in charge throughout the proceedings. It would not be possible to repeat the experiment on any extended scale. In this connection it may be mentioned that it has recently been decided in the case of the district of Ranchi that it will be both cheaper and more satisfactory to have the work done by the Survey Department, notwithstanding the fact that the Settlement Officer there has special aptitude.

Note, dated 12th December 1904, by the Honourable Mr. L. Hare on the general suitability of existing maps for administrative purposes.

1. It is admitted that the present maps are for the most part old, and contain many inaccuracies. But much of the administrative inconvenience resulting from this can be obviated or mitigated by the use of the thana *mujmilli* (or congregated *mauza*) maps. These maps show the position of every revenue *mauza* in the district, and it is generally easy to fix the position of any place with sufficient accuracy for practical purposes by ascertaining within which revenue *mauza* it is situated. And this can generally be ascertained without difficulty. Almost every owner of land knows in what revenue *mauza* his land is located, and from the land-owners and occupiers the name of the revenue *mauza* can generally be ascertained; and if the *tauzi* number of an estate is stated (and every land-owner knows this), the Collector's registers will show in what *mauza* the estate is situated. Similarly a revenue *mauza* can be readily found if its name is given, its position in the thana and its surrounding *mauzas* being known from the *mujmilli* map.

2. The information contained in the maps can be thus supplemented and corrected from time to time by the local officers as required. The great changes in the rivers even can be noted by ascertaining the *mauzas* which are now on their banks.

3. In any new survey these *mauzas* and their boundaries will necessarily be shown, and their old or original revenue names must be recorded as well as any new or modern names by which they are now better known in order to maintain the connection between the old and the new revenue records.

4. For almost every practical administrative purpose the skeleton *mujmilli* map can thus be amplified by the method indicated, so as to serve almost every immediate practical purpose. Though maps correct topographically would be a great improvement their necessity for administrative purposes is not so urgent as to render necessary any immediate expenditure in anticipation of the re-mapping which will accompany the regular programme of survey and record-of-rights for the Province.

5. A point which it is advisable to notice is that it is very doubtful whether as regards Eastern Bengal and the delta any map on a scale of one mile to the one inch could show all the physical features which a good military map should contain. The country for the most part, *i.e.*, excepting embanked roads and the high banks of rivers and khals and the village sites which are usually artificially raised, is under water every year for a large part of the year, and even in the dry-weather months is full of dips and hollows which cannot be passed on foot. These, owing to drainage and silting, are continually varying; and even if they could all be shown in the map (which they cannot be), the map would never be reliable for any long time. Many of the water-courses, though too small to be shewn in a map of one mile = one inch, are practically impassable, owing to the nature of the soil and their muddy bottoms.

Joint note by the Financial Commissioner, the Settlement Commissioner and the Director of Land Records and Agriculture of Burma, in answer to the first series of questions with a note by the Honourable Sir H. S. Barnes, K.C.S.I., K.C.V.O., Lieutenant-Governor of Burma. Burma.

Q. 1.—Except in the delta districts where the topographical maps were prepared from cadastral surveys made more than ten years ago and where changes in the course of rivers, rapid extensions of cultivated area and the establishment of new villages have altered the face of the country, the topographical maps of districts under supplementary survey are in good order and generally fully up to date. Of the total area (exclusive of Feudatory States) of 158,404 square miles in the province, 45,654 square miles are under supplementary survey, and the upkeep of the topographical maps for this area forms a principal care of the Land Records officers who are guided by the Director of Land Records and Agriculture's circulars Nos. 5 of 1895 and 6 of 1901. Each district keeps up a complete set of the 1″ topographical maps to which the various topographical changes are transferred by pentagraph from the accurately surveyed 16″ sheets. When these changes become numerous a ferrotype copy is sent down by the Survey of India on which these changes are shown. Within the area under supplementary survey such corrections as may be necessary can be locally effected and orders have issued to this effect. But in areas outside the limits of supplementary survey extensive revision would appear necessary. The Ruby Mines, Upper Chindwin, Bhamo, all report the necessity of revision of ¼″ maps or of fresh survey on 1″ scale to a greater or less extent. Much topographical survey is still required in parts of the country.

(1) Generally then it may be said that the topographical maps so far as they go are up to date.

(2) They are generally admitted to be suitable for administrative purposes, but for use by local officers it would be better to print them by districts instead of by standard sheets. At present we may have parts of two districts falling on one sheet. This is inconvenient.

(3) There is a certain amount of delay in publication, but when once published they are easily obtained on requisition from the Survey of India. As, however, the stock of maps is kept in Calcutta and applications for them have to go through Heads of Departments and the Local Government, some delay is caused. This would be obviated if a stock were kept in the province. There is also sometimes delay in publication, *e.g.*, the Survey of India maps of Maymyo town completed in 1902 have not yet been published, and topographical maps of districts cadastrally surveyed are not published as quickly as is desirable.

Q. 2.—Officers in frontier districts regret the absence of good topographical maps on the 1″ scale, but there has been no inconvenience where maps already exist. The continuance, however, of original topographical survey till the entire country is properly mapped is most essential.

Q. 3.—16″ maps for the annual supplementary survey of the Land Records Department.

32″ maps where details are very minute (*e.g.*, in Prome) or land very valuable (*e.g.*, in parts of Mandalay).

64″ maps for towns (Bassein, Pakokku, etc.).

50′, 100′ for the most valuable building blocks (as in Rangoon).

1″ maps (reductions from the 16″ of all cadastral surveys, and topographical surveys of the uncultivated gaps, hills, etc.).

½″ topographical maps in English and vernacular as tour maps for district officers.

¼″ index maps showing kwin boundaries, principal physical features and towns and villages and 10 miles of country beyond the border.

Divisional maps on $\frac{1}{8}$″ scale, and provincial maps on $\frac{1}{16}$″ scale.

The 1″ topographical maps should be printed by districts and should show—(1) Kwin boundaries; (2) Names of towns, villages and hamlets; (3) Township boundaries.

They should show 5 miles of country beyond the district boundary.

In 16″ maps village boundaries should be shown; but as they are liable to frequent alteration they should only be inserted locally and not printed on the published sheets. It is desirable that all 1″ topographical maps should show contours. This might be done in colour.

Q. 4.—We prepare at the Government Press, Rangoon, the prints of maps of revision or original surveys executed by local agency and also reprints of maps of which the stock has run low or on which numerous corrections necessitating redrawing, have been made. We print now annually about 3,000 16″ maps (25 copies of each) from 100 to 200, 1″ and ½″ maps: about 200 ¼″ indices and various small scale district, fishery and other maps. Amongst these township and sub-divisional maps on the 1″ and 2″ scale prepared by the Land Records Department are the commonest. These are compiled from the Survey of India maps and show village boundaries, etc. Maps on various scales showing police station jurisdictions and village maps on the 2″ and 4″ scale showing the position of survey marks are also prepared. The Government Press does all this work; we do not employ the Survey of India. The Govern-

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ment Press is largely equipped for mapping work both by lithography and by the Vandyke process.

Q. 5.—The only maps sent to the Survey of India are the 1″ sheets when corrections have become so numerous that a reprint is necessary. It is perhaps as well that this work should continue to be done by the Survey of India as the work is of a higher class than could be managed locally. If, however, it were decided to do the work locally, a small extra establishment would be required, though the rare occasions on which reprints of these topographical maps are needed would necessitate only a very small additional staff for a very short time. The cost would be insignificant but probably more than at present (owing to higher labour rates in Burma) when it is done by the Survey of India.

Q. 6.—Special maps are issued because the standard survey maps are inconvenient in that sheets do not follow township boundaries. They do not show village boundaries which are necessary for administrative purposes: and moreover vernacular maps are required for Burmese officers.

Q. 7.—Yes. Superintendents of Land Records keep up a complete set of 1″ or 2″ topographical maps to which all important topographical changes are transferred from the 16″ supplementary survey maps. These are reduced by pentagraph and shown in red ink on the smaller scale sheets. All changes in subdivision, township, circle, and kwin boundaries together with their names and numbers are also shown. The situation of grazing-grounds, cattle paths and fisheries, the position of the head-quarters of districts, subdivisions, townships, and the places at which post and telegraph offices are established, are also clearly and neatly delineated on the maps. When the changes become numerous and important, the Superintendent of Land Records reports to the Director of Land Records and Agriculture. The Director of Land Records and Agriculture then asks the Survey Office to send down a ferro-type copy on 1″ scale of the printed sheet affected by the changes reported for correction in the District Land Records Office. The corrections on this copy are also made in red ink and the ferro-type is returned by the Director to the Survey office where *facsimiles* of the published sheet will thus be complete and up to date when the time comes for the publication of a fresh edition of the map. After the changes have been transferred to the ferro-type copy, the Superintendent has the red ink entries on his map gone over in blue ink to show that the changes have been communicated to the Survey of India. Previous to the issue of any new edition, the ferro-type copy is sent down for comparison with the corrected map in the district office and the latest alterations and additions are put in. It would, perhaps, be better if a fresh edition of each sheet were struck off whenever a ferro-type copy is sent back corrected, instead of waiting for a general republication.

Q. 9.—The Surveyor-General arranges annually the programme of cadastral surveys in consultation with the Local Government which takes the Financial Commissioner's opinion. A five years' programme for topographical work was drawn up in 1903.

The imperial survey parties and drawing offices (if any) are not under the orders of the Local Government.

Q. 11.—Trained surveyors can be obtained for cadastral work in the province. The men are the product of our survey schools with a sprinkling of men who have served in Survey of India parties. Local surveyors are trained in our survey schools of which there are 18 in the Province under the local Superintendents of Land Records. These youths are trained in the theory and practice of surveying by plane table and chain or prismatic compass. At the end of the course they appear for an examination in surveying, revenue law, and arithmetic conducted by the Educational Syndicate. When they have passed this they are attached to the District Land Records staff where they learn, under the Inspector of Land Records, Land Records work and further qualify in survey. After a year they are examined by the Superintendent of Land Records and, if they pass, given a final certificate of qualification in surveying and Land Records work. When local parties are at work they are frequently given work as chainmen to familiarise them with survey detail and subsequently are appointed revenue surveyors. There is an ample supply of locally trained men always available for special surveys.

Revenue surveyors get salaries of from Rs. 20 in Upper Burma to Rs. 50, the highest grade in Lower Burma.

Field Surveyors get	Rs. 30—40.
Sub-surveyors	„ 50.
Inspector of Land Records	„ 60—100.

The local men are all Burmans or Karens.

No topographical training is given.

Q. 12.—Yes. The more important large scale surveys of municipalities and towns, with the agency by which they have been effected, are the following:—

By Survey of India—

Rangoon town and Cantonments	50′ scale and 100″ scale.
Moulmein	50′ and 100′
Bassein	64′
Toungoo	64′
Pakokku	64′
Yamethin	32′
Meiktila	40′ to inch.
Akyab	64″

By local agency—

Prome	1″=50 feet (Government and Municipality).	Burma.
Tavoy	64″	
Mergui	33 feet to the inch.	
Henzada	64″ (Municipality).	
Ngathainggyang	64″ Municipality.	
Zalum	64″ (Municipality and Government).	
Lemyethna	32″ plane table. Worthless. Municipality.	
Mandalay (Government and Municipality)	40 feet to inch.	

There are no hard and fast rules about the incidence of cost, this being separately determined in each particular case. The cost in some cases is borne wholly by Government and in some wholly by the Municipality, in others partly by Government, partly by the Municipality.

Q. 14.—Invariably: whether the survey was done by local agency or by the Survey of India.

Q. 15.—Yes; the protection of permanent survey marks is rigidly insisted on and the inspection of them forms an important part of the work of revenue surveyors. They are generally, except where placed in dense jungle, well preserved and maintained. They are handed over to the custody of the village headmen in whose charge they fall and they are held responsible, with the cultivators in whose land they are, for their proper up-keep and maintenance. Neglect in the matter is punishable under the Burma Boundaries Act and a few prosecutions have taken place. When broken or damaged, these marks are replaced. Village headmen are required to examine all permanent survey marks in their charge once a year after the monsoon and report their condition to the township officer. To protect them the village headmen are required to erect earthen mounds over the marks wherever practicable.

The revenue surveyor is supposed to visit all marks in his charge once in three years. He takes up a section of his charge annually and visits all the marks in it. He renews all broken or damaged marks and reports all losses to the Inspector. He marks each pipe on the 16″ map with a symbol indicating its condition. Each surveyor also keeps skeleton maps on the 2″ scale showing merely the kwin boundaries and position of the marks. The condition of the marks is annually shown on a fresh copy of this map by means of exactly the same signs as are used on the 16″ maps.

Every revenue surveyor submits an annual report to the Deputy Commissioner through the Superintendent of Land Records showing the condition of permanent survey marks in his charge together with a map. Inspectors replace lost marks. Inspectors examine one-fourth of the permanent survey marks in the kwins inspected by them and one-eighth of the marks in their charges annually. They submit a map, showing marks visited.

If there is good ground for not replacing a permanent survey mark, it may be abandoned with the permission of the Director of Land Records and Agriculture.

Great Trigonometrical Survey Stations are also visited at least once in two years by Superintendents or Gazetted officers.

Q. 16.—The cost of the more important recent cadastral survey (which concern generally only the parts of districts omitted by the Survey of India) is as follows:—

	Rs.	
Katha { Traverse	44·1	per square mile.
Katha { Cadastral	167·08	„
Pegu	110	„
Thaton	154	„
Mindon Valley	160	„
Myaungmya—		
Traverse	12	„
Cadastral	235	„
Thaton (1899-1900)	106	„
Myaungmya (do.)	100	„

It may be remarked that most of the original surveys undertaken by local agency are in the remote parts of districts, undeveloped when the Survey of India did the main survey, somewhat inaccessible as a rule and with scattered cultivation.

The surveyors' salaries are included in all cases and no free labour is obtainable in Burma or can be depended on.

Q. 18.—We have two officers (Messrs. Gibson and Ford) permanently transferred from the Survey of India and 8 seconded officers (Messrs. Torrens, Beechy, Haddock, Wood, George Johnson, Baker, and Powell). They are all employed as Superintendents of Land Records and as such are more employed on record work than on survey. They are responsible for the upkeep of the district cadastral maps and for the preparation of the Annual Supplementary Survey records. Their services could not be replaced, if they are taken back to the Survey of India without serious detriment to the Land Records Department of the province.

Note by the Lieutenant-Governor on some points connected with maps in Burma.

I do not propose to go into the numerous small details which were discussed by the Committee with the Departmental Officers in Burma. I am mainly concerned with the broad

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requirements of this Province. There is no doubt that the maps in existence, except those of the 1″ survey, are very incomplete and inadequate. We have no complete map of Burma, and though many of the ¼″ maps are very useful, many of them are very incomplete; see, for example, the sheets relating to Aracan where nearly the whole of the country, between the sea and the Yomas, in the Kyaukpyu and Sandoway Districts, is unsurveyed: ⅛″ maps are also of very little use. In the Tenasserim Division there is little or no detail away from the sea coast. There is no doubt that the maps on the scale of 1″=1 mile are those which are most generally useful, and I wish to press very strongly for the completion of the mapping of the whole Province on this scale. No doubt this means a considerable amount of work, and I understood that the President of the Committee was anxious to know whether we considered any particular parts of more value than others, so that they might be undertaken first. This is a difficult question to answer.

Burma is moving so fast that one never knows what part of the country one may not have to refer to next. At one time we are in want of complete maps of the partially surveyed part of the Province, where there are gaps in the information, and then all of a sudden owing to mining or other projects, a question comes up in one of the less explored regions, and the want of maps for road or railway communications is brought to notice. For example, I felt the want of maps lately in connection with the survey of the Southern Shan States line, and of the proposed railway from Arakan over the Yomas to Taungup and thence to Akyab; also in connection with the making of roads in the Tavoy and Mergui Districts, where I found, during my tour last year, that the question of communications had been very much neglected. I am therefore of opinion that the Government should undertake as rapidly as possible, the completion of the mapping of the Province on the 1″ scale. Hitherto, until recently, there have been 3 Survey parties in the Province, and I understand that if these 3 Survey Parties are maintained, it is estimated that the completion of the maps on the 1″ scale may be expected in about 17 years. I am inclined to think that this is an optimistic estimate. In very hilly and dense forest tracts such as occur in the greater part of Burma, the operations will naturally be slow; the period required may easily be longer than 17 years, and in the meanwhile we should often be inconvenienced for the want of good maps of those parts of the country, where development may be at any time greatly desired. All the work, therefore, whether it is the work of completing the surveys of tracts already partially surveyed or of correcting existing maps and bringing them up to date, or of mapping a new country, is important. The more rapid the progress that can be made, the better, and I think 3 parties is the lowest number with which we should be supplied. I also think that, if possible, some special arrangements might be made to correct and bring up to date the maps in the lower part of the Delta, and I would sooner do without the 4″ maps of the Forest Survey, rather than delay the completion of the 1″ maps of the whole country.

H. S. BARNES,
Lieutenant-Governor.

The 24th March 1905.

SECTION VII.

MISCELLANEOUS PAPERS.

Hyderabad.

Memorandum of a discussion at Hyderabad on 21st January 1905.

Present:

Mr. Perram, C.I.E., Superintending Engineer, Irrigation and General Branches, Hyderabad; on the part of the Darbar.

Mr. J. O. Miller and Lieutenant-Colonel Longe of the Survey Committee.

Mr. Miller explained the objects of the Committee's visit, with reference to specimens of modern topographical maps which were produced. The existing maps of the State are topographical 1″ maps, the result of surveys made at various periods from 1816 onwards to 1866 and there are also atlas sheets on the ¼″ scale.

Some of the maps have been issued as standard sheets. The latest index shows 24 such sheets as practically complete and about 32 which show portions only of the area covered by the sheet.

There are also 31 sheets on the ½ inch scale.

For the remainder of the territory the maps have been published by Circars—an obsolete area—on the 1″ scale. These maps are very inconvenient, as they only show up to the Circar boundary and some are out of print. Mr. Perram says that they are issued with an index of the map for each Circar and are numbered in a separate series for each Circar which he finds inconvenient. The specimen brought with the Committee of the Bathalwady Circar, published in 1846, has no number, but there appear to be only two sheets of this map. There are no maps in standard sheet form for the greater part of the territory, but Mr. Perram thinks that more standard sheets have been published than the index shows.

Mr. Pope, an Assistant Irrigation Engineer, produced a map of the Dharur Circar, one of six sheets—also not numbered. None of these maps give any list of symbols.

No attempt has been made locally to join different Circar maps together to make a complete map. No special tests of the accuracy of the maps have been made, but the village sites are not correct in many cases, owing to changes. New villages have formed as cultivation has extended. The roads shown are generally wrong and new roads have been made. The roads shewn on the map are generally old tracks which have been abandoned. Mr. Perram thinks the drainage areas, which is what he is specially interested in, are generally correct, but cases of inaccuracy have been found. He depends on the maps for his drainage areas and does not make fresh surveys. He frequently sends to Calcutta for maps. He cannot get on without them for his irrigation works, and finds even the old maps of great use. Maps similar to those of Burma and Bombay produced would be of great value.

Mr. Perram feels sure that State the would welcome good maps, if it is decided to survey the country topographically, but of course the question of cost would come in, about which he is not empowered to offer an opinion. New maps might not save much expense in making irrigation projects, but they would enable him to judge where suitable projects could be undertaken and would save some expense. If the Circar maps were printed in the shape of complete standard sheets, they would be much more useful; and if the following information were added:—taluk boundaries, district boundaries, roads and railways—they would be still more useful.

The correction of village sites would also be of advantage, but he recognises that this would be a big work; so too with contours, they would be useful, but their delineation would involve a new survey. It would in fact be impossible to have up-to-date maps without a new survey: but Mr. Perram could get along better than at present if he had the old maps patched up, though of course this would not be really satisfactory.

Independently of any question of cost to the State, he certainly thinks it would be a very good thing to have modern maps made on the same standard as for the rest of India.

He would, also, like village boundaries shown for his purposes. It is thought that there has been a revenue survey of the whole of the Dominions—and village maps are prepared—on a scale of 8 inches to a mile. Occasionally Mr. Perram uses them: they are accurate locally as far as he knows, but could probably not be joined together correctly. Mr. Pope, Assistant Engineer, says that taluk maps, scale one mile to an inch, are made by the Revenue authorities by joining village maps together. Colonel Longe explained that it would be possible to shew village boundaries by picking up the trijunctions by plane table, as in Mysore, and putting in the boundaries after making reductions from the village maps. The trijunctions are believed to be marked as a rule; if not, the State would no doubt order them to be marked on the ground. Boundary stones are generally maintained in good order.

The village maps show wet and dry land separately, the tanks and their areas and the village sites, but do not profess to show hills, which Mr. Perram thinks are generally left bank. Mr. A. J. Dunlop was in charge of the survey. The Maharatwara country on the west is black cotton and trap rock country and has extensive plains with some hills. The

Hyderabad.

Telingana is a country of red soil and granite. As a rule, the country is in both cases fairly open, but the extreme east near the Godavery is all jungle—say from standard sheet 140 to the south-east part of the Dominions. There are large areas of reserved forest in this. There is another tract of jungle in the south, which has been roughly marked off on the India map.

Mr. Perram says that, while a map on the 4″ to a mile scale would be useful for irrigation purposes, he does not think that it would be worth the extra cost of making it.

Assam.

Note of opinion expressed by the Honourable Mr. Fuller, C.S.I., Chief Commissioner of Assam.

[*Gauhati, 26th November 1904.*]

Mr. Fuller, after hearing the results of the Committee's examination of the maps, gave his opinion that the part of the province of which, for purely administrative purposes, maps are most necessary is the district of Sylhet, the 1″ maps of which are based upon no proper survey and are incorrect and obsolete. The ¼″ map is also so incorrect as to be almost useless. There has never been anything but the roughest survey. It is possible that a cadastral survey of the district may be required. The Deputy Commissioner has recommended it, but Mr. Fuller would not advise postponing the topographical survey until it is undertaken.

For Cachar, a map of which is also wanted for administrative purposes, there is also no adequate topographical map ; the plains portion can be compiled from cadastral maps ; but the hills have never been regularly surveyed at all.

2. More important from the military standpoint, and of great importance for administrative purposes, are the Naga Hills and Manipur, including the country right up to the eastern frontier or beyond it if possible. Maps of these tracts are constantly wanted.

For Manipur he would like the plains on the 1″ scale and the hills on at least ½″, though 1″ would of course be preferable. The Manipur State would be quite ready to pay for the survey of the plains portion of the State.

3. From a military point of view the northern boundary of the Province is perhaps the most important of all. The old 1″ maps are of little use, and the cadastral maps that are now being utilized for their revision do not run up to the boundary. Beyond that there is only patchy reconnaissance, and it does not seem possible to do more than take advantage of any expeditions, etc., to supplement the work. A survey of the route towards Towang would be very useful, as this is a route of some importance to Tibet. The open country of the Assam Valley could probably wait till these other surveys are made. But it is desirable that the revision of the 1″ maps now in hand should be completed.

The Lushai Hill survey is not very urgent. The one inch survey of some sheets was quite unnecessary though well done.

There are very good maps indeed of a part of the Khasia and Jaintia Hills on the 1″ scale, but they do not cover much of the country. Mr. Fuller's impression is that they want minor revision, and that they may not be good enough for military purposes ; but they are not of equal urgency with the others.

4. No more assistance is to be expected from cadastral surveys. Any further surveys of the kind will be dealt with locally. Mr. Fuller thinks a traverse is certainly required when any cadastral survey of a district or continuous large tract of country has to be undertaken, but not when only isolated plots are being dealt with, as is likely to be the case in future cadastral surveys on the Assam side. He thinks there should be no difficulty in getting men trained to do a traverse such as he requires for his districts independently of the Survey Department.

5. The cadastral survey is valuable wherever village boundaries have to be put on the maps. He was under the impression that reducing from cadastral maps effected great economy in the preparation of topographical maps, but if the latter can be prepared at Rs. 25 per square mile, he would agree that there would not be much saving. In the Central Provinces difficulty was experienced in getting the map office to prepare fresh 1″ maps by reduction of the cadastral maps. Maps showing village boundaries (which are greatly needed for district administration) could be prepared locally without any difficulty by pentagraphing. As to changes that ought to be included in 1″ topographical maps that have been issued, he thinks that it would be easy to direct the Public Works Department to give the Survey a list of such changes. That Department should be able to give notice of the construction of new roads, railways, etc.

6. The patwari can hardly be expected to do topography well. It is not his business, and he is a man on low pay, Rs. 12 or so, per month. The two styles of survey—cadastral and topographical—are absolutely distinct. The civil officer wants village and administrative boundaries, the survey and military authorities want topography, and neither is really interested in what is of most importance to the other. He inclines to think that the policy of working from the patwari maps for topographical purposes was a mistake. He thinks that the best plan would be to keep the two classes of survey distinct.

7. Village boundaries are not wanted on topographical maps in Assam. They can be plotted on skeleton congregated maps. But topographical maps in order to be useful for the District Officer must show roads, railways, embankments, thanas, rest-houses, tahsils, dispensaries, post offices, telegraph offices and, if possible, schools, and *cultivation* as opposed to *jungle*.

It would also be advisable to have mauza or pargana boundaries shown. These do not change much. The most convenient scale for District maps would be the $\frac{1}{2}$" scale. The $\frac{1}{4}$" is rather too small, though it would be possible to make shift with maps on this scale. Mr. Fuller explained that, though he did not wish village boundaries shown on the topographical maps, still it was essential to have some maps showing village boundaries. These, however, could be prepared locally. They would show only roads, etc., and not all topographical features. They would be on the $\frac{1}{2}$" scale.

8. As regards the issue of maps prepared by the Survey, Mr. Fuller states that no topographical maps of the Cachar survey done in 1889 have been issued yet. None of the sheets of the valley districts as surveyed by Mr. Barrett have been received by him. It also appears that standard sheets of the latest surveys have not been issued to the Chief Commissioner. The advertisements of new maps, periodically issued by the Survey Department, should specify the districts to which the sheets relate. At present numbers only are given and District Officers cannot see (without reference to an index map) whether new sheets concern them.

9. Mr. Fuller thinks that there will be no difficulty in getting together locally a reliable agency for cadastral survey in Sylhet. He would probably have one European officer in charge of the operations with the camps under native officers. The European officer would probably be a specially trained civilian. He thinks that the survey can be done by Sub-Deputy Collectors properly trained and supervised. He does not think that natives require more supervision than Europeans and Eurasians of the class employed in the Provincial Service. On the contrary he thinks natives are better suited for field work than many of the European and Eurasian class. They are more capable of undergoing the rough experiences of travelling about in boats, living in grass huts, etc. He has found natives quite capable of controlling their men, but he confines all his remarks on the subject to the matter of which alone he has practical experience, namely, the conduct of cadastral surveys. As regards the class of natives to be employed, he would hardly ever appoint a native to such posts as those of the Provincial (Survey) Service, who was not a graduate. He rarely appoints any one who is not a B.A. to the post of Sub-Deputy Collector, the pay of which begins at Rs. 100. He does not think that any one but a B.A. should be admitted to posts of Rs. 120 or thereabouts. He has the impression that the Survey are somewhat prejudiced against the native and that they might find it possible to get a better class. His idea would be to recruit men with a high educational qualification tempered by selection, say, by a Board. There is no difficulty in getting B.A.'s with the necessary physical qualifications.

10. As regards the actual surveyors he would regard Rs. 12 as a low pay for men who could survey accurately. He would not give less than Rs. 20 to start with and at this rate he thinks that F. A.'s could be obtained. There ought to be absolute freedom in rejecting probationers. He could not say whether such men would serve all over India, but he thinks that men, with educational qualifications, willing to undertake the liability could be obtained. If, however, the men were not liable to service everywhere in India, he has no doubt there would be a chance of getting a slightly better class than when they must accept an obligation for general service. He is aware, however, that any attempt to change the existing system would undoubtedly lead to much trouble and would require a determined man and persistent pressure to carry it through. He thinks that good material exists for surveyors amongst the pupils of High Schools, but is ready to admit that there may be some advantages in the old class of men, who have grown up in service and may in some respects be more useful than outside recruits.

11. As to the general relations of the Survey and Local Governments, it is almost unavoidable that there should be some friction between them and an Imperial Department, like the Survey. It would be an excellent plan if the Survey officers and some of the civil officers were to meet in conference once a year. If the Deputy Surveyor-General visited the province at least once a year and met the Director of Land Records, the Superintending Engineer and representatives of the Military Department, interviewing the Head of the Local Government, this would do more than anything else to prevent friction. There should be a fixed time at which a formal conference would be held to discuss the programme, the progress made in carrying it out, and the arrangements to be made for the future. It should be an official and formal conference, not a casual one. If these had been held in the past, many mistakes would have been prevented.

12. In the case of local surveys it would be invaluable to have the Deputy Surveyor-General as expert adviser to the Local Government.

13. Much money has been wasted on Forest Surveys. In the Central Provinces there have been cases in which expensive surveys were undertaken which were in no way required. Surveys are made because working plans cannot be drawn up without them and working plans are often not needed at all. For many forests a single boundary line survey would suffice.

He does not think any Forest Surveys are required in Assam except perhaps in the Goalpara Sal Forests. Forest surveys should be undertaken as the necessities of the exploitation of the Forest require and should not be pushed on independently of actual practical requirements.

North-West Frontier Province.

Letters received from officers serving in the North-West Frontier Province regarding the Preliminary Report of the Departmental Committee on topographical maps.

Note by Secretary, Public Works Department, North-West Frontier Province, on the Preliminary Report of the Departmental Committee to consider the topographical work of the Indian Survey Department.

So far as I can judge, what is in most cases required is revision rather than fresh surveys, in order to bring the maps up to date with respect to roads, railways, canals, new posts, etc. All the sheets of the Frontier Province require to be gone over again and brought up to date, and more heights added.

In the case of Hazara, Sheet No. 28 of the Indian Atlas shows the topographical features with much distinctness, and although the scale is only 4 miles to the inch, it is preferable to the more recent sheet of 2 miles to the inch. Both are probably based on the same survey, but in the Indian Atlas the reproduction, which was done in England, is incomparably superior to the photo-zincography carried out in the Calcutta offices, where I understand the climate does not permit of certain processes being resorted to which can be employed at home and where the services of skilled trained Europeans are not available for printing.

In the one inch to the mile sheets of 1870 the features are clearly indicated and the marge and plateaux about Bhattakundi can be recognised, which is not the case in the half-inch sheet.

Further, as regards the names of places, in the one inch sheet the small lake up the Narung Valley is correctly shown as Safr Malook, but in the later sheet the name has become mutilated.

In the small scale maps, with horizontal hachures in sepia, very steep slopes cannot well be distinguished from those which are quite gentle, but they are much clearer where vertical hachures have been used.

In some cases I have remarked that ravines which rarely carry more than a trickle of water are shown as large perennial rivers.

Roads and canals are not always distinguishable from each other and from kutcha and cross country tracks. From all points of view, military as well as civil, an improvement in this respect is desirable to bring the reproduction nearer the standard of the British Ordnance and other European maps.

In conclusion, I would venture to suggest that the most satisfactory way of ascertaining what tracts require revision, and to what extent and where new surveys are required, would be to depute a Survey officer with a small staff to go over the various frontier roads and, in communication with the local civil and military officials, note what is wanted to bring the maps up to the requisite standard, so that they may be reliable and good enough for military purposes.

We have to make special surveys for roads, as the Irrigation Department has for canals, but I should like to say that the maps as published are but little help to us in this, as they only give as a rule the heights of a few prominent peaks. What we want specially to know is the elevation of the various saddles or kotals. I do not think the maps in our possession were of any use for laying out either the Zhob, Gomal or Mullagori roads. In the Dera Ismail Khan District the maps are 25 years old and want bringing up to date. The map of Waziristan is not only unreliable but misleading. For example, at least one post, Nili Kach I think, is shown on the wrong side of the river, and the position of others are not at all correct. The Khagan Valley map is out a bit, though the features are well shown on the old lithographed map, reproduced in England. The newer map does not give any idea of the country, and there are existing tracks which are not shown.

As to scale, a good reliable 1″ map would be most useful.

Letter from Major W. J. D. Dundee, R.E., Commanding Royal Engineer, Peshawar District, Military Works, No. 6545, dated 6th August 1904, to the Commanding Royal Engineer, North West Frontier Province.

In the Peshawar district the maps in present use are—

	Scale.
No. 586-S., 1901 No. 580-S., 1901	1″=1 mile.
No. 513-S., 1899	1″=2 miles.
No. 1944-I., 1902	1″=4 miles.

2. *Maps No. 586-S. and 580-S.*—These are the maps most used by the troops, and from these the handkerchief maps in general use on manœuvres are prepared.

I have the sheets of these maps before me, but it will be sufficient to criticise sheet No. 80, *viz.*, No. 586-S., and the remarks I make upon it may be taken as applying to the other continuation sheets—

(*a*) The map is not up to its date 1901. No road between the words "Cherat Cantonment" and "Bahadur Khan" is shown. The Jalozai encamping ground is indistinguishable.

(*b*) The heavy black hill shading of the Cherat ridge is not only confusing in itself, but obliterates the general features of the ground. The hill shading should be in colour.

(*c*) The valley lines are very misleading; there are hundreds of nullah beds shown in which no water flows, except during floods, and which on the map have the same appearance as the Bara River at Bara Fort, where this river is quite a nice sized and permanent stream.

(*d*) Elevations are given to some of the hills, but are not marked along the valley lines. For instance, there is no guide as to the descent from the words "Cherat Cantonment" to "Kamar Mela," yet from a military point of view the difference of the elevation between these two points is as important as the horizontal distance. Again, the interpolation of the letter B against all elevations noted by an aneroid is a most useful warning to those about to use such marked elevations for datum points.

(*e*) *Roads and Canals.*—These are shown exactly the same (see the Michni Canal), and there is no means of distinguishing a canal from a road if the occasional words "Michni Canals" be overlooked, in the "Symbols and abbreviations." The difference between a metalled and unmetalled road is, to the best eyesight, practically *nil*, and as an example upon the map look at the points, close to one another, where the roads from Sham Shattu to Azar Khel Bala and from Umar Paian to Jalozai cross the Cherat-Pabbi road. To all appearance these roads are all the same, but the facts are as follows:—The Cherat-Pabbi road is a good cart road, metalled at this point and for some 17 miles from Pabbi; the other two roads mentioned are kutcha, only passable in fine weather with difficulty by carts, and for this reason are usually avoided by any but empty carts.

Again, look at the road from Mattani to Fort Mackeson. This appears to be the same as the Kohat road at Mattani, whereas the Mackeson branch is kutcha, and at one nullah ponies, etc., have to be unharnessed and a cart man-handled, whereas the Kohat road is a good metalled cart-road. On the map, if there be any difference, it is in favour of the Mackeson road which I call most misleading.

(*f*) The defensible Border Military Police posts should be shown as such—for example Ghari Jani looks like a village. Julao Talao is not shown. I have said enough to show the need for the thorough overhaul of all the sheets of this map, *viz.*, sheets 50, 51, 52, 78, 79, 80, 105, 107 and 108.

3. *Map No. 513-S., 1899.*—The remarks made upon the above map also apply except that the hill-shading being in colour does not obliterate the features of the country. The omissions in this map are more numerous than in the one already criticised. The cart-road Pabbi-Cherat, which had been completed more than 10 years before the date of this map, is not shown. Instead the old route to Cherat is shown and shown incorrectly. The cross road from Sper Sung to Pir Bala was in existence in 1899, and is not shown. The map is thus very far from being corrected up to the date enfaced on it.

4. *Map No. 1944-I., 1902.*—This map like the others requires to be brought up to its date. The road leaving the Kohat road near Mashu Gaggoo and going to the Border Military Police post at Julao Talao, is not shown. It was not shown in the 1899 map above remarked upon; it was entered in the 1901 map above referred to, and is omitted in this map; also the police posts. Most of the remarks made upon the above maps apply in degree to this one except that the coloured hill-shading is satisfactory, and that in this map a differentiation is made between the different classes of roads. This differentiation, however, is occasionally quite wrong. The road from Bara Fort to Jamrud and thence to Shahgai is shown as a mule road. On the contrary, it is a kutcha road, fit for wheeled traffic along which one can drive at 8 miles an hour in comfort. The road too does not join in at Jamrud Fort.

Again look at the road from Peshawar to Abazai. This road is a cart-road; it is metalled for the first 11 miles, then kutcha, but still a good cart-road; it is shown as a mule road on this map; so is the Michni road.

In fact, most of the roads to the north of the railway are shown wrongly.

Something wrong has happened to the Michni Canal which, according to this map, derives its water from the Mallagori road instead of the Kabul river near Michni.

Even on this map the Cherat cart-road, which at the date of this map had been completed some 15 years, is not shown.

I have, I think, said sufficient to show how very badly this map requires correction.

5. Another map I propose to remark upon is that of the Khyber, made in 1898; its hill features are very vague, and the map always gives me the impression of having been drawn from the road itself. The Mullagori country does not appear to me to have been properly surveyed.

6. Finally, I have before me sheets 1 and 2, Northern Afghanistan; in these a road is shown as running from Jamrud to 1 mile short of Ali Masjid, then a mule track from this

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point to Landi Kotal, and a road from Landi Kotal to the Kam Shilman and thence to Shahgai; this was never correct. The map is very much out of date.

7. Regarding question 2, the most recent map I have is No. 1944-I.-1902, upon the deficiencies of which I have remarked.

8. Regarding question 3, I am not in a position to say, without most careful and lengthy check, and full information at my disposal, whether the Committee's proposals for re-survey are sufficient or not, but I do strongly contest the proposal to take a "not estimated" time to bring frontier surveys up to date (see paragraph 34) if the Peshawar district be included in frontier survey, or to take "12 years" if it be included in "the Punjab." In my opinion the maps of this district should be at once revised and brought up to date, and the re-survey undertaken when money, establishment or order of urgency may dictate.

I also entirely agree with the note by Major Maconchy appended to the Departmental Committee's report, forwarded with your letter under reply.

Letter No. 1606, dated 16th August 1904, from Captain D. B. Blakeway, Deputy Commissioner, Bannu District, to the Revenue and Financial Secretary to the Chief Commissioner, North-West Frontier Province.

In compliance with your Circular No. $\frac{66\text{-H.}}{1\text{-}5}$, dated 29th July 1904, I have the honour to submit a list * of the existing maps of this district, and, with reference to paragraph (1) and paragraph (2) of your letter, to say that the only maps in general use in this district are the standard survey of 1″ to 1 mile contained in several sheets, and the reduced reproduction of this map (2′ 10″ × 2′ 3″) which shows the old Bannu district on a scale of 1″ to 4 miles. It is unnecessary, I think, to discuss the obsolete maps dating back to the annexation of the Punjab, but a scrutiny of the above-mentioned two maps shows that police stations and posts, rest-houses, post offices, and Border Military Police posts are not correctly marked; that the tribal boundary on the north of the district requires to be re-drawn; that canals—a most important feature of Bannu topography—are conspicuous by their absence; and that, generally speaking, though the physical features of the present Bannu District, with perhaps the exception of the Kurram river, are accurately exhibited, the maps are out of date and require revision. I must add that a republication of the standard survey of 1″ to 1 mile is now being undertaken by the Survey Department and three sheets have been furnished to me. As these sheets only comprise very small portions of the Bannu District, I cannot express an opinion as to how far they have been brought up to date, though I have detected two errors at all events in sheet No. 57, which erroneously locates a police station at Landiwah and Darra Tang where none exist, and also omits mention of the rest-house at the latter place. In reply to a reference by me on the subject, the Assistant Surveyor-General has informed me that this republication will not be completed for some time, as the maps in stock are sufficient for present requirements.

2. As regards the suitability of the recent maps of the Survey Department for administrative purposes, I have the honour to state that no new maps of this district have been issued for many years, but the provision of one small scale map of the district to supplement the standard one inch survey, as has hitherto been the custom, seems all that is necessary. Care must, however, be taken that the district map is not reproduced on too small a scale. In Bannu, for instance, I think, that a larger scale than 1″ to 4 miles might well be employed for the district map, which is probably more consulted than any other by the District Officers in the ordinary course of their duties. This scale is too small to permit of the features of the country being exhibited in sufficient detail, and villages have also been omitted wholesale. Generally a rule might be laid down that the district map should be on as large a scale as should be compatible with convenience in handling it. A map sheet to measure 5′ or 5′ 6″ square can be placed on a table without difficulty, but the actual length and width of the present Bannu District, as represented on the 1″ to 4 miles, are 14″ and 13″ respectively.

A defect common to all district maps issued by the Survey Office which I have seen, must be mentioned here, as it seems to me to detract considerably from their utility. I refer to the fact that the adjoining districts and trans-frontier territory are never shown on the map sheet, but a blank space is left round the district, which remains as it were *en l'air*, and does not appear in its proper relation to the adjoining country. I would recommend that the sheet or sheets of the district map should always be topographically filled up to the margins. This would be an advantage from every point of view, but especially when, as frequently happens, the map is consulted to discover routes and distances between places on either side of the district border. Amongst minor advantages (*sic*? defects), the removal of which would increase the usefulness of the district and standard survey maps, are incorrectness of spelling and the representation of all roads by one conventional sign on the maps now in use. In the former case the Hunterian system of transliteration might be adhered to, and in the latter different signs might be employed to designate metalled, unmetalled, and unbridged roads. In arid tracts like the Lakki tahsil of this district, it would be desirable also if a note were made of a well or tank anywhere on a main road or at a halting place.

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* Not printed.

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3. With respect to the Committee's proposals for future topographical surveys in the Punjab and North-West Frontier Province, which are referred to in paragraph 3 of your letter under reply, it appears probable that Bannu was omitted by an oversight from the list of districts about to come under cadastral survey which was given by the Committee in paragraph 9 of their report, and this may have been the reason for the inclusion of this district amongst those which are said to require new surveys. Bannu is at present under settlement and is being re-mapped for revenue purposes. The necessary topographical corrections of the old maps will be embodied in the index maps now in course of preparation, which will be grouped together and sent to the Survey Department in accordance with the procedure laid down in Settlement Commissioner's Circular No. 16. The grouped map should provide sufficient material for the revision and correction of the existing topographical map of the district, with the assistance of a supplementry survey, and an entirely fresh survey, as proposed by the Committee, scarcely seems to be necessary.

4. The above remarks and the list of maps submitted with this letter only refer to the Bannu district proper. With respect to the trans-frontier area under the political control of the Deputy Commissioner, Bannu. I can only say that the maps are astonishingly defective and misleading. I know of no map which gives even an approximately correct idea of the country between Thal and Bannu, in spite of the prominent manner in which this tract has been brought to notice in recent years. This will be seen at once if reference be made to Sheet No. 442, North-Western Trans-Frontier, corrected up to September 1902, which, I believe, is the latest map of this area published by the Survey Department. As, however, a survey of the Thal-Tochi tract is projected, it is unnecessary to say more regarding the deficiencies of the existing maps of this portion of the district frontier. But though Sheet No. 443, North-Western Trans-Frontier, published in August 1900—the latest map of the neighbouring trans-frontier country to the south of the Tochi—exhibits equal defects, I observe that this area is not proposed for fresh survey. Merely from the point of view of a Political Officer, the want of a map showing tribes and places in reasonable detail in the country bordering on his district is very inconvenient, until he can personally visit and acquaint himself with its topography. Without therefore discussing the military considerations involved, I hope it will also be possible to do something to remedy the incorrectness of the maps of this part of the border.

Letter No. 102-C., dated the 21st August 1904, from Dr. M. A. Stein, Inspector-General of Education and Archæological Surveyor, North-West Frontier Province and Baluchistan, to the Revenue and Financial Secretary to the Chief Commissioner, North-West Frontier Province, Peshawar.

With reference to your No. 65-H., dated 23rd July 1904, I have the honour to express my thanks for the opportunity given to me to acquaint myself with the measures contemplated for the revision and extension of cartographical materials at present available for this Province. The subject is one in which I am bound to take a considerable interest, not so much from an administrative point of view, but as a student of the geography of the frontier region, both in its modern and historical aspects.

2. I have had little opportunity to observe the uses to which the maps at present available are put by the District Officers and others for the purpose of general administration. But I have had constantly to use the maps published on the scales of 2 miles to 1 inch and 4 miles to 1 inch in the course of archæological tours. I have besides taken a special interest in the maps of those parts of North-Western India (Kashmir, Gilgit, Baltistan and the Punjab districts near the Indus) with which I have been able to acquaint myself personally in the course of my travels. In view of the practical experience thus gained, and also as a geographical student, I may be allowed to offer observations which are not restricted exactly to the maps available for the districts of this Province, and to touch also upon the question as to the style and technical reproduction of the maps embodying the surveys for this region. This question (not especially discussed in the Report of the Departmental Committee, but distinctly raised in the notes of His Excellency the Viceroy initiating the Committee's labours) has a very important bearing upon the practical and scientific utility of the maps.

3. With regard to the question as to the present state of the topographical maps of the Province, I can express my opinion only with regard to the materials at present accessible to me. These consist mainly of the "North-West Trans-Frontier Sheets" published on the scales of 2 miles to 1 inch and 4 miles to 1 inch, as well as of the few available sheets of the "Indian Atlas" (4 miles to 1 inch) showing portions of districts in this Province. The maps on a scale larger than 2 miles to the inch are, as I understand, treated as confidential in the case of the Trans-Frontier tracts, and I have had no opportunity of examining them.

4. Taking first the maps on the scales of 2 miles to 1 inch, I believe I can recognize 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

North-West Frontier Province.

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 surveys 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.

Due regard to the military importance of all natural features of the ground, and possibly also the direction of exceptionally qualified officers seem to have secured for territories only temporarily accessible maps more accurate and reliable than those which we possess for ground inside the border, and which were apparently based upon materials originally collected for revenue purposes. In illustration of this, I would call attention to the almost complete omission in the 1″=2 miles maps showing parts of the Peshawar district (Sheet Nos. 36 and 432) of all those numerous mounds (*dheri*) which form such prominent, and from a military point of view, often important features in the level plain of the valley.

Another serious deficiency in the maps based on the revenue surveys is the want of adequate indications of height. Whereas in the Trans-Frontier portions all passes and many other localities of topographical interest are shown with their approximate heights ascertained by clinometer or other means, such indications of relative heights are almost completely absent within the administrative border (see, *e.g.*, the tract between Pehur on the Indus and Shiva, where the only elevation marked is that of the Punjpir Hill, which happens to have been a Trigonometrical Station). This deficiency is felt all the more, because the system of hill-shading adopted and the imperfect means for its reproduction make it practically impossible to obtain a graphic idea of the configuration of the ground.

5. The technical imperfections in the photo-zincographic process of reproduction of these maps are fully illustrated by the maps just considered. Without going into details of a technical character, with which I can claim only a partial acquaintance, I may point out that maps reproduced in the manner of the "Trans-Frontier Sheets" must suffer from at least two great drawbacks. On the one hand, the photo-zincographic process is too coarse to permit of the insertion of 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, etc. An illustration of these remarks is supplied, *e.g.*, by the very inadequate way in which the steep slopes to the south of 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.

6. It seems to me that it is, indeed, far more the technical deficiencies of reproduction than the want of accurate surveys, which makes all these maps done on the relatively large scale of 1 : 126,720 appear so inferior to the corresponding maps of European Ordnance Surveys as mentioned in the notes of His Excellency the Viceroy.

It is not only to such maps, produced by engraving or photogravure, that our Indian photo-zincographic maps are inferior in the matter of clearness and ampleness of detail. We make the same observation in comparing these sheets with earlier maps of the Survey of India Department produced in England forty or fifty years ago. As an instance, I may quote the very superior topographical survey sheets of the Jhelum and Rawalpindi districts, which were prepared within the first decennium after the occupation of the Punjab, and reproduced by lithography in England. I have had an occasion to use these maps (which are referred to in paragraph 9 of the Committee's Report) on the ground and could not fail to appreciate their superiority in the representation of all natural features. The surveys made recently on the Frontier are probably in their topographical accuracy fully equal to those old maps of a half century ago; but imperfectly reproduced as they are, I doubt greatly whether they will stand the test of practical use in the field with equally good results.

7. These remarks on the system of technical reproduction now followed, apply with even greater force to the Trans-Frontier sheets on the scale of 4 miles to 1 inch. The hill shading seen, *e.g.*, in Sheet No. 3-S. W. (parts of Kashmir, Hazara, Buner, and Dir), fails to convey any picture of the configuration of the mountain ranges and valleys in that area, and owing to the difficulty of reproducing small print by that process, the number of local names shown is restricted to a minimum.

The fact that the defects of these maps are due, not to the want of accurate surveys in the first instance, but mainly to the inadequate method of reproduction, is strikingly illustrated by comparing with them those sheets of the "Indian Atlas" which show identical portions of ground. The "Indian Atlas" sheets are also on the scale of 4 miles to 1 inch, but are printed from engraved plates which were originally produced in London by the firm of the late Mr. John Walker. Unfortunately only the districts of Peshawar and Hazara are completely included among the "Indian Atlas" sheets, and no attempt appears to have as yet been made to supplement the "Indian Atlas" from more recent surveys across the Border.

For purposes of comparison, however, it is sufficient to examine the surveys of Kagan (the northernmost part of Hazara) as represented in the "Indian Atlas" sheet No. 28,

published originally in the year 1867, and the corresponding portion of North-West Trans-Frontier Sheet No. 3-S. W., published by photozincography in 1901. As far as a scrutiny of these maps over portions of the ground permits me to judge, both maps are based on an identical survey. For all purposes, however, whether of practical use or of study, the older map of the "Indian Atlas" seems to me decidedly superior. The trend of all mountain ranges and even of their minor spurs is delineated with clearness, and, as far as I have been able to judge, with considerable accuracy in the engraved map, whereas the "hill-shading" of the photo-zincographic sheet presents, in the copy before me, what is practically an amorphous mass of indistinct hachure, without any relief or indication of slope. In this map it is quite impossible to distinguish narrow defiles of the Kunhar Valley from relatively wide expanses, or to distinguish other important features that might acquire military importance. The same remark as to the relative value of these two maps, applies equally to adjacent parts of Kashmir territory with which I am acquainted.

8. On the ground of these observations, I believe that a great service would be done to the cartography of the Frontier Province, if an early revision of the existing "Indian Atlas" sheets 28, 14 and 4 could be assured, and if the additional sheets 14*a* (Chitral), 5 (Bannu and Waziristan) and 6 (Dera Ismail Khan) could be completed. According to the indication furnished by the index map of the "Indian Atlas," these sheets do not appear to have ever been published completely. Considering that a proper engraved map permits far more of exact detail to be shown than the best photographic map of an equal scale, I believe that the extension of the Indian Atlas to the regions mapped at present in Trans-Frontier sheets would be highly desirable both from the geographical and the military point of view.

I am fully aware the process of engraving is costly, even when modern methods of photogravure, etc., are resorted to, and possibly beyond the resources even of a technically so well equipped and efficient establishment as that of the Survey of India Offices at Calcutta. But I also believe that the correction and keeping up to date of engraved plans, is relatively easy, and this circumstance might help hereafter in keeping at least these maps from becoming obsolete too rapidly.

9. These and other similar points (*e.g.*, the use of distinguishing colours for rivers, hills perpetual snow, etc., as in most modern maps) will, no doubt, be fully considered by the Committee in connection with the second question raised by His Excellency the Viceroy. The important issues involved in the methods of reproduction are then sure to have full light thrown on them by the unsurpassed experience of the Survey of India Department itself. In the meantime, it may, perhaps, not be useless to point out the great extent to which the *practical* utility of the survey results in the frontier region must be affected by the methods adopted for their reproduction and publication.

Opinions of Local Governments regarding the decentralisation schemes put forward by Col. Gore and Lieut.-Col. Longe, Surveyors General of India.

Madras.

Demi-official letter No. 15, dated 16th January 1905.

From—J. N. ATKINSON, Esq., I.C.S., Acting Secretary to the Government of Madras, Revenue Department,

To—The Secretary, Indian Survey Committee.

Referring to your demi-official letter No. 10—2, dated 26th November last, and in continuation of my letter No. 226, dated 5th December 1904, I am directed to say that this Government consider that Lieutenant-Colonel Longe's alternative scheme printed at page 4 of the Surveyor-General's notes seems the more suitable so far as this Presidency is concerned. Under it, there would be a Deputy Surveyor-General at Ootacamund to superintend all surveys conducted by the Survey of India in Madras, Hyderabad, Berar, Mysore and Burma, and there would be Drawing and Map Issue Offices and a training school at Bangalore.

2. The places proposed, *viz.*, Ootacamund and Bangalore, also seem to Government to be suitable. The location of the Provincial Deputy Surveyor-General at Ootacamund would, in the words of the Surveyor-General, "bring the Local Government into closer touch with the Survey of India," while the location of the Drawing and Map Issue Offices at Bangalore, which is a convenient place for the training school also, would facilitate the more expeditious issue of maps, as the materials for compilations of maps already available in the Madras Survey Office would be easily accessible to the Provincial Deputy Surveyor-General. The local Survey Department also—more especially the Photo-zincographic Office attached to it—would have facilities for copying the improved methods of drawing and reproduction adopted in the Survey of India Drawing and Map Issue Offices at Bangalore.

3. A copy of a note (not printed) drawn up by the Local Superintendent of Survey on the suggestion made in the Surveyor-General's printed notes is enclosed.

Central Provinces.

Demi-official letter dated the 8th April 1905.

From—B. ROBERTSON, Esq., C.I.E., I.C.S., Chief Secretary to the Hon'ble the Chief Commissioner of the Central Provinces, Civil Department,

To—The Secretary, Indian Survey Committee.

I am to refer to your demi-official letter No. 10—8, dated the 26th November 1904, on the subject of the decentralisation of the control of the surveys, with which was furnished a note containing two schemes of Colonel Gore and Colonel Longe respectively. I am to say that the Honourable the Chief Commissioner considers that Lieutenant-Colonel Longe's scheme is the preferable one, provided Berar and the Central Provinces are placed together in the same circle. As to the location of Drawing and Map Issue Offices, Sir Frederic Lely is of opinion that Nagpur should be selected rather than Jubbulpore.

Punjab.

Demi-official letter dated the 13th March 1905.

From—The Hon'ble Mr. J. M. DOUIE, I.C.S., Settlement Commissioner, Punjab,

To—The Secretary, Indian Survey Committee.

The Punjab Government asked me to lay the enclosed printed papers before the Survey Committee. Perhaps you had better have them today.

I send four copies.

Letter dated Lahore, January 1905.

From—L. H. LESLIE JONES, Esq., I.C.S., Senior Secretary to the Financial Commissioner, Punjab,

To—A. H. DIACK, Esq., I.C.S., Chief Secretary to Government, Punjab.

With reference to your demi-official letter dated 1st December 1904 on the subject of a demi-official letter No. 10—3, dated 26th November 1904, from the Secretary, Indian Survey Committee, relating to the decentralisation of Map Offices in India, Sir Lewis Tupper desires me to send a copy of Mr. Douie's reply, and say that subject to what is about to be said he agrees generally in his remarks.

As regards the distribution of Provinces, etc., between 4 (not 3) Deputy Surveyors-General, the really important point, so far as the Punjab is concerned, is that we should have an opportunity of personal consultation with the Deputy Surveyor-General, within whose charge the Punjab is included, for some considerable part of the year. This is secured under present circumstances if he summers at Simla.

To his mind, however, Mr. Douie's proposed distribution of work seems a much better one than that suggested at page 4 of the printed papers. No doubt a good deal would depend on the number of parties actually at work from time to time on the several areas, but he supposes in this behalf re-arrangements could be made whenever necessary. Apparently the idea of having one Deputy Surveyor-General for each Presidency has affected Colonel Longe's scheme. The Financial Commissioner thinks such an idea wholly antiquated in the present condition of India. What we have to think of is facilities (1) of travel and post, and (2) of personal communication with local authorities. Accordingly if there are only three territorial

charges, (the 4th Deputy Surveyor-General undertaking the Astronomical and Tidal and similar scientific work), (1) the Peninsular, (2) North-West India, and (3) the rest, seems as good an arrangement as is possible. Punjab.

The Surveyor-General would himself take the North-West Frontier charge and anything outside India.

This is very much what Mr. Douie proposes, but Burma is a difficulty. It might go to the Peninsular charge or the Residuary (Bengal) charge, whichever had the lesser number of parties at the time.

Letter dated Lahore, 13th December 1904.

From—J. M. DOUIE, Esq., I.C.S., Settlement Commissioner, Punjab,

To—L. H. LESLIE JONES, Esq., I.C.S., Senior Secretary to the Financial Commissioner, Punjab.

With reference to your demi-official letter of the 2nd December, I understand that an opinion is required on the two points mentioned in the letter of the Secretary, Indian Survey Committee, to the Chief Secretary to the Punjab Government, *viz.*:—

(*a*) the decentralisation of the control of the surveys; and

(*b*) the establishment of separate Drawing and Map Issue Offices in various centres.

The present organisation of the Survey Department as described on page 2 of the printed notes seems to be a very weak one. I do not suppose there is any other great Indian Department in which so few controlling officers of rank and authority are interposed between the head of the department and the executive officers (in this case the officers in charge of the different working parties). Colonel Longe's scheme, by which there would be four Deputy Surveyors-General, seems to embody the minimum of reform necessary for efficient control. A Provincial Government must desire as much decentralisation as possible, for it is its interest to have as much personal consultation as possible with the Deputy Surveyor-General. No doubt our own ideal would be a Deputy Surveyor-General to control the three parties and the revising unit required for the work of the Punjab and the North-West Frontier Province. But that, I fear, we cannot expect to get. I venture with diffidence to suggest that the charge of the 1st Deputy Surveyor-General, which is to stretch from Peshawar to Shillong and to have its head-quarters at Calcutta, will be an extraordinarily straggling one. Something might be said for the following division of charges:—

(1) North-West Frontier Province, Punjab, United Provinces, Rajputana,—Head-quarters Allahabad.

(2) Bombay including Sind, Hyderabad, Mysore, Madras, with the Baluchistan Agency (unless the Surveyor-General controls the Baluchistan Agency himself),—Head-quarters Poona.

(3) Bengal, Assam, Burma, Central Provinces, Central India Agency,—Head-quarters Calcutta.

The United Provinces Government would be in touch with the Deputy Surveyor-General of the 1st Circle at Allahabad, and the Punjab Government would be in touch with him in Simla.

New Map Offices (page 3 of printed notes) are obviously required in view of the existing congestion in the work of producing maps for publication, and Simla would of course suit us as the locality for the Punjab under present circumstances.

Demi-official dated the 17th March 1905. North-West Frontier Province.

From—T. COPELAND, Esq., M.A., I.C.S., Offg. Assistant Secretary to the Chief Commissioner, North-West Frontier Province,

To—The Secretary, Indian Survey Committee.

I am directed to state in reply to your demi-official No. 10—7, dated the 26th November 1904, that the Chief Commissioner is of opinion that the suggested decentralisation of the control of the surveys would undoubtedly bring the Survey Department into closer touch with Local Governments.

I am to say that the Chief Commissioner approves the proposals of Colonel Gore and Lieutenant-Colonel Longe that the North-West Frontier parties should be directly under the Surveyor-General, and that the North-West Frontier Province Drawing and Map Office should be at Simla.

Demi-official dated the 2nd March 1905. United Provinces.

From—W. H. L. IMPEY, Esq., C.S.I., Chief Secretary to the Government of the United Provinces,

To—The Secretary, Indian Survey Committee.

In reply to your demi-official No. 10—4, dated the 26th November 1904, I am directed to forward for the information of the Committee a copy of notes by the Junior Member of the

United Provinces. Board of Revenue and by the Superintendent of Provincial Surveys and to say that the Government is of opinion that Colonel Longe's scheme is far the better of the two. I am to add that Naini Tal would not be a suitable place for the location of a Drawing Office. Of recent years it has been made the summer head-quarters of many officers who did not reside there before: the place is already overcrowded and no houses are available. Many of the Naini Tal officials go down to Hadwani during the winter to avoid the cold. A site for the location of an office might be obtained at Bhim Tal which is about 8 miles from the Kathgodam Railway station, and has an elevation of about 4,000 feet, or at Dehra Dun.

Note by the Hon'ble Mr. J. Hooper, C.S.I., Junior Member of the Board of Revenue, United Provinces.

The Junior Member is not at present in a position to give more than a general opinion on the scheme for the administration of the Department: but at the same time he is of opinion that there can be little doubt that with the increase of work contemplated it will be necessary to strengthen the administrative and controlling staff, and that a scheme of decentralisation on the lines proposed is desirable. Of the two schemes Mr. Hooper agrees with Captain Coldstream (a copy of whose note is enclosed) in preferring Colonel Longe's. The Punjab, the United Provinces, Bengal and Assam would be more than a sufficient charge for a Deputy Surveyor-General, without the addition of the Central Provinces and Central India.

The Junior Member agrees, for the reasons given by Captain Coldstream, that a special map issue office for these provinces would be desirable. At present there is great delay in publication. As regards the location of the office, if the choice lies between Naini Tal and Mussoorie, the former would be more convenient from an administrative point of view. It should, however, be added that this office is not an administrative necessity, to the cost of which Government should be required to contribute.

Note by Captain W. M. Coldstream, R.E., Superintendent, Provincial Surveys, United Provinces, dated 25th December 1904.

The difference between Colonel Gore's and Colonel Longe's schemes is, as far as these provinces are concerned, confined to the limits of the 1st Deputy Surveyor-General's circle. I much prefer Colonel Longe's scheme because it gives a smaller circle for the Deputy Surveyor-General. Personally I consider the charge will still be too onerous.

There will be extended topographical operations in all four provinces (the United Provinces, Bengal, Punjab and Assam). Officers in charge of parties have not always full information regarding the work of other parties, or even as to the available mapping material at head-quarters and in other offices. The Deputy Surveyor-General must therefore control and co-ordinate the different operations over an immense area arranging for the best use of all available mapping material. This with the administrable control of the large scattered establishments is a very heavy charge.

I should like to see an administrative and inspecting officer for the United Provinces and the Punjab alone, or even for the one province if all survey operations (traverse, revenue and town surveys as well as topographical and mapping) were included in his charge.

2. A special map issue office for the United Provinces is very desirable (please see my reply to question I (3) of the questions on some points on which the Survey Committee require information). A special map reproduction office would enable us to publish our sheets more promptly, its advantages are obvious; I have not sufficient information to discuss its cost and disadvantages.

3. The map issue office could be conveniently placed under the officer in charge of the Drawing Office. This would save supervising staff and also rent or building. Fair maps ought to be drawn in a cool climate. Mapping in the heat of May or June in the plains is difficult to do neatly and cleanly. The ideal location would, I think, be at about 4,000 elevation where neither the cold nor the heat is excessive, but extremes of cold matter much less than extremes of heat. Either Naini Tal or Mussoorie would be suitable for the Drawing and Map Issue Office; as Naini Tal is the seat of Government for half the year, the latter is preferable.

Bengal.

Demi-official No. 491, dated the 24th December 1904.

From—The Hon'ble Mr. A. EARLE, I.C.S., Secretary to the Government of Bengal, Revenue Department,

To—The Secretary, Indian Survey Committee.

I am desired to reply as follows to your demi-official letter No. 10-5, dated the 26th

November 1904, regarding (1) the decentralisation of the control of the surveys, and (2) the establishment of separate Drawing and Map Issue Offices in various centres.

2. The Lieutenant-Governor is of opinion that the proposal to have separate Drawing and Map Issue Offices is sound, and would have the effect of expediting the publication of the standard maps, etc. For Bengal the offices should, as proposed, be located in Calcutta.

3. As regards the proposed decentralisation of the control of the surveys, I am to observe that, as far as this Province is concerned, the main difference between the schemes formulated by Colonel Gore and Colonel Longe is that according to the former the post of Superintendent of Provincial Surveys is retained; while according to the latter that post is abolished altogether and the Bengal Provincial Surveys are brought directly under the Deputy Surveyor-General, 1st Circle.

4. Prior to the passing of the Bengal Tenancy Act, 1885, the surveys conducted in Bengal for Provincial purposes were of little importance; and, with the exception of some minor operations entrusted to non-professional agency, were carried out by the Survey of India Department under the immediate supervision and control of the Deputy Surveyor-General in charge of the Revenue Branch, Survey of India. The authority of the Local Government extended only to intimating what work should be done; and the decision of all further questions rested with the Survey of India Department subject to the control of the Government of India. This dual control over the Provincial settlements by a Provincial and an Imperial agency led to friction; the Local Government finding that, although it was obliged to provide the requisite funds, it was precluded from exercising any sort of authority in regard to expenditure.

5. This question was considered at a Conference held at Delhi in the year 1888; and the system that was eventually adopted upon the basis of the recommendations of that Conference is described in paragraphs 2 and 3 of the letter of the Government of India, Revenue and Agricultural Department, to this Government, No. 342 C.I., dated the 24th March 1890. According to the arrangement then made, the Local Government was given powers to control the budget and to lay down the programme of the Survey parties working in the Province. The work continued, however, to be carried on under the supervision of the Deputy Surveyor-General in charge of the Revenue Branch, Survey of India.

6. On the resumption of the Bihar survey this Government represented that operations were thenceforward to be carried on on an extensive scale; that closer supervision was necessary than was practicable under the system then existing; and that experience had shewn that the Government of Bengal had not in practice had sufficient control over the expenditure on surveys. The Lieutenant-Governor moved the Government of India therefore in Mr. Buckland's letter No. 1 L.R., dated the 2nd January 1892, to appoint a Survey officer who should have charge of all the cadastral surveys in Bengal and work under the administrative control of the Local Government. This proposal was recommended by the Government of India to the Secretary of State in their Despatch No. 26, dated the 10th February 1892, and was approved by that authority in his Despatch No. 23 Revenue, dated the 17th March 1892. The appointment thus created was given to Colonel J. E. Sandeman.

7. In March 1895 Colonel Sandeman was selected to succeed Colonel Strahan as Deputy Surveyor-General in charge of the Revenue Branch, Survey of India; and the Government of India proposed that he should continue to carry on the work of the Director of Bengal Surveys in addition to that of his new appointment. The Bengal Government thereupon suggested that the post of Director of Bengal Surveys should be abolished and that the duties of that appointment should be entrusted to an officer of lower rank to be known as Superintendent of Settlement Surveys. This proposal was sanctioned, and Lieutenant (now Major) R. T. Crichton, then in charge of the Bihar Survey Parties, was appointed to the new post. The Superintendent (now called Superintendent of Provincial Surveys) is directly subordinate to the Board of Revenue, except that in professional matters he is subject to the control of the Deputy Surveyor-General in charge of the Revenue Branch, Survey of India.

8. The table hereto appended shews that survey operations in Bengal are now more extensive than when Colonel Sandeman was in charge as Director of Bengal Surveys; and, as it is proposed gradually to survey and settle the whole Province under Chapter X of the Bengal Tenancy Act, there will be three large survey parties working for many years to come, the annual programme being—

Parties.	Square miles.	Parties.	Square miles.
Traverse survey	1,600	× 3 =	4,800
Cadastral survey and khanapuri . . .	1,600	× 3 =	4,800

Besides these large operations, numerous smaller surveys of Government or private estates will also have to be carried out by detachments. In the circumstances and in view of the past history of surveys in Bengal, His Honour as at present advised is strongly of opinion that the post of Superintendent, Provincial Surveys, should be retained on its present footing.

Item of work.	Actual annual outturn under the Director of Bengal Surveys.				Programme.	
	1891-92.*	1892-93.*	1893-94.*	1894-95.*	1895-96.*	1896-97.*
1	2	3	4	5	6	7
	Sq. m.	Sq. m.	Sq. m.	Sq, m.	Sq. m.	Sq. m.
Traverse survey . .	4,712	5,253	3.485	3,091	6,684	5,246
Topographical ,, . .	900	...	...	1,026	1,559	240
Skeleton boundary ,, . .	187	1,247	175	23	...	...
Cadastral ,, . .	2,290	3,090	3,754	2,786	4,191	5,006
Initial record-writing . .	1,452	2,912	3,622	3,120	4,430	5,006

* Survey year.

Opinions of Heads of European Schools on the rules for admission to the Provincial Service.

Questions issued by the Director of Public Instruction, Bengal.

1. Whether, if the number of openings in the Survey Department were increased temporarily, say 20 or more posts filled up annually in place of about 10, as at present, there is likely to be any difficulty in securing the necessary number of men without lowering of existing standards of qualification.

2. Whether you have any suggestion to make about the method of recruitment or examination.

The Revd. Father Meunier, S.J., Rector, St. Joseph's College, North Point, Darjeeling. Letter dated 22nd January 1905.

Q. 1.—I am of opinion that if the number of openings in the Survey Department were increased temporarily, say 20 or more posts filled up annually in place of about 10, as at present, there is likely to be no difficulty in securing the necessary number of men without lowering the existing standards of qualification, provided the objection noted under question 2 be removed.

Q. 2.—The method of examination seems to be good and well adapted to the recruitment of the Department. But the method of recruitment seems to be capable of improvement. Allow me to explain my mind.

The "memorandum of instructions" issued to candidates for the Provincial service of the Survey of India contains the following rule (the IVth): "The most suitable of the candidates who qualify will be selected." This rule is very wise as it stands; but there is an impression abroad that it is not fairly carried out and that among the candidates who obtain qualifying marks at the examination, those are preferred who have family or friendly influence within the Department. Whether this impression is based on facts or not, I am unable to say, but such as it is it places a check on the aspirations of otherwise desirable young men who think they do not possess the said influence.

I would suggest that the examination be made strictly competitive, *viz.*, that the applicants whose certificates, previously furnished, have established their suitability for employment be taken in order of merit according to the number of vacancies offered. The Department is always free to test the successful candidates individually during their subsequent period of probation.

Mr. W. H. Arden Wood, Principal, La Martinière College, Calcutta. Letter dated 23rd January 1905.

Q. 1.—The information desired would, I think, be best obtained by ascertaining whether the number of candidates who now qualify in the competitive examination for admission to the Survey Department, but fail to get in for want of a sufficient number of vacancies, is large enough to provide men for double the number of vacancies.

Q. 2.—Candidates for the Survey Department must be between 18 and 22 years of age. Boys who go through the full school course in a school like La Martinière leave at about 18, and unless they are quite exceptional boys they would probably have little chance of success at once in a competitive examination open to young men up to 22 years of age.

Again, as the examination is held in Mathematics and Drawing only, the tendency is for boys going in for the Survey Department to make a special study of these subjects after they have completed the ordinary School course. Now the great difficulty we have is to get boys to stay on to do this, for if their abilities are such as to make it likely that they would have a chance of being successful in the Survey examination, it is not difficult for them to get work of a tolerably remunerative kind at once.

I think that the Survey Department would attract more boys from *European* Schools—

(i) if the competitive examination for admission to the Department were restricted to boys under the age of 20, and

(ii) if the examination were extended so as to include subjects which might form part of the ordinary school course on a modern or science side.

It would then be more in touch with the school course, and boys who had the Survey Department in view would not be tempted to drop parts of their work, valuable in regard to their general education, in order to prepare themselves for a competitive examination in, as now, Mathematics and Drawing only. For example, in this school, the boys who in the last two years of the school course are preparing for the Cambridge University Senior Local Examination, could take up, in addition to English, Mathematics, and Drawing, Physical Geography, which includes a knowledge of the construction and use of maps, and Mensuration and Surveying. It cannot be doubted that a candidate who had at school gone through such a scientific course in Physical Geography, as is required for the Cambridge Senior examination, would be likely to do purely technical work in the Survey Department more intelligently.

I enclose the schedule* for Physical Geography for the Cambridge Senior Local examination which will show the nature of the course both theoretical and practical, and also a copy of the last papers* in Physical Geography and in Mensuration and Surveying.

* Not reprinted.

I have seen a note by the Surveyor-General commenting upon the low standard in Geometrical Drawing reached by candidates in the recent examinations held for admission to the Department, and prescribing as a remedy the XIth Book of Euclid. In the interests of education and of the Survey Department I would suggest that the mathematical part of the examination should be brought into line with modern educational opinion by being remodelled in accordance with the suggestions of a Committee of the Mathematical Association contained

Rules for admission to the Provincial Service.

in a report published by George Bell & Son. These suggestions have been acted upon by most of the examining bodies in England.

I enclose a syllabus* showing the new course in Geometry prescribed for the Senior Cambridge Local examination, in which, it will be observed, the adequate treatment of Geometrical Drawing is provided for. I may add that the standard of the papers set in Algebra and Trigonometry in the examination for the Survey Department is much the same, judging from the papers, as that in the Cambridge Senior Local examination, though there are differences in the character of the questions set.

* Not reprinted.

Mr. W. W. Hornell, B.A. (Oxon.), Inspector of European Schools, Bengal. Letter dated 23rd January 1905.

Q. 1.—From my experience of European Schools in Bengal, I should be inclined to say that the annual number sufficiently educated to be able to profit by such a course of study as that, through which they are, I imagine, taken at Dehra Dun was owing to defective teaching—especially mathematical teaching,—for the present a small one. There are, however, schools in the province, notably St. Paul's School, Darjeeling, and La Martinière College, Calcutta, where masters, who have some knowledge of mathematics, are employed, and a general bracing up of schools may at least be hoped for in a not very distant future. For the present I would suggest that this question could best be answered, by the examiners, who have lately conducted the entrance examination into the training school at Dehra Dun.

Q. 2.—In answering the second question I am at some difficulty owing to my not being able to procure the examination regulations. While acting as Secretary to the Committee of Directors of Public Instruction I went into the whole question of the admission of Indian born "Europeans" into Government service and to the best of my recollection the rules for the admission into the Survey Training School are as follows:—

(i) that no boy can enter for the examination who has not passed the High School examination, Algebra being one of the subjects, in which he has satisfied the Examiner;

(ii) that the age of admission to the examination is from 19 to 22;

(iii) that the examination consists of papers in English, Mathematics, Map and Geometrical Drawing with some optional subjects.

On the assumption that this represents generally the facts of the case, I beg to suggest—

(*a*) that no candidate who is over 20 should be admitted to the examination;

(*b*) that in the examination technical subjects such, for example, as Survey-Map Drawing should be avoided and that the examination should be as far as possible confined to such subjects that intelligent boys from sufficient secondary schools should be able to answer them, without having received any training in work definitely preparatory to surveying. Such preparation should not begin at school, and the entrance examination for the Survey Training School should in my opinion aim at nothing further than testing a boy's general education, in which in the case of a boy preparing to be a surveyor, Mathematics and Drawing should play a considerable part.

As regards suggestion (*a*), the age should, I think, be 20, because very few boys can afford to spend more than about 18 months after the school final examination, preparing for 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. The intelligent boy is probably at his best after the school final examination.

Revd. E.A. Newton, Rector, St. Paul's School, Darjeeling. Letter dated 2nd February 1905.

Q. 1.—I am of opinion, judging from the number of candidates who entered for the Survey examination on the last occasion on which we sent up boys from here, that it would be quite easy to increase the openings without lowering the standard of admission to that Department.

Q. 2.—With regard to the method of recruitment, I should like the department to give a certain fixed number of nominations annually to certain recognised schools, and to inform the head masters of such schools as to what preliminary training they would like their recruits to receive for a year or two prior to their admission into the department.

I should like to suggest that some definite certificate, such as the Senior Cambridge Local certificate, or its equivalents, be required as a preliminary to nomination. A further year's training, on lines suggested by the department, might then be required in all cases. As it is not always easy for European schools to make adequate arrangements for the teaching of geometrical drawing, perhaps the department could undertake to provide for any deficiency in this respect after the admission of the candidates.

Mr. T. G. Sykes, Principal, La Martinière College, Lucknow. Letter dated 21st January 1905.

As the Survey Committee seems to be willing to consider suggestions regarding the mode of admission into the Provincial Branch of the Survey of India, and the Lucknow Martinière occasionally sends in boys for the examination for admission to that service, I should like to be allowed to lay my views before your Committee—and to point out with proper deference that there are in my opinion one or two points in which the present Entrance Examination regulations are open to modification.

Rules for admission to the Provincial Service.

I believe that if the alterations which I am about to suggest were made, the result would prove advantageous to the fairly educated young men of this country and to the Provincial Branch of the Survey of India, inasmuch as the manner of recruitment would be made more attractive than it is at present, and larger numbers of well qualified candidates would present themselves. In fact, I believe, there would be no difficulty in getting at least a score of good men annually. It will be observed that my proposals, if accepted, would not have the effect of lowering, but on the contrary would raise, the standard of qualification for admission.

I.—Of the regulations, as present in force, the clause most open to objection is the one given in the last sentence of No. 4 of the "Memorandum of Instructions for applicants":—"The most suitable of the candidates who qualify will be selected." This clause destroys the confidence of the public and of teachers and candidates in the examination and its results, and prevents the better class of candidates from presenting themselves. They are under the impression, whether mistakenly or not, the Survey Committee may probably be able to determine that extraneous considerations may be allowed to influence the selection. My own opinion is that the question of suitability or non-suitability should be determined in the preliminary enquiry, that is to say, before the applicants are accepted as candidates and allowed to sit at the examination; only those candidates who are *primâ facie* admittedly suitable should be allowed to enter for the competition. After the candidates have once been accepted and allowed to appear, the appointments available should be given to them according to their order of merit in the result of the examination and not by any other process of selection. Clause 1 of the "Memorandum of Instructions" calls for full information regarding a candidate's age, character, health, eyesight; such certificates "as will clearly establish his suitability;" so the regulation itself expresses it.

After this suitability is established there should be no further picking and choosing; the examination should determine the rest. Make the preliminary restrictions and limitations for admission to the examination as close and stringent as you like; and having done so, accept the award of the examiners.

The present regulations leave it open to the authorities to reject the highest on the list, though their Descriptive Rolls have already been accepted as clearly establishing their suitability, and to accept others lower down on the same examination list, whom they have beaten, it may be, both in school and in the crucial test of competition. This does not seem right.

After the preliminary differentiation has taken place, those who have been admitted to competition and have proved themselves the best are entitled to have the rewards they have fairly competed for and won.

On these grounds I venture to advocate the removal of the last clause of No. 4 from the "Memorandum of Instructions" and the substitution for it of something like the following:—"The examination shall be competitive. Those who stand highest on the list of passed candidates will be selected in order of merit to fill existing vacancies."

II.—I have always been in favour of extending the area of competition for admission to the Roorkee Engineer Class (Provincial) by rescinding the "Statutory Native of India" clause in section 1 of the Roorkee "Rules of admission." I am equally in favour of rescinding the "Statutory Native" restriction contained in No. 2 of the "Memorandum of Instructions" of the Provincial Survey Regulations. The removal of this limitation would have the twofold advantage of increasing the area of selection and improving the quality of the candidates. Many of the non-domiciled Europeans in India are as much in need of assistance and as deserving of it as their domiciled friends. Some of our most promising boys leave school before the proper time because they are prevented from entering certain of the Indian Provincial Branches of Service owing to this question of domicile; for instance, one boy left solely on this ground last month: and the enclosed letter* shews that another boy will soon be removed for the same reason.

* [Extract.]

"24th December 1904.

Dear Sir,

When I sent my son to school I did so in the hope and with the intention of finally sending him to Roorkee, but I now learn that he cannot go there as he was not born in India; nor am I domiciled. I shall be much obliged by your letting me know if this is so. If it is, there will not be much use in keeping him in school much longer, as the career I had mapped out for him will be spoilt."

III.—It would be a great improvement if the Roorkee Engineer Entrance Examination (Provincial) were made the test for admission to the Provincial Service for the Survey of India. As will be seen from the accompanying published documents, this examination has in the past frequently been the prescribed competitive test for the Superior Accounts Department, Assistant Engineer Grade, and for the Superior Traffic Department of the State Railways. These last named Departments are allied in a kind of way, and the Provincial Survey Department is just as closely allied, to the Provincial Engineer Department. The examination conducted by the Roorkee authorities is one of the best examinations in India and has the perfect confidence of the general public and of the schools. The standard of this Roorkee Engineer Entrance Examination is considerably higher than that of the Provincial Survey Entrance Examination; but if the former were made the prescribed test for admission to the Provincial Survey Department, I am convinced that the higher standard which would be exacted would not cause a reduction in the number of candidates, but on the contrary would bring forward better men and as many of them as might be required.

Rules for admission to the Provincial Service.

The utilization of a single examination for a double purpose is no new thing. It is merely a new application of an arrangement which, as we have shewn, has frequently been made use of in connection with the Roorkee Examination itself, making it the simultaneous test for Engineering, Accounts, and Traffic; distinct and separate departments. A similar arrangement is annually made use of in the English Universities in conducting their Open Scholarship Examinations, two or three Colleges combining; for instance, Worcester, B. N. C., and New College setting papers in common; Balliol, Christ Church, and Queens doing the same.

In the Open Competition of the Civil Service Commission we find the same arrangement adopted, the same papers being given to candidates for—

(*i*) The Civil Service of India;

(*ii*) English Clerkships, Class I ... Admiralty, Board of Trade, India Office, War Office.

(*iii*) Eastern Cadetships in the Colonial Service. Malay Peninsula, Ceylon, Straits Settlements, Hong Kong Cadetships.

As in the above combined test the letters I, H, C, are added to the names of the candidates to indicate the service (India, Home, Colonial) for which they offer themselves; so, under the arrangement now proposed for consideration, E would be taken to mean an Engineer candidate; S a Survey candidate; ES a candidate who would prefer an Engineering appointment, but, if he could not get one, would be glad to accept an appointment in the Provincial Survey Department; SE in the same way would of course mean "Survey for choice." The published examination results would determine what each of the successful candidates would get.

The subjects of the present curriculum of the Entrance Examination for the Provincial Survey Department are given as follows in the "Memorandum of Instructions for applicants." The Roorkee Engineer Entrance Examination subjects for the June 1906 examination are given side by side for comparison:—

PROVINCIAL SURVEY.	ROORKEE PROVINCIAL ENGINEER.
Two subjects only, *viz.*,—	Six Subjects.
MATHEMATICS.	MATHEMATICS.
ALGEBRA up to and including the Binomial Theorem.	ARITHMETIC (The whole).
GEOMETRY Books I-IV and VI with problems.	ALGEBRA to Binomial Theorem and beyond it.
PLANE TRIGONOMETRY, MENSURATION and LOGARITHMS.	GEOMETRY, Books I-IV, VI, and XI, with riders.
	TRIGONOMETRY, MENSURATION & LOGARITHMS.
DRAWING.	DRAWING.
Freehand from Copies.	*Freehand.*
Map Drawing.	*Model.*
Geometrical.	*Geometrical.* [And four more subjects—see next paragraph but one.]

A comparison of the papers in the above subjects given at the two examinations will shew that the Roorkee Examination is of a Higher Standard than the other, and that Mathematics and Drawing are both compulsory subjects in the Roorkee Examination: in other words a candidate must make at least half the maximum of marks in each of these subjects, otherwise he fails to pass, whatever his aggregate of marks for the whole examination may be. It will further be observed that the Provincial Survey Entrance Examination takes up only two subjects, Mathematics and Drawing.

In addition to these two subjects, the Roorkee Engineer Entrance Examination takes up English Composition, Urdu, Science (Physics and Chemistry), History, and the so-called "Special Subject No. 6," namely, a second language, or Mechanics, or a further course of Science. Most of the above subjects would be found as useful for a Surveyor as for an Engineer.

The only item in the present Survey Entrance Examination Course which is not in the Roorkee Engineer Entrance Examination Course is "Map drawing," which is sometimes called "topographical drawing." To provide for this I would suggest that it should take the place and marks now assigned to History. Map drawing would be a more useful subject than History either for an Engineer or a Surveyor; and moreover History has already been taken up by the candidates in the preliminary qualifying test which every candidate must have passed before he can be allowed to sit at the Roorkee Engineer Entrance Examination.

(See the Engineer Regulation No. 8, page 36, Roorkee Calendar, 1904.)

One of my reasons for making the suggestion contained in III above is that more candidates pass the Roorkee Engineer Examination than can be admitted into the Roorkee College. One of the foot-notes on the last published list, dated Roorkee, 15th July 1904, says;—"The first 20 passed candidates can be admitted."

Rules for admission to the Provincial Service.

Now numbers 27, 29, 31 on the list of passed candidates are Martinière boys. They passed the examination not only as a whole making 414, 410, 382 marks respectively out of a maximum of 750; but they passed in the "Provincial Survey Examination" Subjects, Drawing and Mathematics, their marks in the former being 74, 92, 82 per cent.; and in the latter 55, 57, 51 per cent. Some of the best candidates enter for the Roorkee Examination in the hope of passing high enough to take Government and Martinière scholarships to enable them to bear the expense of going through the three years' course of training in the Roorkee College. To gain any of these scholarships a candidate must not be lower than fifth on the published list. Sometimes these candidates pass well, but not quite sufficiently high to take a scholarship, consequently they have not been able to join the Engineer Class at Roorkee. Others many places below them have gone in, as they have been able to meet the expense. Really good men are occasionally stranded for this and similar reasons. They generally manage to get work of some kind, but not so good or lucrative as they would get in the Survey Department; on the other hand, the Survey Department accepts men not so well qualified as those to whom I have referred. These are some of my reasons for saying that if the proposal made in III above be accepted, I feel sure the result will be satisfactory in proving beneficial not only to the class of young men referred to, but also to the Provincial Survey Department.

The above proposals look forward to the Roorkee Engineer Examination of June 1906; but I do not see why a beginning should not be made with the examination of June 1905. Of course, the regulations for the next June examination cannot now be altered; but if it were announced that candidates who passed that examination might be admitted to the Survey Department on probation for three months, the confirmation of the appointment being made to depend on the candidates passing the required test in Map drawing at the end of the three months, I think there would probably be a dozen eligible candidates even at this first and tentative examination, though the notice admitting candidates to the examination would necessarily be very short. This would give the Survey Committee an opportunity of judging of the proposal as it stands.

Memorandum by Mr. J. Eccles, Superintendent, 2nd grade, In charge, Computing Party, Trigonometrical Branch Office, dated 21st February 1905.

In the last examination some 35 candidates passed in mathematics and a considerable proportion of this number in Geometrical drawing also. Of this number 17 were examined in Calcutta, and we may presume that a large number of these were natives. Allowing for this, it will be moderately near the truth to say that 20* candidates passed, so that the supply would seem to be equal to the demand.

* Only nine Europeans.

The only reason that I can think of against reducing the age to 20 is that the men will be much more likely to contract diseases when sent so young to unhealthy climates. This could be counteracted by giving a further year's training or service in some healthy district.

I do not agree with Mr. Wood about increasing the range of the present examination; if considered advisable, by all means make the passing of the Cambridge Senior examination compulsory. I doubt, however, whether this would meet the views of other schools, such as the Mussoorie ones, whence most of our assistants have come in times past. Mr. Wood's notion seems to make our examination suit his school curriculum and not the reverse. His remark that the Surveyor General prescribed the XIth Book of Euclid as a remedy for bad Geometrical drawing must have been made under a misapprehension. I asked the Surveyor General to enquire if Book XI could be taught in the school, as such a course would facilitate the teaching of Spherical Trigonometry to the successful candidates.

I think it would be a great pity to remove Geometrical Drawing from the list of subjects examined in, as it is a subject which teaches two of the things required in a good surveyor: "accuracy" and "neatness."

Memorandum by Lt.-Col. S. C. Burrard, F.R.S., R.E., Superintendent, Trigonometrical Survey, dated 21st February 1905.

I attach Mr. Eccles's opinion: he has conducted the examination for many years.

(1) I think that we could secure 20 qualified candidates annually without lowering the standard of qualification.

(2) I think that the age might be advantageously lowered to 20. But from my experience of young officers here, I agree with Mr. Eccles that we should have to be careful about their health in camp. The youths who join us now are far from robust.

(3) Formerly we used to examine in English: now we accept a High School Certificate. In my opinion this has resulted in a decline in our standard. For example, I asked a European officer "where is Mr. Hughes?" He replied "I seen him over there just now." He always used this form of speech, *e.g.*, "I done my work before it rained." "I broken my pencil." Speaking generally, the candidates we get now are superior in mathematics and ability to the Provincial officers of 20 years ago: but they are inferior in English and in letter-writing. In some ways this is serious, because they can learn mathematics in the Department, but I doubt if they will ever learn English.

(4) I think that the sentence "the most suitable who qualify will be selected" might be changed. It seems to give rise to misconceptions. To the best of my belief the appointment of Europeans is regulated by competition: in the case of natives a certain amount of selection is necessary, as we want our native officers drawn from different provinces and races and not for one.

Rules for admission to the Provincial Service.

(5) At present there are two examinations, one conducted in English and Algebra *outside* the Department, the other in mathematics and drawing conducted *by* the Department. The school masters that have been consulted are not in agreement in their recommendations: and if we consulted other schools we should probably find other disagreements. We cannot therefore accept the Rector of St. Paul's proposal, and give nominations until definite proposals have been formulated by the educational authorities or by a Head Master's Conference; we cannot dispense with the Departmental examination, until the tests applied by schools are definite and reliable.

(6) I see no objection to abolishing Map-drawing as a subject of examination, if we retain other forms of drawing. I do not know why Mr. Arden Wood objects to our geometrical drawing. It is a subject that ensures neatness and accuracy, and these are valuable qualifications for a surveyor. I agree with him that Physical Geography and Mensuration would be good additional subjects, but we do not want to overburden our candidates. Other schools, too, might object to these subjects being included.

(7) We want candidates who have been educated in mathematics and drawing and English: we institute our Departmental examination because we know of no other way of testing our candidates. I am rather inclined to agree with Mr. W. W. Hornell's paragraph 2 (*iii*) (*b*), but the proposal there made hardly differs from the actual present practice.

An Account of the Scientific work of the Survey of India, and a comparison of its progress with that of Foreign Surveys, prepared for the use of the Survey Committee, 1905.

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An Account of the Scientific work of the Survey of India, and a comparison of its progress with that of Foreign Surveys, prepared for the use of the Survey Committee, 1905.

By Lieut.-Colonel S. G. Burrard, R.E., F.R.S.,
Superintendent of Trigonometrical Surveys.

The scientific work of the Survey of India consists of—

Principal Triangulation.	Tidal Operations.
Levelling Operations.	Magnetic Survey.
Astronomical Operations.	Solar Photography.
Pendulum Operations.	

2. I beg that I may show in a few brief notes the uses and aims of the scientific work of the survey, but before doing so I wish to premise that no distinction can properly be drawn between scientific and practical work. Many operations conducted on scientific principles have immediate practical uses: they may in fact be likened to the exploitation of visible outcrops of coal. Others are more experimental, and may be likened to borings for invisible coal, believed to exist at certain depths. Others again are speculative, and may be likened to deeper borings, made to ascertain the strata in the crust, with the hope that something valuable, perhaps coal or iron or gold, may turn up. But whether such operations are practical or experimental or speculative, they all have the same twofold purpose, *viz.*, the acquisition of information and the rendering of that information useful. Almost all the scientific operations of the Survey of India will be found to fall into the first category and to possess immediate practical uses.

3. Before I enter into the details of the different scientific operations of the Survey of India, I may perhaps be allowed to refer briefly to the general question of the connection between science and surveys in modern times.

The primary object of a national survey is the making of maps, and all operations are subordinated to that end. It is for topographical purposes that a national survey measures its allotted portion of the Earth's surface. If, however, these measurements be subsequently combined with astronomical determinations, the size and shape of the Earth can be deduced, and a knowledge of this size and shape is essential to astronomers, geographers, geologists and meteorologists, all of whom look to surveys for information.

The great accuracy of modern astronomical observations for stellar and lunar parallax, and the difficulty which mathematicians still experience in predicting exactly the places of the moon and the planets, are constantly necessitating more refined determinations of the figure of the Earth, and astronomy is continually bringing pressure to bear upon surveys to lend her their aid,—for her celestial measurements must always emanate from a terrestrial base.

Man's first conception of the Earth's figure was a plane: Greek philosophers thought it a sphere: Sir Isaac Newton showed that it must be a spheroid. Colonel Clarke, of the Ordnance Survey, contended that it was a triaxial ellipsoid. Modern Geodesy, after encountering great difficulties in testing in the field the theories of Newton and Clarke, has pronounced it a geoid. Astronomy now wishes us to tell her the dimensions of this geoid, and its departures from a spheroid.*

4. In the days of Everest the figure of the Earth was deduced from linear measurements, and the Great Arc of India was the only series of triangulation in India originally designed for a figural determination: all our other triangulation was intended and executed for the purpose of controlling topography. In 1858 Colonel Clarke showed that the figure and dimensions of the Earth could be better deduced from measured areas than from measured arcs, and the whole triangulation of India became at once available for the discussion, provided it were subjected to astronomical tests.

A small portion only, however, of the Earth's surface has so far been surveyed; and our present idea of the dimensions of our planet has been derived from wide generalisations. The total area of land and sea amounts to nearly 200 millions of square miles: the areas that have been surveyed do not aggregate 6 millions of square miles.

5. The determination of the figure, and of the dimensions and of the specific gravity of the geoid is now in the hands of an International Geodetic Association, at whose conferences Professor George Darwin, F.R.S., represents Great Britain: India's co-operation is the more valued by the association, because she alone of the civilized nations possesses an equatorial area, and because she includes within her dominions the highest points of the Earth's surface.

The amount of money spent annually by Europe and America on astronomical observations runs into many millions sterling: humanity is striving to discover new facts concerning the myriads of distant bodies moving in space. As her developement progresses, she grows ever more desirous too of investigating the one celestial body, which she can touch, and on which she finds herself travelling amongst the stars.

* The geoid is the figure enclosed by the surface of the sea: this surface is that of a spheroid disfigured by protuberances and hollows.

Scientific work of the Survey of India.

The difficulties, however, of studying even our own Earth are great, because we are tied to its surface: our meteorologists cannot ascend into the atmosphere, our geologists cannot penetrate into the interior. We have learnt that the globe of rock, which constitutes our interplanetary home, is the source of two great forces, gravity and magnetism, and a knowledge of the actions of these forces has become of importance to almost every branch of science. Their actions we have discovered are strangely dissimilar, and vary both with time and place.

The civilized nations are now making gravimetric and magnetic surveys of the Earth, and are measuring the intensities, the directions and the pulsations of the terrestrial forces. India has been asked to bear her share, and to carry these operations over her own fraction of land-surface.

II.—The Principal Triangulation of India.

(*a*) *Its Accuracy.*

6. The Principal Triangulation of India has been repeatedly attacked on the grounds that it is too accurate and too scientific for practical purposes. In 1800, in 1824, in 1850 and in 1886 attacks were made, but the Government after enquiry ordered its continuance. The present seems a good opportunity to take stock, to see what the triangulation has done for us and what it has cost us, and to consider by the light of modern requirements its accuracy and its errors.

7. The operations of a survey may be conveniently divided into (1) the controlling framework, (2) the artistic superstructure. In discussing errors and accuracy it is advisable to keep these two divisions distinct, for whilst the controlling framework has to be guarded against cumulative errors, the artistic superstructure is only liable to accidental or local errors. The framework is constructed as follows:—

Foundation	Principal Triangulation.
Plinth	Secondary Triangulation.
Walls	Tertiary Triangulation and Traversing.

Points fixed by tertiary triangulation or traverse should be sufficiently numerous to save the topographer from cumulative errors. Tertiary triangulation and traverses themselves are liable only to accumulate errors over the short distances between secondary stations. In secondary triangulation the accumulation of error is confined to the distance which separates stations of the Principal Triangulation. In all survey operations therefore *after* the Principal Triangulation the accumulation of error is arrested: but what arrests the accumulation of error in the Principal Triangulation itself? The answer is that observations of a Principal Triangulation must be sufficiently accurate in themselves to avoid *embarrassing accumulations of error.*

8. We have been accustomed to state the error of triangulation in so many inches or so many feet per mile, and this custom has led laymen to believe that the errors of principal triangulation are dispersed throughout its length. But the statement that an error has been found of 1 foot in a mile, is merely made to enable the merit of the triangulation to be gauged: in a length of 500 miles an error generated of a foot a mile is not dispersed, but is accumulated at the terminal. It follows therefore that the *requisite* precision of a Principal Triangulation must vary with the *distance* to be triangulated.*

The following table shows the relative degrees of accuracy in the triangulations of different countries: the precision and length of the triangulation of Great Britain have been taken as the units:—

Country.	Precision of triangulation.†	Length of triangulation.	Ratio of precision to length.
Russia	2·0	3·3	0·6
India	2·2	3·0	0·7
Great Britain	1·0	1·0	1·0
Austria	2·0	1·4	1·4
Italy	2·0	1·25	1·6
Spain	2·2	1·2	1·8
France (modern)	3·0	1·2	2·5
Prussia (modern)	3·6	1·4	2·6

* The *weight* of triangulation varies inversely with its distance. The error of mean square increases with $\sqrt{}$distance, but in practice the terminal accumulation over a great length appears to be generally more due to systematic than accidental errors.

† General Ferrero's report to the International Conference at Stuttgart in 1898.

Scientific work of the Survey of India.

The triangulations of South Africa and the United States are equal in precision to those of France and Prussia.

9. So long as a country is isolated, its survey will not concern itself with errors accumulated at its frontiers: a country like Prussia whose triangulation meets other triangulations on all sides has experienced troubles that India has never felt. But India is losing her insularity, and though the loss may be slow, it is certain. Fifteen years ago the Indian frontier topographers began to experience embarrassments, because the longitudes of Indian mapping were 2½ miles in error. It was futile to tell them, that an error of 2½ miles in 6,000 miles was a small matter; the error was not dispersed over the 6,000 miles between Greenwich and India: it came in between our Indian and Afghan topography. The frontier surveyors suggested that each meridian should be drawn in two places on all Indian maps, and they subsequently proposed to project transfrontier maps in terms of Europe instead of in terms of India, thus transferring the 2½-mile gap from their front to their rear. It was the topographical surveyor and not the scientific branch, that was experiencing the trouble. The incident teaches that an error of 2½ miles may remain unnoticed during a century of insularity, but that at the first appearance of a small scale transfrontier survey it begins to cause embarrassment.

The accuracy of European surveys gradually increased throughout the nineteenth century, and the difficulties of adjusting the discrepancies between contiguous triangulations became ever correspondingly greater. Eventually it was agreed to create a permanent court of arbitration, and the International Geodetic Association, to which all civilised nations now belong, was called into being.

(b) Its errors.

10. The triangulation of India has been controlled by Base Lines: its errors of length do not therefore need consideration.* But Base Lines exercise no control on direction, and if our astronomical results are to be believed, the triangulation has exhibited a constant tendency to deviate from the true course. Between Karachi and Calcutta an error in azimuth of 11″ has been generated, and this has increased to 15″ at Mandalay: our trigonometrical points in Eastern Burma have consequently been all displaced some 400 feet too far south. Between Cape Comorin and Peshawar an azimuthal error of 12″ has been generated, and the relative orientation of these two places is 200 feet in error in consequence.

But the chief errors in the framework of Indian mapping are due not to faults in its construction, but to its location on the globe. Owing to errors in the original observations of longitude the Indian area has been placed on the globe 2½ miles too far East: owing to obstacles placed by nature in the way of correct determinations of latitude in Central India, the Indian area has been located some 600 feet too far north on the globe.

11. Owing mainly to the deformation of the geoid in India, Everest's Figure of the Earth, on which all our calculations of latitudes and longitudes are based, has been given a diameter too small by 2 miles; the result is that our maps, though correct in their detail, have all been given too large a share of the Earth's surface: our distance from Peshawar to Cape Comorin has been accurately measured, but we have given it in our maps 11 seconds more of latitude than it has a right to: our distance from Karachi to Mandalay has been made to embrace 17 seconds more of longitude than it is entitled to. At present we have no neighbours complaining of these overlaps, and the time has not come for us to trouble about them: it would in fact be premature for us to adopt a new figure, when great Earth measurements are now in progress in Africa and America, and it would be premature for us to attempt a new location of India on that figure, until our pendulum and astronomical work has been extended.

12. If we sum up the errors in position accumulated on our frontiers, they are as follows:—

Peshawar has been placed too far north in latitude by 400 feet owing to figural errors and by 600 feet more owing to errors of location on the globe: it is thus shown on our maps 1,000 feet too far north. Peshawar is, moreover, shown 2½ miles too far east of Greenwich.

The Salween has been placed in longitude 1,100 feet too far east owing to figural errors, and 2½ miles too far east owing to errors of initial longitude: it is thus shown on our maps 2¾ miles too far east. The Salween is shown some 300 feet too far north, the effects of the initial latitudinal error and of the accumulated azimuthal error being opposite in East Burma.

13. It is difficult to define numerically the meaning of an "embarrassing accumulation of error," because as a survey matures it begins to feel the pinch of errors, which it failed to notice in its youth. Any accumulation of error is embarrassing that obliges surveyors to recalculate their data. Changes in data due to revisions of computations, even when such revisions are based upon important new observations, cause great inconvenience, and decrease the value of the data for co-ordination purposes.

In dealing with problems connected with the determination of the figure of the Earth no inconvenience arises from using revised data, and it is relatively to easy to make revisions, as comparatively few points are concerned.

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* In the 747 miles separating Karachi and Attock the error in length accumulated in the triangulation and eliminated by the measurement of the Attock Base-line was 99 feet.

When triangulation is being used for controlling maps and co-ordinating surveys, the aim of adjustment is to avoid purely local distortions; but when it is being employed to investigate the form of the geoid, it is of importance only to have correct relations between very distant points. In discussing then the meaning of "embarrassing accumulations of error," we have only to consider the geographic purposes of triangulation, and we can dismiss from our minds the geodetic.

14. There is no doubt that the error of 2½ miles in longitude has already become embarrassing to India: our $\frac{1}{1,000,000}$ maps have different longitudes to our 1-mile maps, and our 4-mile maps have longitudes differing from the other two, and these discrepancies must be inconvenient to the great body of map-users, who are not in the secret of the longitude footnotes. The longitude error is in fact so large that it will probably in the future necessitate a revision of data: and if such a revision comes to be carried out, the opportunity will doubtless be taken to eliminate also our figural and latitudinal and azimuthal errors.

As to the error of 1,000 feet in the latitude of the triangulation at Peshawar, this accumulation causes at present no inconvenience: but if our triangulation ever comes to be connected with Russia's, the overlap in latitude will amount to half a mile or more, because Russia is projecting her triangulation on too small a spheroid, just as we are doing. The two surveys will then have different values of latitude for every boundary pillar; it is impossible to foresee now what course they will agree to take: but if we may judge from examples in Europe, they will refer to the International Association, and they will perhaps be advised to correct their data.

(*c*) *Its cost.*

15. In a Parliamentary paper published in 1851, Sir A. Waugh estimated the cost of the Principal Triangulation at Rupees 7-2-5 per square mile. If the same work were to be executed now, it would probably cost double. Since the estimate was prepared, triangulation has been carried over Rajputana, Sind and the Punjab at a cost averaging 15 rupees per square mile. The average original cost of the whole Principal Triangulation of India may be estimated to have been about 9 rupees per square mile. This cost applies to the area actually triangulated, and not to the total area controlled.

16. In 1798 Colonel Lambton started working on the network system, but in 1824 Colonel Blacker and Colonel Everest substituted the gridiron system and by so doing greatly reduced the cost. The whole area of India is almost three times as large as the area triangulated, and as the whole has been controlled by principal fixings, the cost of the triangulation works out at about 3 rupees per square mile. The cost of a 1 inch = 1 mile survey exceeds generally rupees 20 per square mile, and amounts at times to rupees 40 or more. The secondary and tertiary triangulation on which a 1-inch survey is based will cost 10 rupees per square mile: the traversing on which a 1-inch survey is based in flat countries will cost 15 rupees per square mile. The Principal Triangulation will therefore increase the original cost of a 1-inch survey by less than 10 per cent.—by less perhaps than the cost of its fair-mapping.

17. But a 1-inch survey requires to be periodically revised, and the Principal Triangulation remains available for all revisions. Moreover, surveys on larger scales than 1 inch are in progress throughout the country at costs varying from rupees 60 to rupees 200 per square mile, and these are all based on the same Principal Triangulation. Furthermore, it must be remembered that the true expense of our Principal Triangulation has not been its total additional cost, but its excess over the cost of the secondary triangulation, which would have had to be substituted, if it had not been executed.

18. The differences between our principal and good secondary triangulations have been as follows:—

(*a*) The principal costs perhaps 20 per cent. more than the secondary.*

(*b*) The principal stations are more solidly built, and the positions of the markstones are carefully protected for the use of the future.

(*c*) Our principal triangulation has generated an error in position of 200 feet and in azimuth of 12″ between Cape Comorin and Peshawar: our good and expensive secondary work such as the Quetta Series might easily have generated over the same distance an error in position of half a mile and in azimuth of 150″. Triangulation such as the Kalat Series might well have generated between Cape Comorin and Peshawar an error in position of a mile and a quarter, and in azimuth of 400″. Secondary work, such as that observed with a 12-inch theodolite on the Cutch Coast, might have generated an error of 5 miles in position and of 20 minutes in azimuth.

(*d*) *Its uses.*

19. It is a great mistake to imagine that the Principal Triangulation of India was executed for the purpose of measuring the figure of the Earth. *The Principal Triangualtion of India was executed to control the topography.* A triangulation, however, furnishes only the distances

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* Secondary is cheaper than Principal in that its progress is faster, but dearer in that its triangles are smaller. In clear weather and suitable country the extra size of the Principal triangles will at times compensate the slowness of progress, and render the Principal on the whole cheaper than Secondary.

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apart of the points fixed and their mutual directions: these data are not sufficient for topography, which requires the latitudes and longitudes of points. In order to convert the distances and directions of the triangulation into the latitudes and longitudes of topography, we require knowledge of the Earth's dimensions. When Lambton commenced the triangulation of India, the figure of the Earth was not known with sufficient accuracy even for the calculation of the spherical excesses of his triangles. During his twenty-five years of trigonometrical work he was always, as he extended his triangulation, having to recalculate the Earth's figure, and he died without having succeeded in obtaining a satisfactory result. In 1823 Everest attacked the problem, and in the belief that Lambton's arcs had been too short, he extended the triangulation northwards into Central India. To his great disappointment a careful determination then gave the polar diameter of the Earth longer than the equatorial. Though this anomaly had been met with in other countries, Everest was convinced that the fault lay in his measurements and not in the theory of gravitation.

It was not till 1830 that Everest succeeded in obtaining a figure of the Earth sufficiently accurate for the needs of topographers.

There is no doubt that Lambton's and Everest's unexpected difficulties attracted much attention in Europe: these officers were testing in the field the great Newtonian theory that the Earth was an oblate spheriod, and their instructive failures took the scientific world by surprise. But the interest excited in their work does not alter the facts, that the Principal Triangulation was executed for the control of topography, and that its utilisation for figural determinations was incidental.

20. The *first* great practical use of the Principal Triangulation has been its prevention of embarrassing accumulations of errors at our frontiers.

Its *second* use has been to unify and co-ordinate all the separate surveys of Madras, Bombay, Sind and Bengal; to give them one origin; to combine them into one harmonious whole; to get rid of gaps and overlaps from the internal mapping of India; to free India from the internal boundary disputes that have so troubled other countries.

Its *third* use has been to facilitate and cheapen by tower stations the topographical surveys of the extensive plains of Upper India, a difficult country to map, being the only large portion of the Earth's surface that is flat, intricate and valuable.

Its *fourth* use has been to enable the positions and heights of distant peaks to be determined with accuracy all along our trans-frontier, and thereby to afford points to topographers in Afghanistan and Tibet.

Its *fifth* use has been to furnish perpetual points for the use of posterity, without which revisions of maps would be impossible.

(*e*) *Its future.*

21. The questions, that arise concerning the future of the Principal Triangulation, have to do, firstly, with the preservation of its stations, and secondly, with its extensions.

The measures that have been taken to preserve the stations have not been altogether successful and require I think to be supplemented—but not supplanted—by departmental inspections: furthermore, seeing the importance of preserving all these marks intact, I think that a call by the Government of India for a special report on the condition of all existing stations, if made every 20 years, would tend to prevent the protective work from degenerating into routine.

22. The only future extensions of triangulation that require present consideration are those of Burma and Baluchistan In Burma the completion of the Great Salween Series, the extension of the Mandalay Meridional Series to Sadiya, and the revision of the Assam Valley triangles are required to consolidate the triangulation east of Chittagong and Gauhati.

A Principal Series is being carried westwards from Kalat in order to co-ordinate the separate surveys that have been made of recent years in Baluchistan, and to provide a foundation for other surveys that are likely to be required in those regions in the near future.

23. If we are to follow the practice of European nations, of the United States, and of South Africa, we should arrange to measure 2 or 3 Base-Lines in Burma, and possibly one in Baluchistan within the next few years.

The following table shows the number of Base-lines of the first class, measured in various countries:—

	No. of Base-lines.*	Area triangulated in thousands of square miles.	Ratio of Base-lines to area.
Italy	9	110	$\frac{1}{12}$
Germany	13	204	$\frac{1}{16}$
Great Britain	6	121	$\frac{1}{20}$
France	7	207	$\frac{1}{30}$
Russia	19	2000	$\frac{1}{105}$
India	10	1520	$\frac{1}{152}$
Burma	0	240	0

* General Ferrero's report to the International Conference at Stuttgart in 1898.

There is a Base-line at Mergui in South Burma, but its length of 3 miles is too small to allow of its being classified as first-class. The Base-lines in India proper are completed, and though it is a matter of regret that the projected Base-line at Bombay was omitted, the question is closed: whether our distant successors will reopen it will depend upon the future developments of geodesy.

In the above list there is little doubt that the 2,000,000 square miles allotted to Russia are in excess of her triangulated area: prior to 1895 good triangulation had been carried over Western and Southern Russia, Finland, the Caucasus and the Cis-Caspian provinces: and a great arc of parallel had been taken eastward from Warsaw to Orenburg, and was being extended into Central Asia.

III.—The Levelling Operations.

(*a*) *Their uses.*

24. Levelling operations conducted on scientific principles form as essential a part of a survey as triangulation. Levelling constitutes the framework that controls the vertical measurements of a survey, just as triangulation controls the horizontal measurements. In addition to affording a basis for topographical heights, levelling contributes to topography by co-ordinating the Canal and Railway levels and rendering them available for maps.

(*b*) *Errors of vertical angles.*

25. The altitudes entered on Indian topographical maps have been mostly derived from vertical angles: the degree of accuracy, with which these angles have been measured, has varied from those observed to decimals of a second with large telescopes to those observed to the nearest degree with wooden clinometers. Our levelling operations have brought to light the following errors in the first class heights of the Principal Triangulation :—

Madras Coast	5 feet too high
Bombay Coast	17 feet too high
Mysore	9 feet too high
Deccan	7 feet too high
Cutch Coast	11 feet too high
Khandesh	14 feet too high
Punjab	5 feet too high
Ganges Valley	errors varying from 13 feet too high to 31 feet too low.

Errors of height amounting to 20 and 30 feet are of but little importance in mountainous regions, but are liable to mislead engineers who have to study the hydrography of the plains.

To take a well-known example—Umballa is in the Indo-Sutlej basin and its height is 902 feet: Saharunpore is in the Gangetic basin and its height is 903 feet. From Umballa to Saharunpore the ground rises 11 feet in the first 20 miles; the natural watershed between the drainage systems of the Arabian Sea and the Bay of Bengal is 913 feet high near Mustafabad Railway Station: the ground then falls 7 feet in the 13 miles to the Jumna, and 3 feet in the 17 miles between the Jumna and Saharunpore.

(*c*) *Work in hand.*

26. The work in hand at present in connection with levelling may be classed as follows :—

(1) Erection of standard bench-marks.
(2) Extensions of lines of levelling in the field.
(3) Preparation of level charts.
(4) Preparation for press of half a century's levelling results.

27. The scheme of erecting standard bench-marks has been initiated this winter. From information received at different times there are reasons to fear that numbers of ordinary bench-marks are destroyed, when towns expand and when railways or roads are widened. In the last few years we have discovered that the bench-marks between Rangoon and Mandalay have not maintained their original altitudes: the discovery was accidental; we had not intended to revise the Burmese levels. Revisions in India might bring to light similar displacements. We now proposed to erect standard bench-marks in the important towns of India: these new marks will be solidly built in carefully chosen places, and will be handed over to the local engineers who will report to the Survey annually; their heights will be determined by levelling and engraved on the stones.

(*d*) *Projected extensions.*

28. The lines of levelling that remain to be executed may be divided into three classes :

(i) The scientific, which are required to close circuits and to furnish the closing errors for the forthcoming adjustment of the level net. These amount to 6 years' work.
(ii) The engineering, which are required by the Public Works Department to control and unify their Canal and Railway levels. These amount to 17 years' work.
(iii) The protective, which are required to fix the heights of our standard bench-marks and to preserve thereby for posterity a few of the altitudes determined in our time. These amount to 20 years' work.

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Of these three classes the third is of supreme importance: to postpone, however, the lines of levels required by the Public Works Department for 20 years is practically to omit them altogether.

For many years past the levelling detachment has been assisting the Public Works Department and has furnished bench-marks to the Bengal State Railways, to the Burma Railways, to the Burma Irrigation Department and to the Irrigation Department of Sind. There has been no opportunity of completing the scientific lines, which are wanted to consolidate the network.

29. The preparation of Level Charts was commenced thirty-eight years ago: 34 Charts have been published, and 112 remain. Level Charts are intended to show all Canal and Railway levels in terms of the datum of the Survey, and will be of use to both engineers and topographers.

(e) Comparison with foreign surveys.

30. I have endeavoured to ascertain the amount of levelling executed in Europe and America, but it is difficult to obtain statistics: in all countries the publication of results lags behind the fieldwork.

India: Up to May 1904 there had been executed in India 15,500 miles of precise levelling.

Great Britain: Prior to 1861 the Ordnance Survey had executed 4,000 miles of accurate levelling in England and Wales, 3,000 miles in Scotland and 1,500 miles in Ireland. These operations have been widely extended since 1861.

France: Prior to 1893 France had carried out (*a*) 7,000 miles of levelling of the highest degree of accuracy, (*b*) 10,500 miles of a class of levelling, denominated by her surveyors second class, (*c*) 4,900 miles of so-called third class, (*d*) 10,200 miles of so-called fourth class. The lower orders of levelling are used in France to break up the fundamental network into smaller areas.*

United States: In 1899 the Survey adjusted their precise level net; 19,753 miles of precise levelling were included in the net: between 1899 and 1903 additional first class levelling extending over 6,000 miles was carried out.*

Germany: Prior to 1892 Germany have carried out 18,600 miles of first class levelling, and Austria had carried out 10,000.*

Japan: Prior to 1898 Japan had carried out and projected 5,700 miles of levelling, of precision.*

31. Ratio of first class levelling to area:—

Germany in 1892	$\frac{1}{11}$
Great Britain in 1861	$\frac{1}{14}$
Austria in 1892	$\frac{1}{21}$
Japan in 1898	$\frac{1}{33}$
France in 1898	$\frac{1}{70}$
India in 1905	$\frac{1}{110}$
United States in 1899	$\frac{1}{110}$

Seeing how valueless large portions of the Indian area are, no one could advocate that the ratio for India should be raised to that of Great Britain. American surveyors would probably take exception to the ratio allotted to their country, as it makes no allowance for the large unsurveyed regions that form part of the United States.

32. In adjusting the errors of her levelling net, France had to take into account that her lines had been connected with those of foreign countries at 18 different points, *viz.*:—

With Spain at three points,
" Italy at three points,
" Switzerland at five points,
" Germany at three points,
" Belgium at four points.

Owing to the errors in her connexions with France, Switzerland had to revise 80 miles of levelling in 1896 and 183 miles in 1897. India's insularity renders her levelling independent of foreign checks.

(f) Their cost.

33. Seeing how useful our levelled heights and bench-marks have been in India to the engineering departments, it is questionable whether we ought to charge the total expenditure on them against topography. If, however, we decide to do so, the cost to topography of the levelling control, up to the present time, will work out at about nine annas per square mile of area controlled.

On the average four bench-marks have been erected in every one-inch Standard Sheet of surveyed area.

VI.—The Astronomical Operations.

(a) Primary aims.

34. The primary duty of the Astronomical party is the location of India in its correct position on the globe. The origin of our triangulation is a point in Central India: we have

* Reports of the International Conferences, Stuttgart 1898, Paris 1900, Copenhagen 1902.

had to determine astronomically the terrestrial position of this point, and we have had to determine astronomically the terrestrial directions in which our several diverging series of triangulation have trended: one series has run into Makran, others into the Punjab and Himalayas, others into Assam and Burma, others into South India, and in spite of unremitting care, all these ramifications have developed errors of orientation and direction.

The area of India is more than one-fourth of the total triangulated area of the world: it is the largest triangulated area that has yet been undertaken by one survey; it is the largest triangulated area that has ever been made to emanate from a single point: and our astronomical officers have had to fit this area into its true position on the globe. They have had to discover the relative dimensions of the area to be located and of the globe receiving it: they have had to keep a watch on the triangulation, to see that it is not trespassing beyond our correct frontiers and coasts, and to warn us of the errors, that we shall have to deal with, when we meet with a foreign survey.

It must be remembered that nature has placed obstacles in the path of astronomical surveyors in India: the direction of gravity is the only test they have of verticality, the surface of liquid at rest is their only test of horizontality, and in no other part of the world has the direction of gravity been found to undergo such abnormal variations, as have been discovered by the Russians in Fergana and by ourselves in Northern India: in no other country does the surface of liquid at rest deviate so much from the horizontal.

35. There appears to be an idea that the primary object of our astronomical work is the investigation of mountain attraction, and of deflections of the plumb-line. But this is a mistake. Its true goal is the determination of the geographic errors of area, shape, and position, that have been generated by the triangulation. But just as the triangulators found themselves unable to control the topography without a knowledge of the figure of the Earth, so have the astronomers found themselves unable to control the triangulation without a knowledge of the direction of gravity. Just as the triangulators had to digress, and make Earth measurements, so have the astronomers had to halt on their way to investigate the attractive effects of mountains.

It is true that discoveries made in the course of these secondary operations have won the interest and sympathy of learned societies in Europe: the discovery that an extraordinary deficiency of matter underlies the Himalayas, that a range of mountains is hidden and buried beneath the plains of Central India, that seaward deflections of gravity prevail round the coasts of Southern India,—these discoveries have led geologists and geodesists to press for a further investigation of the distribution of mass in the Earth's crust. But the interest that has been awakened does not alter the fact, that the primary object of our astronomical operations is geographic.

(*b*) *The heights of Himalayan peaks.*

36. Difficult questions have arisen in connection with the heights of the Himalayan and trans-frontier peaks: our values for these heights are in error, (*1stly*) because of the extraordinary deformation of the level surface at the observing stations in sub-montane regions. (*2ndly*) because of our ignorance of the laws of refraction, when rays traverse rarefied air in snow-covered regions. (*3rdly*) because of our ignorance of the variations in the actual heights of peaks due to the increase and decrease of snow. It is part now of the programme of the Astronomical Party to determine the errors in height arising from geoidal deformations, to investigate the laws of refraction at high altitudes, and to measure the actual variations that are occurring in the heights of peaks.

37. There are but three known methods of determining the height of a station, *viz.*, (1) by spirit level: (2) by atmospheric pressure: (3) by angular measurement: of these three methods the first two require the station itself to be visited, and the third alone is available, when the station is inaccessible.

To obtain an idea of the degree of uncertainty, which attaches to values of heights determined from very distant observing stations, we may suppose that an observer measured the elevation of Mount Everest from Darjeeling in October and again from the plains of Bengal in April: his second series of observations might give a larger value of height than his first series by 100 feet on account of geoidal deformation, by 300 feet on account of inequalities in refraction,* and by 100 feet or more on account of increase of snow,—by 500 feet in all.

I do not presume to argue that our heights are in error by this amount, but I do say that the above figures give a fair numerical idea of the range of uncertainty. Apart from topographical requirements, it is of interest to the world at large to know the heights of the highest points of the Earth, and the duty of determining them belongs to the Indian Survey.

38. The values of height now attaching to the three highest mountains in the world are by no means the most probable.

Heights of the three highest mountains in the world.

	Present Survey values of height.	Most probable values.
Mount Everest	29,002 feet	29,141 feet.
K_2	28,250 ,,	28,191 ,,
Kanchanjangha	28,146 ,,	28,225 ,,

* Refraction is probably less at Darjeeling than over the plains: if therefore the same co-efficient be employed, the height obtained from Darjeeling will be less than that obtained from the plains.

It is possible that we are robbing Kanchanjangha of the honour of second place.

My most probable values of height have been derived from observations of refraction that were not available, when the present Survey values of height were adopted. It would, however, be premature to exchange yet our present values for the most probable values, for nothing leads more to confusion than repeated alterations of data.

It is true that the values at present most probable would be improvements on the accepted values, but we want something more than improvement or correction to justify us in changing data: we want finality and certainty, and these we shall never attain, until we appreciate the magnitude of the problem, and go systematically to work. In the course of the Trigonometrical Survey we have accumulated a mass of evidence relating to refraction, but it is entangled with the effects of local attraction and of snowfall, and it cannot be classified or utilized, until we have disentangled the three.

(*c*) *Special duties in the past.*

39. The Astronomical Party of the Survey has been often called upon in the past to perform miscellaneous duties, that would in Great Britain have fallen upon the staff of Greenwich Observatory. It has had to observe Transits of Venus: in 1894, 1895 and 1896 it was observing in Persia and Europe to determine the error of Indian longitudes: in 1898 it was deputed to assist the Astronomer Royal in observations of the total Eclipse of the Sun. It has worked in conjunction with the Government Astronomer at Madras to obtain a fundamental value of latitude for the Indian Star Catalogue.

(*d*) *Special future work.*

40. The Director of Kodaikanal Observatory requested the Survey some years ago to determine his geographical co-ordinates both astronomically and by triangulation: I regard this request as of first importance, but no officers have been available for the work.

41. It is to be hoped that in the future the Astronomical Party may be given an opportunity of determining the mean density of the Earth: Astronomers Royal did this for Great Britain at Schiehallion and Cardiff, and the Ordnance Survey made a fine determination at Arthur's Seat at Edinburgh. The three measures were, however, not accordant*, and a determination in the low latitudes of India would be a valuable contribution. The present time is peculiarly opportune, because we could count upon the co-operation of our pendulum party: in no one of the British determinations could astronomical and pendulum observations be combined. When therefore the Ordnance Survey had to deduce the weight of the Earth from the weight of Arthur's Seat, they were not aware of the density of the crust underlying Arthur's Seat, and they were obliged to assume that it was normal: if we undertook to measure now the relative weights of the Earth and Mount Abu, we could with our pendulums discover whether the foundations to Mount Abu were abnormally heavy or light.

(*e*) *Comparison with foreign surveys.*

42. The errors in the geographic position and area and shape of a survey are determined by astronomical measurements of latitude, longitude and azimuth at stations of its triangulation. The following table shows the present position of the Survey of India as compared with other surveys:—

Survey of	The proportional number of stations of the triangulation at which astronomical observations have been made†		The total number of arcs of longitude measured†
	For Latitude.	For Azimuth.	
Germany	1 in 3	1 in 2	107
Trans-continental triangulation of America	1 in 2	1 in 3	67
Great Britain	1 in 7	1 in 4	‡
Austria	1 in 6	1 in 7	95
France	1 in 8	1 in 11	62
Italy	1 in 11	1 in 12	34
Russia	1 in 12	1 in 12	81
India proper	1 in 11	1 in 12	47
Baluchistan	0	0	2
Burma§	0	1 in 11	5
Kashmir	0	0	0

* Mr. Maskelyne at Schiehallion . 4·56
Sir George Airy at Cardiff . 6·57
Sir Henry James at Edinburgh . 5·32

† Reports of the International conferences at Stuttgart 1899 and at Copenhagen 1903.

‡ Many of the arcs of longitude measured by Great Britain cross the English Channel and the Atlantic, it is doubtful whether these should be included in the table.

§ Including the Manipur Meridional Series.

(f) Normal future work.

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43. Observations for latitude are still much wanted on branches of our triangulation, more especially in Burma, Baluchistan, Kashmir and the Himalayas.

Observations for azimuth will be required on future extensions of the triangulation.

The measurement of a few additional arcs of longitude in Burma, the Punjab, South India and Kashmir has for many years been considered desirable.

(g) International determination of the variation of latitude.

44. Of recent years endeavours have been made in Europe and America to measure the changes in the positions of the Earth's centre of gravity and of the Earth's rotation axis; that changes are always going on has been made clear by the discovery that the latitude of every place is continually varying. Some few years ago an International Congress decided that a systematic investigation should be made, and they suggested that the Earth should be surrounded by a girdle of special observatories. The parallel of 39° north was selected for the girdle, with the result that three observatories fell in the United States, one in Japan, one in Russia, one in Sardinia. The Russian Government was asked in accordance with this scheme to erect an observatory at Tschardjui: Russia had been already for some years observing the variations of latitude at Pulkowa, at Moscow, at Warsaw, and at Kazan, and the new observatory at Tschardjui made her fifth. India has so far not been asked to contribute to this work: she profits nevertheless from the results.

V.—The Pendulum Operations.

(a) The progress of foreign surveys.

45. The number of stations, at which the pendulum had been observed prior to 1903, were*—

Great Britain	63	Germany	280
Italy	193	United States	108
France	89	Russia	153
Austria	569	India	29

Pendulum observations are now being taken by the surveys of France, Germany, Russia, Austria, Italy, Japan and the United States.

France has volunteered to undertake a gravimetric survey of the Andes: Germany has undertaken one of the oceans and coast lines of the world; the United States and Russia have enormous areas of their own; and Great Britain sent a complete pendulum equipment to the Antarctic two years ago.

46. But for pendulum research the most interesting place on the Earth is the mountainous region of Northern India, and the International Conference that met at Copenhagen in 1903 passed the following resolution on this subject for submission to the Government of India.†

"Il est desirable qu'on fasse dans les Indes anglaises une étude approfondie de la reparti-
"tion de la pesanteur, tant dans les contrées montagneuses que dans les plaines.

"Attendu que c'est seulement par cette étude qu'on pourra obtenir une representation
"exacte de la distribution des masses dans l'écorce terrestre et de la forme du géoide dans
"ces contrées."

The British Ambassador at Berlin submitted the above resolution to the Government of India on October 6th, 1903. Pendulum observations were commenced in India in 1904.‡

(b) The purposes served by Pendulum observations.

47. Pendulum observations measure the intensity of gravity and are of use—

1stly. For correcting and perfecting our astronomical checks on the triangulation.

2ndly. For determining the earth's ellipticity by a method independent of arc-measurements.

3rdly. For investigating the departures of the geoid from a Newtonian spheroid.

4thly. For investigating the constitution of the earth's crust.

The first purpose served by pendulum observations is therefore geographic, the second and third are astronomic, the fourth is geologic; all are geodetic.

48. We are profoundly ignorant of the constitution of the earth: we do not know if its interior is rock or metal, solid or molten: we talk of its crust, but we do not know if it has a crust distinct from its core: we do not know if the existence of high mountains is an incident of the Earth's surface only, or if their superincumbent weight is producing inequalities of density at great depths. We do not know how these mountains have arisen. Pendulum operations have consequently a high value and interest for geologists and geodesists.

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* Reports of the International Conferences at Paris in 1900 and at Copenhagen in 1903. Observations at 29 pendulum stations in India were made between 1866 and 1871: the work was stopped because the only apparatus procurable was too heavy and wearisome. Of the 63 stations appertaining to Great Britain, but 16 fall in Great Britain itself: the remainder, though occupied by British observers, fall in Spitzbergen, South America, and other places.

† See A Proceedings No. 2, December 1903, Department of Revenue and Agriculture, Government of India.

‡ The Surveyor-General had obtained the sanction of Government to the purchase of a pendulum apparatus in 1902, and had thus anticipated the wish of the International Conference.

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Geographical, astronomical and geological observations have all in their turn revealed peculiar physical features in the Himalayas, and we are now calling the pendulum to our aid to supplement our knowledge of Himalayan structure.

49. But when discussing the numerous uses of pendulum observations we must not lose sight of the important fact that the pendulum is primarily a surveying instrument. The connection between topography and pendulum work is, however, too complex to be described clearly in a single sentence, and must be traced step by step, as follows :—

(i) The geographical adjustment of the triangulation is dependent upon astronomical observations.

(ii) The correctness of astronomical observations depends upon the direction of gravity.

(iii) We cannot *measure* the direction of gravity, because we have no zero from which to measure. We can measure the *height* of a station, because the mean level of the sea is a reliable zero : we can measure *temperatures*, because the freezing point of water is a reliable zero : we can measure the deviation of the needle from true north. But we cannot measure the deviation of gravity from the true vertical, because the true vertical is not discoverable by observation, as the true north is.

(iv) Owing to the deflections of gravity, astronomical measurements may cause an error of 800 or 1,000 feet in the geographical position of any point, and an error of a mile in the position of a Himalayan point.

(v) No deflections of gravity would occur on a perfectly level spheroid formed of homogeneous spheroidal layers : they are caused by the irregular distribution of masses at the earth's surface and in the earth's crust. The pendulum is required to demonstrate the true distribution of mass, and to show to us the extent to which our actual earth differs from a level spheroid composed of homogeneous layers.

(vi) If we know the mean density of the earth and the local distribution of mass at its surface, we can calculate the amount that gravity will be deflected from the normal. By providing us therefore with an ideal spheroid, the pendulum supplies the zero, which nature has failed to furnish.

50. The primary use then of pendulum work is that it enables the surveyors to correct their astronomical results for the unavoidable errors caused by deflections of gravity. The location of India on the globe has, for instance, rested upon astronomical observations made at a point in Central India. Everest selected this spot, because there were no mountains visible, and because it seemed to be a place at which the direction of gravity would be truely vertical, and at which the instrumental levels would be truly horizontal. But only in the last few years we have discovered that Everest's point is situated on the scarp of a buried range or table-land ; this range is deflecting gravity out of the normal, and must have disturbed the horizontality of Everest's levels : pendulum observations will disclose the mass and position of the hidden range, and will enable us to compute corrections for the astronomical results.

Thus it will be seen that pendulum observations are used to control astronomical results, just as astronomical observations are used to control the triangulation, and as the triangulation is used to control the topography : all are links in one chain.

VI.—The Tidal Operations.

(*a*) *Retrospect.*

51. The investigations and writings of Professor George Darwin have within the last thirty years considerably increased our knowledge of the tides. Though we are still unable to foretell the course of the tides at places, where no observations have been taken, yet our predictions at ports, at which the tides have been observed, are now attaining an accuracy, which would not have been credited half a century ago.

52. Tidal operations in India were initiated for the following purposes :—

(1) To provide a datum for the levelling operations of the survey.
(2) To afford data for the calculation of tidal predictions.
(3) To obtain evidence of the rising and sinking of land, and of variations in mean sea level.

53. Up to 1883 predictions of the tides were calculated by an arbitrary method which made no allowance for what is known as the diurnal inequality.*

In home waters the diurnal inequality is practically absent, and the European Admiralties and Surveys have never been really troubled by it. But in Indian waters it is very large, so large that in some of our ports at certain times there is only one tide in 24 hours. Owing to this phenomenon the earliest attempts at tidal prediction which were made in India for Karachi and Bombay were not successful : and for many years all endeavours to foretell the tides at Aden failed. In 1883 Darwin revised the method of Harmonic Analysis, as applied to the tides, formulated by Sir William Thomson in 1872, and we are now able to unravel

* This inequality is easily understood from a diagram.

their extreme complication in Indian waters. The average error in the predicted height of high water at Aden is now one inch. If we reflect that the motions of the Sun and Moon, the complex outlines of our coasts, the ever-varying depths of the sea, and the Earth's rotation and figure are all involved, we cannot but regard modern tidal prediction as one of the greatest triumphs of science.

India was the first country to adopt this method of prediction : her success has been extraordinary, and her example has been slowly followed by Canada, the United States, by France and other European nations.

By means of Harmonic Analysis we can separate the observed tides into twenty-four components, and by means of Lord Kelvin's tide-predicting machine we can again combine these components, and discover mechanically the actual tides of the future. For many years India was the only country that possessed a tide-predicting machine : but latterly France, the United States, and Canada have had machines constructed. The tide-predicting machine of the Indian Government has been used in Europe for the tidal predictions of British colonies, and for this reason has never been sent to India. For many years it stood at Lambeth, but has lately been received at the National Physical Laboratory at Teddington.

54. The predictions of the Indian tides are carried out under the following quadruple arrangement :—

(i) The tidal observations are taken under the superintendence and orders of the local port officers and engineers.

(ii) The Survey of India has the duty of inspecting the several tidal observatories and of maintaining uniformity of method : the Survey of India has the further duties of reading off the tidal diagrams and of calculating by Harmonic Analysis the twenty-four tidal components.

(iii) The National Physical Laboratory in England sets the tidal machine to accord with the results of our calculations, and prepares the tidal predictions from the curves drawn by the machine.

(iv) From the beginning, the operations have been under the scientific direction of Professor Darwin, whose advice has been constantly sought.

55. If tidal observations are taken for 5 years, sufficient data are accumulated to enable predictions to be made ; the present predictions for some of the Indian ports are being still based upon observations taken more than twenty years ago and continue to be accurate. But lest in the course of years the tides may be slowly varying, or lest the relative heights of sea and land may be altering, a few observatories have been established on a permanent basis.

Between 1874 and 1904 tidal observations were taken at 42 places : of these observatories 34 were temporary and 8 permanent. At the present time one temporary observatory and the eight permanent are working.

Of our 42 tidal observatories two were in the Red Sea, two in Arabia, one in the Persian Gulf, one in the Maldives, three in Ceylon, one in the Andamans, twenty-four in India and eight in Burma.

(*b*) *Comparisons with Foreign surveys.*

56. The levelling results have been tested against tidal determinations of Mean Sea Level at 20 different places on the coasts of India.

In Great Britain, prior to 1861, the levelling results of the Ordnance Survey had been compared with tidal measurements of Sea Level at 30 places in England and Wales, at 18 places in Scotland and at 21 places in Ireland.*

The following table shows the number of permanent tidal observatories working in 1902† :—

Country.	Length of coast-line in miles.	No. of tidal Observatories.
Tonquin (France)	150	1
Austria	300	1
Holland	400	20
Denmark	500	10
Algiers (France)	600	1
Germany	800	26
New South Wales	800	3
France	1300	11
Italy	1600	16
Canada	2000	7
Russia	2000	10
Japan	2600	10
New Zealand	3000	6
Great Britain	3000	9
India	4000	8

* Abstracts of Spirit Levelling, Ordnance Survey, 1861.
† International Conferences, Stuttgart 1898 and Copenhagen 1903.

(c) *Future work.*

Scientific work of the Survey of India.

57. The following tidal work will be carried out by the Survey of India in future :—

(i) Maintenance of 8 permanent tidal observatories.

(ii) Annual Calculations for the tide-predictions for 42 different ports.

(iii) Opening of new tidal observatories, of which two have been proposed for the Malay Peninsula, one for the Red Sea and two for the Gulf of Cutch.

(d) *Scientific investigations.*

58. Up to a few years ago it was generally held by geologists that the earth was a globe of molten matter enclosed by a thin crust. Lord Kelvin has, however, shown that such a globe would yield to tidal forces, and that the oceanic tides would then be imperceptible. The oceanic tides consist in a motion of the water relatively to the land, and their existence proves that the land does not yield with perfect freedom. From the fortnightly tide observed in Indian waters, Lord Kelvin and Professor Darwin have shown that the Earth possesses a rigidity greater than that of solid glass, though not greater than that of solid steel.

59. In my previous note on Astronomical work I alluded to the variation of latitude : this phenomenon has been attributed to shiftings of the earth's axis of rotation, to movements of the earth's centre of gravity, and to variations in the position of the equatorial protuberance with reference to places fixed on the earth's surface ; as the axis of rotation and the centre of gravity and the equatorial protuberance shift, the oceans become disturbed, and a tide becomes generated. We are endeavouring now under the direction of Professor Darwin to detect a tide at Karachi corresponding in its period of 430 days with the variation of latitude : the United States Geodetic Survey have discovered such a tide on the coasts, and the Geodetic Survey of Holland has also detected it. This tide is of course minute, as the movements of the Earth's axis are small : if the displacements of the axis were considerable, whole continents would be drowned by gigantic waves.*

VII.—The Magnetic Survey and Solar Photography.

60. A Magnetic Survey of India was proposed in 1896 by Sir John Eliot and General Strahan, and was recommended by the astronomers, who visited India in 1898 on the occasion of the total Eclipse of the Sun.† At the outset there was some uncertainty as to whether the work should be undertaken by the Survey of India or by the Meteorological Department and it was eventually decided that the field work should be carried out under the Surveyor-General, and that the fixed observatories should be under the Meteorological Reporter. By mutual agreement, however, the Meteorological Reporter has now handed over the charge of four of the five observatories to the Surveyor-General. The magnetic survey of India was begun in 1900.

61. Many branches of science are interested in a magnetic survey : the meteorologists require it to assist them in their investigation of the connection between sun spots and rainfall : the geologists expect it to show them the positions of magnetic rocks : geographers and navigators derive from it their knowledge of the declination of the compass, and the secular changes in the declination.

The existence of magnetic rocks in the crust can at times be detected by ordinary compasses, but if iron ore is lying concealed at any great depth from the surface, its presence would be only discovered by a systematic and rigorous survey.

Though the magnetic surveys of Europe and America have greatly progressed of recent years, but a small fraction of the surface of the globe has as yet been examined. We do not at present know whether the Earth's magnetism is due to permanent centres of attraction or to its rotatory motion : we do not know whether the Earth is a permanent magnet or not.

(a) *Dates of Magnetic discoveries.*

62. 1492. Discovery that a needle does not point true north, and that its declination differs in different parts of the earth.

1576. Discovery that the north end of a needle, if properly balanced, will dip below the horizon, and that the amount of dip differs in different parts of the earth.

1634. Discovery that the magnetic declination constantly undergoes slow changes in the course of years, and that the rate of its change differs in different countries.

1720. Discovery that the strength or intensity of the Earth's magnetic force differs in different countries, and at different times.

1722. Discovery that the magnetic declination is subject to an appreciable diurnal tide, and that the range of this tide differs in different countries and at different seasons.

19th century. General Sabine shows that the Earth's magnetism is not only a telluric but a cosmical force.

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* Darwin's Tides : page 230.

† See reports by Sir W. Christie, K.C.B., F.R.S., and Sir Norman Lockyer, K.C.B., F.R.S.

(b) The Indian Magnetic Survey.

Scientific work of the Survey of India.

63. The immediate aim of a modern magnetic survey is to determine the declination, dip, and the intensity of the Earth's magnetic force in every portion of the area involved, and to measure the several changes that these elements undergo.

In the magnetic survey of India five field parties have been observing the declination, dip and intensity in different parts of India since 1900; annual observations have also been taken at 17 "repeat" stations to test the annual local variations in the elements; and continuous photographic records have been obtained at five observatories of the direction and intensity of the magnetic force.

64. The preliminary magnetic survey of India will be completed in 1906. Charts will then be prepared to show the localities where magnetic disturbances exist, and a detailed magnetic survey of those localities will be commenced under the guidance of the Royal Society.

In projecting the detailed survey, the Survey of India, conscious of a heavy responsibility, will rely upon the co-operation of the Meteorological Reporter and of the Director of the Geological Survey.

We have been much indebted to Sir Arthur Rücker, K.C.B., F.R.S., for his interest, advice and instructions, and we count with confidence upon the continued sympathy of this eminent physicist.

(c) Comparison of the Magnetic Surveys of Great Britain and of India.

65. The first complete Magnetic Survey was that of Great Britain in 1837-38. The example set by Great Britain was followed by Austria, Germany, Holland, France, Canada, Russia, Italy and the United States.

In 1857-62, after the lapse of 20 years, Great Britain repeated its original magnetic survey in order to investigate the changes that had occurred.

Between 1884 and 1888 Great Britain carried out a third magnetic survey, and between 1889 and 1892 it amplified this survey, and made it the most detailed of the world.

Our present Magnetic Survey is the first attempted in India, but magnetic observations have been taken since 1846 at the Observatory in Colaba, which was established by the East India Company, and this continuous series is undoubtedly a very valuable record.

66. The following Magnetic Observatories are now working :—

In Great Britain.	In India.
Greenwich.	Colaba.
Kew.	Kodaikanal.
Stonyhurst.	Debra Dun.
Valentia.	Barrackpore.
Falmouth.	Toungoo.

In Great Britain there were 26 "Repeat" Stations, that is one "Repeat" Station on the average to every 4,700 square miles.

In India there are projected 24 "Repeat" Stations, or one "Repeat" Station on the average to every 73,000 square miles.

In Great Britain there were 882 field stations, or one field station on the average to every 139 square miles.

In India there are projected 1,200 field stations or one field station on the average to every 1,500 square miles.

67. I am not making these comparisons to illustrate the inferiority of the Indian Survey to the British, but to show that the Magnetic Survey of India has been designed with a proper regard for economy, and that no undue multiplicity of observations is being contemplated.

It is possible that when the detailed magnetic survey is being undertaken, we shall be pressed to multiply field stations in regions of magnetic disturbance.

The following information is extracted from the last report of the United States Survey dated Washington, 1904 :—

"Observations have been made at 1636 stations, of which about one-eighth are 'repeat' stations: the average distance between the stations is 25 miles,* although in regions 'of pronounced disturbances the distances are much less: the area covered is one-third of 'the area of the United States."

"Observatory work has been carried on at five stations."

"It is hoped that the next five years may witness greater progress."

(d) Solar Photography.

68. Photographs of the Sun have been taken twice daily, clouds permitting, at Dehra Dun since 1879. Similar photographs have been also taken daily at Greenwich Observatory and at Mauritius. For many years Greenwich, Dehra Dun and Mauritius have acted together under one scheme and one system. We send our photographs to England weekly to Sir Norman Lockyer, K.C.B., F.R.S., under whose directions we have carried out the work from its inception. In 1898 Sir William Christie, the Astronomer Royal, wrote to the Secretary of State: "The daily photographs of the Sun should be continued at Dehra Dun "where they are being taken satisfactorily under the Surveyor General's direction."†

DEHRA DUN,
February 1st, 1905.

S. G. BURRARD.

* Average distance in India 39 miles.

† Report on Indian observatories.

United Provinces Standard Sheets.

Note by Captain W. M. Coldstream, R.E., Superintendent of Provincial Surveys, United Provinces, on the standard sheets of the United Provinces to be used as introduction to register of standard sheets.

The one-inch standard sheets of the United Provinces have been surveyed and mapped (or are being mapped) by several widely different methods, and vary greatly in style of drawing and in value.

2. They may be classified as under :—

I.—Sheets prepared from the old 4″ Revenue Surveys.

(*a*) Surveyed as separate village plans, 1833—1840.
(*b*) „ „ congregated „ „ 1859—1879.
(*c*) „ on graticuled sheets 1873—1876.

II.—Sheets of hill districts prepared from the 1″ topographical surveys of 1867-68 and 1881—86.

III.—Sheets prepared from the 2″ topographical surveys of plains districts, of 1877—84.

IV.—Sheets prepared from 16″ cadastral surveys executed by regular parties of the Survey of India, the fair sheets being drawn by the party that carried out the work, 1871—1890.

V.—Sheets prepared from the 16″ cadastral surveys executed by the Land Records (afterwards the Provincial) surveys : the fair sheets of the various parties being drawn in one mapping office, commenced, 1894.

VI.—Sheets to be prepared from topographical 2″ surveys, commenced, 1901.

In the above classification, no mention has been made of Forest surveys, but classes II, IV, and V include some sheets in which Forest survey material has been used.

Class I.—Sheets prepared from old 4″ Revenue Surveys.

(*a*) *Surveyed as separate village plans.*

3. The following districts were surveyed by this method :—

Allahabad . . .	1838-39 Sheets	140, 141, 154, 155, 156, 167, 168, and 169.
Cawnpore . . .	1838-40 „	89, 90, 91, 92, 105, 106, 107, 108, 123, 124, 125, and 138.
Fatehpur . . .	1838-39 „	108, 109, 123, 124, 125, 138, 139, 140, and 141.
Etáwah . . .	1838-39 „	56, 73, 74, 89, and 90.
Jálaun . . .	1852-55 „	56A, 56B, 75, 76, 77, 91, 92, and 93.
Farrukhabad . . .	1833-35 } 1837-39 } „	70, 71, 72, 73, 86, 87, 88, and 89.
Mainpuri . . .	1837-38 „	54, 55, 56, 71, and 72.

Some of the material of this class was lost or destroyed in the Mutiny and no standard sheets of the above areas are now in print, but modern material has been provided for nearly all.

4. The first three districts have been surveyed since 1901 on the 2″ scale (*see* class VI) by No. 14 Party, and the last three have been surveyed cadastrally by the Provincial surveys (class V). There are, however, gaps in the cadastral survey of Jálaun formed by Native States, and topographical material for them should be provided when the mapping is taken in hand.

New material available.

There remains Etáwah, of which the eastern tahsils, Bidhúna and Auraiya, had already been partially surveyed on the 16″ scale in 1901, when the cadastral survey was stopped in consequence of the postponement of settlement for 10 years.

(*b*) *Surveyed as congregated village plans.*

5. The districts and sheets surveyed in this manner are :—

Districts.	Date.	Standard sheets affected.
Bijnor .	1868-1871	27, 28, 29, 30, 45, 46, and 47.
*Budaun .	1876-1879	33, 34, 49, 50, 51, 52, 67, 68, 69, 84, 85.
Hardoi .	1863-1866	86, 87, 88, 102, 103, 104, 105, and 119.
Sítapur .	1863-1865	116, 117, 118, 119, 131, 132, and 133.
Unao .	1860-1862	105, 106, 107, 120, 121, 122, 123, 136, and 137.
Lucknow .	1861-1863	119, 120, 121, 134, 135, 13, and 137.
Bara Banki .	1862-1864	133, 134, 135, 136, 148, 14, and 150.
Rae Bareli .	1862-1864	122, 123, 136, 137, 138, 139, 150, 151, 152, and 153.
Fyzabad .	1862-1865	149, 150, 162, 163, 164, 176, 177, 178, and 192.
Partabgarh .	1859-1862	139, 140, 152, 153, 154, 165, 177, 178, and 179.
Kheri .	1865-1869	98, 99, 100, 101, 102, 113, 114, 115, 116, 129, 130, 131, and 132.
Bahraich .	1865-1870	129, 130, 131, 132, 144, 145, 146, 147, 148, 158, 159, and 160.
Gonda .	1867-1871	147, 148, 149, 158, 159, 160, 161, 162, 172, 173, 174, and 175.

*Note.—Budaun was surveyed for topographical, not revenue, purposes and in this respect the survey differs from the others of this class (see Markham, 1877-78, p. 29).

6. New cadastral material has been provided for the last three districts by the Provincial surveys (see class V) and the sheets of Kheri are now in hand. A small area in Budaun in sheets 84 and 85 has been topographically surveyed by the Provincial surveys (class V) as the old 4″ work could not be used to complete these sheets owing to the great changes in the Rámganga river. There is some cadastral material under class V for sheets 30 and 47 of Bijnor dated 1898. This material is, however, not complete, and is already getting out of date. The small areas of Sítapur falling in sheets 102 and 116 are being mapped from the old material of this class to complete the sheets of class V. The local authorities have indicated the more important alterations required to bring it up to date, and the necessary field work will be carried out next season.

New material available.

In sheet 120 new material for the city of Lucknow is in hand.

Except for the above no new material is in existence.*

7. The sheets have been reproduced either by photographing down the original field sheets to the 2″ scale and again reducing to the 1″ scale (*e.g.*, sheet 27), or by pentagraphing the original field sheets direct to the 1″ scale (*e.g.*, 117). The printing on the older editions is by hand and conventional signs are of course out of date. The sheets are generally well drawn (121 and 146 are among the exceptions). The country is mostly on a dead level and the few natural features are apparently fairly well shewn by vertical hachures.

Remarks on sheets of Class I (*b*).

8. These maps have lost much of their original value, the sites and names of villages alter rarely, and many groves, streams, and roads remain as when surveyed, but much of the country has been drained, and new railways, roads, and groves have appeared since survey.

Changes.

9. The list of railway lines not entered on these sheets is a long one, and on some sheets lines which are entered have apparently not been surveyed, but drawn in from information supplied by the Public Works Department (*e.g.*, the Rohilkhand and Kumaun line in sheet 116).†

Railways.

The following lines are not entered on sheets of this class:—

O. and R. Ry.	Main line, standard . . .	Sheets 28, 29, 46, and 47.
„ „	Branch Najíbabad-Kotdwára . .	„ 28.
„ „	„ Bálamau-Ataria-Madhoganj .	„ 104.
„ „	Cross line between Sítapur and Bara Banki branches near Lucknow . .	„ 120 and 135.
„ „ and R. and K. Ry.	branches to Sítapur and Bara Banki	„ 120.
O. and R. Ry.	Lucknow to Partabgarh . .	„ 137, and 138.
„ „	Allahabad to Fyzabad . . .	„ 153, 166, 165, 164, and 163.
B. and N.-W. Ry.	Tulsipur branch . . .	„ 160, 161, and 172.
„ „	Jarwa „	„ 172.
„ „	Tulsipur-Uska Bazar . .	„ 173.
„ „	Gorakhpur-Bagaha . . .	„ 190, 204, and 205.
„ „	Bhatni-Benares . . .	„ 194, 208, and 209.
„ „	„ branch	„ 208.
„ „	Jaunpur-Aunrihar . . .	„ 180 and 195.
„ „	Benares-Ballia	„ 210 and 218.
„ „	Ballia-Mau . . .	„ 218.

10. The following are instances of roads not entered on the maps of this class; the list is very incomplete, full information not being available:—

Roads.

Bari to Muhammadabad metalled or partly metalled . .	Sheets 118-133.
Bijnaur-Banthara, 3rd class	„ 121.
Rae Bareli-Sultanpur metalled or partly metalled . .	„ 137, 138, 151 and 164.
Chooka-Púranpur, 2nd class	„ 98.
Púranpur-Dhanaura Ghat, 2nd class	„ 98.
Ajgain-Mohán (metalled or partly metalled) . . .	„ 121.

In nine districts of which the 1st class roads have lately been surveyed, the total mileage of 1st class roads has been found to be 200 miles greater than in 1899, the date of the Public Works Department road statement (Statement of the total length of road communication in the North-Western Provinces and Oudh, 1899). Most of the increase is due to the conversion of 2nd class roads to 1st class, but it affects the value of the sheets, and is presumably likely to continue at some similar rate for years to come.

Remarks on changes in roads.

11. The following are the more important canals constructed since survey:

Canals.

Dist. Jálaun.	Hamírpur Branch, Betwa Canal . . . . Khataund Branch „ „	83 miles in 1887.
„ Cawnpore „ Fatehpur „ Allahabad	Fatehpur Branch, Ganges canal . . . Ghatampur Distributary Ganges canal . .	154 „ 1902.

* NOTE.—The scattered cadastral surveys in Sítapur, class V, 1895-96, can hardly be considered as having provided new material.

† NOTE.—*Cf.* the class I (*b*) and V editions.

United Provinces Standard Sheets.

Each new canal involves a system of branches and distributaries, which materially affect the maps, and the systems of old canals already surveyed are apparently continually being altered or added to (*cf.* Meerut sheets II and V editions).

Rivers.

12. The courses of the Ganges, Jumna, Gogra, Rámganga, and Sardha, and of some minor streams, are continually altering. It would be hopeless to attempt to keep the maps quite up to date as regards river banks and beds, but probably all the sheets of this class, which include the above rivers, are seriously affected.

(c) Surveyed on graticuled sheets.

13. Dehra Dún and the Siwaliks are the only areas mapped in this class and are included in sheets 1, 13, 27, 224, 229, and 230.*

The portion of 27 belonging to this class has been reduced by photography to the 2″ scale (blue print) from the original field sheets and again reduced to the 1″ scale. A new edition was brought out in 1902. No information as to its general value is available (in this office), it appears to be up to date as regards railways, canals, and roads, but many of these have probably only been entered from information.

Class II.—Sheets of hilly country prepared from old topographical 1″ surveys.

14.	Naini Tal, Almora, Garhwál	From 1864 to 1877	27, 45, 46, 63, 97, 230, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261 and 262.

There is no new material for this class, which could be used for topographical mapping.

These sheets vary somewhat in style of drawing and probably in value, but as a whole appear to require comparatively little correction. The hills, as far as information is available, are well represented by a system of "form lines" which are more of the nature of horizontal hachures, than approximate contours and an insufficient number of heights are given at passes in valleys and along roads. Paths to villages are omitted in many instances, and on some sheets, while one plane-tabler has evidently surveyed all the paths, the other has omitted all but main lines of communication.†

Changes.

15. There is a considerable number of forest and other roads which have been made since survey, and in the vicinity of Naini Tal and Almora numerous clearings for potato cultivation have sprung up of late years.

Class III.—Sheets prepared from old topographical surveys on the 2″ scale, 1877–1884.

16. Districts.	Date of Survey.	Sheets.
Sabáranpur	1877-1879	1, 2, 3, 4, 5, 7, 8, 9, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 51, 52, 53, 184, 185, 186, 187, 197, 198, 199, 200, 201, and 202.
Muzaffarnagar	1878-1880	
Meerut	1879-1882	
Bulandshahr	1881-1883	
Aligarh	1882-1884	
Mirzapur	1882-1886	

Portions of Etah appear to have been surveyed on the 2″ scale (*vide* footnotes to S.S. 35, 36, 52, and 53). I have been unable to find any record of a topographical survey in Etah.

New material.

17. There is new material (16-inch cadastral and some 2-inch Provincial surveys, class V) available for Meerut 5, 6, 7, 8, 17, 18, 19, 30, 31, 32, and for Etah 35, 36, 52 and 53. Sheet 6 has already been republished from combined material of classes III and V and all the remaining sheets of Meerut are to be republished on the 2″ scale, the fair sheets being corrected from cadastral surveys.

General remarks.

18. The surveys of this class were mapped both on the 2″ and 1″ scales, the standard sheets being reduced from the 2″ sheets and redrawn.

The style of drawing is fairly good and uniform, but conventional signs are of course out of date. Natural features appear to have been accurately surveyed, but on the 2″ sheets have been overdrawn (especially drainage lines and shallow depressions), and this is exaggerated in the 1″ standard sheets, *e.g.*, very slight shallow depressions, with ill-defined sloping banks appear, in a few cases at least, as ravines with abrupt banks. This may be partly due to changes in the ground. The ground has, however, been surveyed in so detailed a manner that if the above defect is overlooked, a resurvey of natural features is unnecessary except in riverain areas, and the new material of class V is in this respect inferior to the old.‡

19. Village sites and names, minor roads, boundaries, groves, and natural features (except as noted above) have altered little and the sheets require few additions as regards railways.

The following new lines are under construction:—

From Agra by Muttra to Delhi—sheet 8.
Delhi to Sabáranpur—sheets 3, 4, 5, 6, 7, 8, and 14.
§ Hapur to Meerut—sheets 18, 19.

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* Apparently out of print.

† Note by Mr. Kennedy—Changes have been made in the alignment of the Bhim Tal-Almora road, and presumably in the alignments of other roads.

‡ Compare 7 and 8 of classes II and V. Portions have been examined on the ground.

§ The survey of this line is to be carried out in 1904-05 if topographical staff is available.

Omissions of railways in sheets 28, etc., have already been mentioned under class II(*b*) as the areas affected were mapped in that class. Probably some of the lines entered are only entered from information.

Roads and Canals.

The general remarks regarding extensions of roads and canals in paras. 10 and 11 also apply to sheets of class III.

The following canal has been constructed since survey: — Aligarh district, Mát Branch extension 40 miles, 1903.

Class IV.—Sheets prepared from cadastral surveys by regular Survey of India parties; the fair sheets being drawn by the party that carried out the survey.

	Districts.	Years of survey.	Standard sheets.
20.	Moradabad (and Rámpur with Naini Tal Tarai).	1871-1877.	30, 31, 32, 33, 47, 48, 49, 50, 63, 64, 65, 66, 81, 97, and 251.
	Muttra (including Jalesar tahsil of Etah).	1871-1874.	10, 11, 12, 22, 23, and 24.
	Agra	1872-1876.	25, 26, 36, 37, 38, 39, and 56.
	Hámírpur	1872-1877.	77, 78, 79, 92, 93, 94, 95, 96, 108, 109, 110, and 111.
	Bánda	1872-1877.	109, 110, 111, 112, 124, 125, 126, 127, 140, 141, 142, 143, 155, and 156.
	Jhánsi (excluding Lalitpur)	1887-1890.	77, 78, 79, 80, 56A, 57, 58, 59, 39A, 40, and 41.
	Jaunpur	1876-1881.	165, 166, 167, 168, 178, 179, 180, and 195.
	Benares	1882-1884.	180, 181, 182, 195, 196, and 197.
	Mirzapur (portions only)	1879-1884.	169, 170, 171, 182, 183, 184, 197, 198, and 199.
	Gházipur	1878-1882.	194, 195, 196, 209, 210, and 211.
	Ballia	1880-1884.	208, 209, 210, 217, 218, 219, 220, and 221.
	Gorakhpur	1883-1888.	213, 214, 215, 216, 217, 203, 204, 205, 206, 207, 208, 188, 189, 190, 191, and 192.
	Basti	1883-1888.	188, 189, 190, 191, 192, 173, 174, 175, 176, 162, and 163.

21. The portions of standard sheets 65, 66, 67, 81 and 97 not falling in this class have been surveyed, mapped and published in class V (or are under publication). New material is also available for the Jalesar tahsil of Etah (class V), sheets 36 and 37 and will shortly be available, for Thákurdwára tahsil of Moradabad (parts of standard sheets 47 and 48) and for portions of tahsils Amroha, Moradabad, Sambhal and Hassanpur of Moradabad district, and also under class VI for the Cawnpore, Fatehpur and Allahabad areas in standard sheets 92, 108, 109, 124, 125, 140, 141, 155, 167, 168 and 169. The cadastral surveys now in progress in Hamirpur and Banda are providing material for correcting the original sheets of these districts.

New material.

22. From what information is available regarding the Bánda, Moradabad and Hamírpur sheets (the only ones of this class examined on the ground) they appear to be good topographical maps and represent the ground well. The limits of cultivation have been slightly overdrawn. The hilly portions have been topographically surveyed and are sufficiently well shewn, while the changes since survey are comparatively few. They are perhaps with those of class II the most satisfactory sheets of the Provinces in existence, after those of class VI. There is no information regarding the value of the maps of the eastern districts of this class, *e.g.*, Benares, Jaunpur, Ballia. They are probably less satisfactory than those of Bánda and Hamírpur.

General remarks.

Changes.

23. The following railway lines are not entered: —

E. I. R.,	Moradabad-Delhi	branch	48.
„	Moghal Sarai-Gaya	„	197.
O. and R. R.,	Moradabad-Delhi	„	48.
„	Benares-Rae Bareli	„	167.
B. and N.-W. R.,	Gorakhpur-Bagaha	„	190, 204, and 205.
„	Tulsipur-Uska Bazar	„	189.
„	Bhatni-Benares	„	208 and 209.
„	Ghàzipur-Ballia-Chapra	„	210, 218, 219, and 220.
„	Jaunpur Sayyedpur	„	180 and 195.
I. M. R.,	Manikpur-Jhansi	„	58, 79, 95, 111, 126, 127, and 142.

Roads.

The improvements in road communications have been specially marked in Bundelkhand of late years (Hamirpur and Banda), and the remarks under roads in para. 10 apply generally to all districts.

The following are instances of roads omitted: —

District Muttra. Ráya to Sádabad, unmetalled, sheets 23, 24, and 37.
„ Hámírpur. Mahoba-Charkhari, metalled, sheet 95.
„ Bánda-Atarra-Narsini, metalled, sheets 126 and 127.

Canals.

The following canals have been constructed since survey:—

Jhánsi-Betwa canal	19·2 miles	1885.
Muttra-Nandgaon Distributary	28 „	1903.
Muttra-Mát Distributary		1903.

The construction of the Ken river canal now in progress affects sheets 110, 111, 125, 126, and 127, and will be given effect to in the cadastral survey now in progress.

Another new canal, the Dusan, is contemplated in Hamirpur, and provided the land is taken up within the next two years, can also be entered by the cadastral survey.

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Rivers.

Where the Rámganga, Ganges, Gogra and upper portion of the Jumna are included, fluvial action has produced great changes, but the Lower Jumna and the smaller Bundelkhand streams have fairly permanent beds.

Class V.—Sheets prepared from 16″ cadastral surveys by the Provincial surveys. The sheets of all districts drawn in one office.

24. The following sheets have been published in this class, or are under publication :—

Lalitpur	1894-1897	41, 42, 43, 44, 59, 60, 61, 62, and 62A.
Meerut	1894-1897	6,7,* and 8.*
Bareilly	1896-1899	65,66,67, and 68.
Bareilly Pilibhít	}	81,82, and 83,
Bareilly and Sháhjahánpur		84.
Sháhjahánpur	1895-1898	85,86,69, and 70.
Sháhjahánpur and Sítapur		102.
Pilibhít	1898-1900	97.
Pilibhít-Kheri		98.
Pilibhít-Kheri and Sháhjahánpur		99.
Kheri and Sháhjahánpur		100 and 101.
Kheri	1895-1899	113, 114, and 115.
Azamgarh	1899-1903	152.

The following sheets have yet to be mapped in this class with the aid of some supplementary topographical material :—

Districts.	Year.	Standard sheets.
†Meerut	1894-1897	5, 17, 18, 19, 30, 31, and 32.
Kheri	1895-1899	116, 129, 130, 131, and 132.
Bahraich	1894-1898	129, 150, 131, 132, 133, 144, 145, 146, 147, 148, 158, 159, and 160.
Gonda	1897-1901	147, 148, 149, 158, 159, 160, 161, 162, 172, 173, 174, and 175.
Azamgarh	1899-1903	177, 178, 179, 180, 192, 193, 194, 195, 208, and 209.
Jálaun	1900-1903	75, 76, 77, 91, 92, and 93.
Farrukhabad	1898-1902	70, 71, 72, 73, 86, 87, 88, 89, and 105.
Etah	1898-1902	35, 36, 37, 52, 53, 54, 69, 70, and 71.
Mainpuri	1899-1903	53, 54, 55, 56, 71, 72, and 73.

Each sheet has been entered separately under each district of which it includes a portion, the total number of these sheets, not yet mapped, but for which cadastral material is now available, is about 63.

Material expected within the next 4 years.

The material for the following 19 sheets or portions of sheets will be provided within the next 4 years :—

Moradabad, portions of 46, 47, 48, 30, 31, 32, and 33.

Hamírpur and Bánda, portions of 77, 78, 79, 92, 93, 94, 95, 96, 108, 109, 110, and 111.

Of these last three districts, there are, however, good maps of class IV, which require merely to be brought up to date (see class IV). In Hamírpur and Bánda blue 2″ prints will be brought up to date from the cadastral sheets, during the cadastral survey, and from these the original 2″ sheets drawn for reduction will be corrected.

Topographical resurvey of the Jumna river bed in sheets 6, 7, 8, and some revision survey in sheets 8 and 19 has been carried out and is being used in the mapping of Meerut. Sheets 17 and 32 have been sent to the local authorities of Muzaffarnagar and Bulandshahr for the indication of changes, and have been returned as unchanged as regards these districts.

General remarks.

25. The maps of this class are inferior in topographical delineation of the ground to the maps of class IV, which were prepared in a similar manner, *i.e.*, drawn in 4 sections on the 2″ scale from pentagraph reductions of the 16″ village maps, and reduced by photography to the 1″ scale.

While a regular survey party working 4 or 5 years in one district, formerly prepared the 8 to 10 sheets of the district in that period under the supervision of a full staff of officers, and the original cadastral sheets were surveyed by professional surveyors, the maps of this class are all drawn in one office, hitherto under a single officer, and the original field sheets are surveyed by the village accountant, the cadastral survey of a district being supervised by 2 officers only, with a very limited professional staff. For some years topographical requirements were not sufficiently regarded, and with the unprofessional establishment of surveyors and the limited amount of professional supervision, it is extremely difficult to ensure the correct survey of such details, as sand banks, broken ground and river beds, etc.

These deficiencies are, however, of much greater moment in some areas (*e.g.*, the submontane tracts of Oudh) than in the flat country of the *doáb*.

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* For methods used in mapping sheets 7 and 8, *vide* class III, page 3.

† The Meerut mapping is an exception to that of this class, see remarks at para. 16.

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The only maps of this class which have been professionally examined on the ground, are those of Lalitpur. In spite of defects, such as the omission of hachures or form lines, except in the actual hills, and of some hamlets, staging bungalows, and milestones, while the hills were only fairly well drawn, the sheets appeared to be otherwise good topographical maps, and streams, boundaries, and villages were well shown.

26. The following railways have been constructed or begun since the preparation of the sheets :—

R. and K. R. Dadua-Mundun Choki branch 113 and 114.

Delhi-Saharanpur (under construction) 6, 7, and 8.

Class VI.—Sheets prepared from modern 2″ topographical surveys (No. 14 Party).

	Districts.	Date.	Sheets.
27.	Allahabad, Fatehpur	1901-1903.	124, 139, 140, 141, 154, 155, 156, 157, 167, 168, 169 and 170.
	Cawnpore	In progress.	

These districts have been surveyed topographically on the 2″ scale and are now being published as quarter standard sheets, on that scale. It is understood that they will be reduced by photography to the 1″ scale direct without redrawing. They will, when published, be the only truly topographical maps of the Provinces of modern date.

Area not mapped in standard sheets.

28. The hill region of Tehri Gárhwal was surveyed about 1850 on the ¼″ and ½″ scales and there is no 1″ material for it. It is understood that standard sheets of Tehri Gárhwal will be produced by instructional surveys as occasion arises.

General summing up.

29. The only sheets which at present require no revision or supplementary work at all are those of class VI.

Those of class III are somewhat out of date in riverain areas, and as regards artificial detail, *e.g.*, roads, canals, railways, and there are considerable changes in the cultivated areas in some sheets.

Those of classes II and IV also require only revision to bring them up to date.

The above classes may be considered as fairly good topographical maps, or at any rate as the basis of good topographical maps.

The maps of class V in flat districts of the *doáb* should be good topographical maps and up to date, but in the less thickly cultivated and more undulating districts, while sufficiently good for administration purposes, as regards topographical detail they are inferior, and supplementary survey is required to make them good topographical maps. All the maps of class I not already replaced by maps of other classes, should be replaced by new surveys of class VI. Much could be done to improve the sheets by revision instead of resurvey, but the best revision would be inferior to resurvey in results, and as the changes are not confined to artificial detail (*e.g.*, roads and railways), revision would imply going over the whole of the ground, and might prove little less expensive than a resurvey. The districts concerned are :—

Bijnor, Budaun, Hardoi, Sítapur, Unao, Lucknow, Rae Bareli, Fyzabad, Sultanpur, Partabgarh and portions of Etáwah.

30. The programme of future surveys should include :—

Field work required to bring the mapping of the province up to date.

A—The topographical survey of the 10 districts mapped in class I above mentioned.

B—The supplementary topographical survey of the sheets of class V, a beginning being made with the sub-montane districts, Bahraich, Gonda, and Kheri. The districts of Mainpuri, Farrukhabad, Etah, and Jálaun will require much less supplementary work, but when opportunity arises they should be examined on the ground to see how far they fulfil topographical requirements. Also the gaps formed by Native States in Jálaun should be topographically revised.

C—Some arrangements will be necessary to bring up to date the maps of classes II, III, and IV. The riverain areas should be resurveyed, but as the topographical detail of the remainder is already sufficiently good in the majority of the sheets, it would probably be sufficient if lists of new works, railways, roads, canals, buildings, and drainage schemes were carefully made out, and each new work surveyed on the ground.

D—Having secured good topographical maps by the above means for the whole Province a permanent revising staff should be maintained to keep them up to date. The existing machinery for obtaining information of changes in the maps appears to be quite inadequate, and information is obtained (in this office) with difficulty. Some scheme could certainly be drawn up with the help of the different Departments concerned, which would provide for a record of all changes affecting standard sheets.

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