For Departmental Use

Surbey of India

DEPARTMENTAL PAPER No. 16.

MAP POLICY

BY COLONEL J. D. CAMPBELL, D.S.O.

PUBLISHED UNDER THE DIRECTION OF
BRIGADIER H. J. COUCHMAN, D.S.O., M.C.,
SURVEYOR GENERAL OF INDIA.

PRINTED AT THE PHOTO.-LITHO. OFFICE,
SURVEY OF INDIA, CALCUTTA, 1937.

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FOREWORD.

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The object of this paper is to stimulate consideration by all officers of the problems that lie before the Survey of India.

For over 30 years we have been steadily pursuing our main function, the production of a contoured topographical map of India, and now that we are within sight of completion it is essential that our ideas as to future work should crystallise into some fairly definite plan.

The organisation necessary for the production of new maps from original surveys is simple compared with that required for efficient and economical maintenance of these maps.

India is a country of contrasts. Over large areas few important changes in topography occur but in others changes are great and rapid. Our organisation for maintenance must take account of these contrasts and we cannot therefore carry out topographical revision or correction on the orderly plan adopted for our original survey.

In some areas 30 year old topographical maps might be tolerated; in others 10 year old maps are unserviceable.

The most important suggestion in this paper is the abandonment of the attempt to maintain one inch maps over a considerable area. The arguments in favour of this are cogent and though at first sight it may seem a retrograde step further consideration will, I feel sure, prove it to be eminently desirable.

Comments on this and other suggestions are invited from all officers. The action to be taken will have to be left to my successor.

CALCUTTA,
31st March 1937.

H. J. COUCHMAN, *Brigadier,*
Surveyor General of India.

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MAP POLICY.

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DEFINITIONS.

I use certain expressions which require definition, as follows:—

"*Maintenance*".—The bringing out of up to date editions at fairly regular and not too long intervals.

"*Maintenance period*".—The period, for any series of maps, when the whole of it is based on modern surveys, or the general period when all our maps are so based.

"*Transition period*".—The period until the maintenance period is reached.

"*Edition interval*".—The interval between successive issues, other than reprints from standing plates.

"*Size of edition*".—The number of sheets printed for sale and free issue, excluding all bulk orders from the Army, or for any special purpose.

The terms "maps for gridding" and "maps in grid areas" include all maps shown on the grid index, including those shown under head "need not be gridded until a demand arises".

OBJECTS OF PAPER.

2. This paper records the conclusions I have come to as a result of consideration of our map policy while Director of Map Publication. Its objects are—firstly, and mainly, to provide an appreciation of the situation and to record facts and figures to help others to decide matters which will, sooner or later, have to be decided; and secondly to record my own personal opinions as to what changes in our outlook and policy are desirable. The paper follows the lines of a note submitted unofficially last year to the Surveyor General and read and criticised, also unofficially, by Colonel Lewis. Some modifications have been made in the light of those criticisms, and of the orders passed by the Surveyor General.

3. The main reason for distribution of the paper is I think that it is desirable in the interest of efficiency and continuity of policy, that all officers should understand the problems ahead of us, even though they may disagree with my particular opinions on them. The lack of continuity and of any general plan in the way our policy has developed since 1905 is, in my opinion, very apparent. It is hoped that, as a result of the opening of these questions, it may be possible to lay down some principles of policy in Chap. I of the Handbook.

4. It is obviously useless for us to take up, or continue to maintain now as part of our permanent policy, any maps which it will be impossible to maintain efficiently during the maintenance period, or which are not sufficiently useful or in demand to justify their retention. In reviewing present policy, I can see no other way than to start with the maintenance period and work backwards. It will, I think, be very difficult when that period is reached, to change to a new policy unless the foundations have been laid by a thought out and continuous one applied during say the next 10 years.

It seems certain that, at no distant date, the whole question of Survey of India policy will have to be reconsidered, possibly by a Government or Departmental committee. If this is so, the more the questions which will arise can be aired beforehand the better.

5. Any discussion now must, of necessity, be based on assumptions as to the future which may well be falsified, as we do not know what changes the 'Reforms' will bring, and,

above all, what the budget provision will be during the maintenance period. Nevertheless, consideration now is, in my opinion, urgent, for the following reasons:—

(*a*) That referred to above, that we shall be better prepared when maintenance policy has to be finally settled.

(*b*) Changed conditions have already arrived, in that correction survey has actually started. It has to be remembered that revision and correction survey will afford no training for surveyors and will give us little data to enable us to classify them. Consequently, in order that training surveys shall not be unproductive, it may be desirable to overlap our correction and original surveys to a greater extent than we now contemplate.

(*c*) Our present policy is far from satisfactory, having been evolved without any real consideration of the all important question of maintenance.

(*d*) We are having more and more to compete with maps prepared by Local Governments, Automobile Associations and other agencies, and we have to reconsider our methods in face of this competition. The rough and ready map kept more up to date is taking the place of the beautifully produced map; and it is disheartening to say the least, that even Survey officers find it necessary to buy the productions of Local Governments for use on tour.

(*e*) Changes now may take a long time to have effect and may only begin to do so after the maintenance period is reached.

(*f*) Any conclusions arrived at affecting personnel may affect our present recruiting policy.

ASSUMPTIONS AS TO THE FUTURE.

6. As regards the assumptions necessary, it is, I think, a foregone conclusion that our total budget will not be increased during the maintenance period. In order to get anywhere, we must make some assumptions, and I assume that it will not be materially decreased, *i.e.* that we shall be allowed to retain more or less our present personnel. If it is decreased, the arguments in this paper will be considerably strengthened.

7. The above is not the only consideration, and a very important point may be whether, if our total budget is not decreased, we shall be able to reorganize so as, if found necessary, to increase expenditure on reproduction, at the expense of drawing and field work. On the face of it, as we shall be substituting revision and correction for original survey, with the result that field work will be many times more rapid than now, and re-drawing will only be necessary of a proportion of sheets, it seems likely that, to preserve the balance, expenditure on reproduction should increase relative to that on survey and drawing. If this is so, will the result be merely a reduction of personnel engaged on field work and drawing, or will we be able to spend more on reproduction? These are points on which we can only conjecture, and the only safe assumption is that we will not be able to expand materially in any direction. In any case, the possibility of expansion in Calcutta is very limited, owing to accommodation difficulties, and any considerable expansion would probably have to be done at Dehra Dūn.

GENERAL POLICY.

8. Before we can consider what our future policy should be, it is important to decide what we mean by 'policy' and what should be included under that head. It is evident that it cannot be looked at merely in the light of maps published, but must include some system of efficient maintenance. It is obviously possible to go on producing maps and series *ad infinitum* if we give no thought to whether we can reissue them at sufficiently regular and frequent intervals to ensure them being kept reasonably up to date.

9. The cardinal principles underlying our general maintenance *policy* should in my opinion be:—

(*a*) *Financial.*—That we have a fixed budget, and that the problem is, with the amount of money at our disposal, to give the best service we can to the map user, and also, as a corollary, get back the maximum amount by sales. Petty considerations of the balancing of costs of particular processes against recoveries, and of losses due to scrapping of obsolete maps, may well defeat the above objects.

(*b*) *Maintenance.*—That the fewer maps there are, the more up-to-date is it possible to keep them. That unnecessary duplication of series is an evil, and that an up-to-date map or series on a smaller scale may be better than a less up-to-date one on a larger.

(*c*) *Technical.*—That the map user mainly wants a clear, up-to-date map which fulfils its object and that he is not usually interested in artistic excellence or in nice points regarding symbols. We should not therefore go in for unnecessary refinements in drawing, and we should face inconveniences arising from processes if they are those which best enable us to maintain up-to-date maps.

These principles underlie all the recommendations made in this paper.

10. When considering the question of keeping maps up-to-date we have, I think, been inclined to take the hopeless attitude that little can be done owing to the "size of India". Actually this has only an indirect bearing on the problem. What counts is the number of maps and series which are published. The larger the country, the fewer of these can be maintained efficiently. With a fixed amount of money to spend, map service may consist of a large number of maps which must perforce be reissued infrequently or a smaller number kept more up date. There is no question in my mind that the latter is the correct policy, and that we have adopted the former. In framing any policy, I think we should bear the above very strongly in mind, and that we should give full consideration to the question of maintenance, ruthlessly cutting out any unnecessary maps and keeping to the smallest scales which serve the purpose. We should at the same time constantly consider technical processes, cutting out any over refinement or unnecessary work.

HISTORY.

11. The following history shows briefly what is our present general policy and how it has developed:—

(*a*) The Survey Committee, in 1905, made recommendations as to what maps it should be the primary duty of the Survey of India to publish, as follows:—

Standard sheets;	1-inch scale.
Reductions from standard sheets;	½-inch scale.
	¼-inch scale (District maps, engraved).
	1/M scale, Map of India (engraved).
General maps of India;	1″=32, 64, 80, 96, 192, 256 miles.

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They also recommended that the Government of India should prescribe the general and special maps which it is the duty of the Survey of India to produce.

(*b*) The recommendation is, I think, worth quoting in full:—

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

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(*c*) Since then, the number of our maps and series has gone on steadily increasing. The actual number now published or which we intend to publish, appears in para. 13.

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(*d*) The Survey Committee recommended an engraved map of India on the scale 1/M, in place of $\frac{1}{16}$-inch provincial maps. The Department had started on a 1/M series of maps in

1899, in accordance with the recommendations of the Seventh International Geographical Congress of that year. The Congress hoped that all civilized governments would co-operate in the production of a map of the world on this scale. At the time of the Survey Committee only a very few sheets had been issued and none completely engraved. Thus the origin of our 1/M Indian and Adjacent countries series was much the same as that of our more recent International series. The Survey Committee recommended the carrying on of the series and placed on record that the Commander in Chief had asked for an engraved map on the $\frac{1}{1\,6}$-inch scale for strategic purposes. They considered that the $\frac{1}{1\,6}$-inch province map then existing, would meet his wishes 'for the present', and that the new map would gradually become the strategic map of India as materials for its production become available from the revision of the 1-inch standard sheets.

(*e*) To this single series we have now added the layered edition of the same series (now being dropped sheet by sheet as replaced by the International sheets), the 1/M Carte Internationale du Monde, and the political and layered editions of the 1/2M. In addition, we have kept up the province maps which were recommended to be superseded.

(*f*) The $\frac{1}{2}$-inch compiled series was introduced, as the Army decided that this was to be the scale for the tactical map of India. This idea was abandoned, but still the $\frac{1}{2}$-inch map remains.

(*g*) Against the above additions, we have cut out the $\frac{1}{8}$-inch series and substituted in (1913) $\frac{1}{2}$-inch for 1-inch maps over considerable areas.

12. The above shows clearly the way our maps, especially geographical series, have been added to without, as I think, any thought for the morrow. There is no evidence that the question of what consititutes efficient maintenance of any of these maps and series has ever been considered, nor even whether their simultaneous production is feasible. In other words we have no 'policy' in the sense defined in earlier paras.

PROGRAMME.

13. The approximate number of map sheets which we shall have for maintenance when that period is reached is as follows—Burma maps being included in the totals. We do not, at present, know whether we shall continue to maintain Burma maps, but it seems certain that we shall for a long time at least, have to print those which Burma decides to keep up. For the present, we must consider India and Burma surveys as one, at any rate as far as reproduction is concerned, with an unaltered programme. The numbers of sheets forming the 1/M and 1/2M series are approximate, as our exact programme is uncertain.

	Approx. No. of sheets.
1/2M political edition	21
1/2M layered edition	21
1/M India and Adjacent Countries, political edition	84
1/M International series	59
1/M Aeronautical series (omitted for the present).	
Province maps	20
General maps, 32 mile map, political	12
General maps, 32 mile map, layered	12
50 mile wall map	4
50 mile road map	1
64 mile map, India with hills	2
64 mile District map of India	2
64 mile Cotton map of India	2
67 mile Railway map of India	1
80 mile Tourist map of India	1
128 mile map of India	1

	Approx. No. of sheets.
General maps, 160 mile Cotton map of India No. 1	1
160 mile Cotton map of India No. 2	1
160 mile Outline map of India	1
192 mile Outline map of India	1
Guide maps, about	30
Manœuvre and Radius maps, about	30
Miscellaneous maps, about	10
¼-inch maps	857
½-inch maps	1821
1-inch maps	5223
TOTAL ...	8198

PRESENT REISSUE POLICY.

14. Our reissue policy, since 1921, has been to print an edition of each individual sheet calculated to last 10 years, on the basis of estimated sales, and to make successive reissues when stocks are approaching exhaustion. (See also para. 50 (*a*)). No difference has, at any rate since 1926, been made with regard to the different maps or series, or maps of different localities, and it has not been considered that any class or scale of map should be reissued, on its merits, more frequently than any other, nor has the question of whether it is possible to reissue the enormous number of maps at 10 years intervals been considered.

Actually, with our present organisation, it is quite impossible to do so. Had estimated sales been realised, we would have been forced long ago to reconsider our whole policy or expand in the necessary directions.

15. The rules governing the size of editions were laid down in 1921, *vide* office order No. 5 (Professional), dated 11-11-21, by D.M.P. (Copy attached, App. A). This order was amplified and superseded by D.M.P., in his C.M. No. 1116/S, dated 26-4-26 (copy attached, App. B). These both laid down 10 years as the interval between editions of modern maps on all scales. Chap. I, para. 9, deals with the question, and lays down that revised editions may be necessary in some areas every 5 years. To print new editions of all our 8200 sheets every 10 years when the maintenance period is reached will entail average annual issue of 820 sheets, a figure which speaks for itself. Actually it is not the full figure, as we have to add an unknown number of Extra-Departmental and miscellaneous maps.

16. It is necessary to go more deeply into the effect of the orders issued as regards size of editions, as these are the bed-rock of our present maintenance policy. It is a matter which particularly concerns the Director, Map Publication, because he has, in the past, been the sole arbiter of how many copies of maps are printed, upon which decision, so long as we normally only reissue when stocks are approaching exhaustion, the amount of work in the Reissue Section and Photo.-Litho. Office in after years depends. To realize this, we have only to contrast the sizes of editions as laid down by different Directors of Map Publication in the orders in App. A and B, and to judge what might have been the different effect on the present situation.

17. It is obviously necessary that the size of editions must have *some* bearing on our reissue policy, because, when stocks become exhausted, we are forced to reissue, whatever our policy, whether or not we have any important office copy corrections, or revision or correction in the field, for incorporation. In the absence of standing plates, we cannot merely reprint, so we are obliged to go through all the processes, including fresh colour separation. This is very undesirable, and points to size of editions being kept large in case of sheets of which plates are not standing.

18. We can only be forced to small editions by Audit objections to scrapping stocks, or by ourselves giving weight to the undesirability of so doing, as is implied by our present policy. The printing of extra copies costs little more than the price of paper, and we must not be prevented from keeping maps up-to date by our own, or Audit, objections to our writing off the value of such copies at face value. Hitherto, the point has had little importance, as it is evident that a policy of only reissuing maps on exhaustion of stocks cannot lead to the necessity for writing off many copies. The position will be quite different if we substitute a different reissue policy as discussed in paras. 48-57.

19. Face value of a map.—It must, I think, be considered that the face value of a Departmental map is largely, if not entirely, an arbitrary figure, representing its value to the purchaser, although the cost of printing a certain number of copies may be a convenient way of calculating it. Any attempt to regulate size of editions in order to recover the cost of printing (see orders in App. B) is futile, especially as such cost, even if realized—as it often is not owing to the copies not being sold—is only an infinitesimal part of that of bringing the map to printing stage. Thus if we should fail to convince Government or Audit that we are obliged in the interests of efficient maintenance to scrap map stocks where necessary, we must face small editions, regardless of the greater cost per copy (on paper) of printing such editions.

20. Without going into actual figures, we can get a fairly true picture of how a 10 years edition policy should have worked it applied from the start, by assuming a programme of 8200 sheets, taking 40 years to prepare; the following would have been the annual issue of sheets:—

	New Sheets.	*Reissues.*	*Total.*
1st 10 years	205	.....	205
2nd 10 years	205	205	410
3rd 10 years	205	410	615
4th 10 years	205	615	820

We should now be somewhere near the end of the 3rd 10-year period, and so should have some 600 annual issues, shortly to increase to 820.

Mention should be made here of fresh plate cases, *i.e.* where an immediate reissue is not contemplated, but fresh standing plates are required. These may not increase the actual number of reissues in a year, but they may add to the number of sheets passing through every process except actual printing, starting from correction in the Reissue Section.

21. The following actual figures for issues other than reprints are interesting in comparison with the above:—

	Topo. Maps.		Geographical Maps.		Total
	New.	*Reissues.*	*New.*	*Reissues.*	
During 1925	225	16	10	2	253
During 1926	236	73	5	25	339
During 1935	143	139	3	5	290

The reason that actual reissues fall so far short of theoretical is simply that expected map sales on which sizes of editions were based have not been realized.

POSSIBLE OUT-TURN.

22. Publication.—The last O. C. P. L. O., prepared a statement, App. C, regarding possibilities of annual publication in his office. It is apparent that the 'bottle-neck' is the Retouching Section which deals with duffing, which must be considered to be the reproduction process which imposes the greatest limit on our out-turn. According to the figures in App. C., we cannot turn out regularly more than some 300 Departmental sheets in the P. L. O., to which must be added a possible 50-90 in the P. Z. O., Dehra Dūn.

These figures have been, to some extent, challenged by the present O. C. P. L. O., who, while admitting that actual out-turn in the Retouching Section does not now, when working

to capacity, exceed a maximum of about 30 Departmental sheets a month, or say an average of 300 per year, points out that, in 1929, with a 16% weaker Section, 422 Departmental sheets were duffed. This is difficult to account for. It may be partially due to reverse duffing for rotary press plates having slowed up the work.

23. We have proved quite clearly that, from the reproduction point of view, our theoretical policy of an average 10 years edition interval is impossible, and that, when the maintenance period is reached, we shall, if we retain our present number of maps without increasing possible output, have to be satisfied with something more like a 20-25 year average interval.

24. Field work and resultant re-drawing and correction.—The question of revision and correction surveys is mainly dealt with in order to consider whether limitations in the number of sheets we can revise and correct in the field are likely to impose a still longer edition interval, *i.e.* whether we can survey and draw fewer than we can reproduce.

25. Regarding field work, the first point for decision appears to be what is to be the extent of revision and correction. The only calculation I have seen regarding probable rate of progress was based on the assumption that a surveyor will be able to correct 6 one-inch or 2 half-inch sheets in a season, or revise 1½ one-inch or ½ half-inch sheets. It was assumed that 4 sheets in 5 will be corrected and 1 revised, and that 150 surveyors will be retained for field work (the remainder being employed on drawing), who will correct 4000 one-inch and 200 half-inch sheets in 5 years and revise 1000 one-inch and 50 half-inch in 5 years. The resulting conclusion was that 150 surveyors could correct all our topo sheets in about 10 years.

26. Correction survey can, I think, be looked upon in two ways—(A) Complete correction, *i.e.* that of all details which have changed, (B) that of particular major items, such as new roads or railways etc. The former must be, to some extent, systematic, *i.e.* carried out in blocks according to a prearranged programme. The latter may be carried out here and there as required. I do not think that (B) should be regarded as correction survey at all when considering our reissue policy, but merely as office copy corrections verified in the field. I shall refer to these two forms of correction as (A) and (B) respectively.

27. The figures in para. 25 are much more optimistic than those in my original note. When one considers that 6 one-inch and 2 half-inch sheets contain 54 and 72 5-minute squares respectively and that there are not more than about 120 working days in the normal field season, such progress, allowing only from 1½ to 2 days in each 5-minute square, seems impossible as an average, unless we intend to confine ourselves to major corrections (B). As reproduction is likely to enforce a much longer edition interval, there seems no point in rushing over the ground at this pace and I assume that we shall carry out correction (A).

28. (*a*) I think the question of correction (A) is a very difficult one especially as regards some types of ground, where it is doubtful whether such correction is justified owing to the very impermanent nature of the detail to be corrected. If we are to restore our maps to anything like their original standard, we must correct all minor changing detail, *e.g.*, roads, paths and tracks, cultivation limits, water channels, buildings, plantations, gardens &c. Vegetation will usually have to be resurveyed.

(*b*) Such correction is justified where minor detail is fairly permanent but this is by no means always the case, *e.g.* in the types of country in the following examples:—

(*i*) In many areas, such as parts of the Lushai Hills and other hill districts of Assam and Bengal, all cultivation is temporary, and, as such, is omitted from our maps. This is not the whole difficulty, as village sites also change continually with the shifting cultivation, as do all communications, which mainly connect villages with each other or with the patches of cultivation. The only permanent features are the streams and hills, which do not require correction, so that correction surveys, if carried out, would only be of constantly changing detail, and consequently of little value, being out of date by the time the map is published.

(*ii*) As a less extreme case—in the country round Bangalore, probably the most prominent features of the landscape are the casuarina plantations which show up at great distances and are very prominent landmarks. According to my recollection, these are always cut down after from 7—10 years growth, so that they are constantly changing.

(*c*) I am not offering a solution to these difficulties, beyond suggesting that there might be cases where correction (A) would not be justified at all, and others where something between (A) and (B) would suffice.

29. For purposes of this note, something has to be assumed, and I suggest an area covered by 3 one-inch sheets as an average out-turn per surveyor per season, on any scale, taking revision and correction surveys together. This may be too optimistic or too pessimistic, but we have no data to go on, and it will serve for an examination of what would be the resulting edition interval.

30. Regarding drawing, the difficulty is to decide what proportion of sheets will require re-drawing. The large majority of maps will require a new tree sheet. All revised sheets will have to be re-drawn, and I consider it safer to assume that at least 40% of the corrected sheets may also require it. I assume that 50% of the total revised and corrected sheets will be re-drawn, and allow for one re-drawn sheet and 1 corrected sheet taking 18 months per draftsman, an average of 9 months per sheet.

31. Proportion of surveyors to draftsmen.—The following calculations are, of necessity, entirely conjectural, but again it is necessary to make some assumptions in order to arrive at an idea of how many surveyors will be available for revision and correction survey.

To determine the proportion of surveyors and draftsmen which will be necessary in order to complete survey, and drawing or correction of originals, in the same time, let X be the number of surveyors and Y that of draftsmen employed on primary topo. sheets.

No. of sheets drawn or corrected per year $= (Y + \frac{1}{2}X)\frac{1}{3}$.

" " " revised or corrected in the field $= 3X$.

In order that drawing shall keep pace with survey, $3X$ must equal $(Y + \frac{1}{2}X)\frac{1}{3}$.

Whence $7X = 4Y$.

32. The actual numbes of sheets accessible for revision or correction in the field will be as follows, see table B, App. G.

	1-inch.	½-inch.	¼-inch.
India	4,350	380	60
Burma	870	34	...
TOTAL ...	5,220	414	60
Grand Total, about ...	5,700		

The total number of sheets for reissue will be about 8200, or about 40% more than the above. As these extra sheets will include all the small scale ones that are particularly required to be kept up to date, we must allow at least 40%, or $\frac{2}{5}Y$, more draftsmen for work on other than primary topo sheets. At the beginning of the maintenance period, when all our 1/M etc. series will not be complete, we may have to allow a higher proportion. Hence if we consider Y' to be our *total* number of draftsmen, $49X = 20\ Y'$ and number of draftsmen will have to be more than double that of surveyors. Our total of draftsmen and surveyors, exclusive of those specially employed, and excluding Burma, is now about 235 draftsmen and 240 surveyors so that we would have to convert about 90 surveyors into whole time draftsmen, although the number might vary from year to year. We would have about 150 surveyors and 325 draftsmen.

33. The conclusion is, I think, that we cannot rely upon having more than about 150 surveyors available for revision and correction survey in India. Considering our acces-

sible topo. sheets in terms of 1-inch sheet areas, there are about 6830 such areas, so that, with 150 surveyors, the work of revision, correction, and drawing, would take about 16 years, on the asumption already made that 3 1-inch sheet areas could be dealt with in a season. This question is further considered in paras 54—56, when dealing with suggested edition intervals.

CONCLUSIONS ON GENERAL POLICY.

34. Considering merely general policy, the conclusion seems to be that reproduction is likely to be the limiting factor as regards average edition interval, chiefly owing to the large number of topo. maps; that we cannot hope for a better average interval than 20-25 years, unless we take one or other of the following steps:—

(*a*) Increase the strength of the reproducing offices. Calcutta is not capable of much expansion, though Dehra Dun is. It looks as though we might sacrifice field and drawing strength to do this.

(*b*) Decrease the number of our maps. This point is dealt with on other grounds later on in this paper. It seems eminently desirable from all points of view.

(*c*) Evolve some new technical methods enabling the reproducing offices to turn out more sheets. This particularly refers to the bottle-neck of colour separation. This is also dealt with later, as there are many other considerations which affect it.

SALES.

35. Before leaving the subject of general policy, I point out the following data regarding sales, in confirmation of the conclusion that our policy has only not broken down because we have not sold our topo. maps. It is not possible to get out complete information regarding sales without undue labour but I have had the information got out for certain areas (details appear in my previous note) selected because:—

(*i*) they contain few gridded sheets (what there are have been cut out).

(*ii*) 1-inch and ½-inch maps have both been in existence for a considerable time.

Thus they give information about typical less important sheets, the sale of which is not abnormal owing to military requirements.

(*d*) Areas selected fall in (*a*) Orissa, (*b*) United Provinces, (*c*) Bombay and Western C. P. (*d*) Madras. They are average areas, no specially marked type of country predominating, sales being the average of the last 3 years.

The following averages result :—

	¼-inch		½-inch.		1-inch.	
	No. of sheets on which based.	Average annual sale.	No. of sheets on which based.	Average annual sale.	No. of sheets on which based.	Average annual sale.
Area (*a*)	3	14	15	4	60	5
(*b*)	2	39	19	19	91	5
(*c*)	4	30	21	3	90	2·5
(*d*)	8	19	38	1·5	157	4
General	17	23	93	6	398	4

Further comments will be made when dealing with policy for topo sheets.

36. We may here usefully compare the above figures with the sales of other maps. I have tabulated actual sales of each map of the 1/2M and 1/M series, and of certain other

important maps, during the last 3 years, and the detailed figures appear in an appendix to my previous note. The results are as follows:—

Map.	*Average annual sale.*
1/2M, political.	30
„ , layered.	23
1/M, I & A. C.	86
1/M, International.	51
Province maps.	79
32-mile, political.	50
32-mile, layered.	*20?
64-mile	28 (very out of date)
50-mile road map.	2928

POLICY FOR INDIVIDUAL MAPS & SERIES.

37. To leave general policy, and to turn to that in connection with individual maps and series, I think that the term 'policy' has here to be held to have a wider meaning. We have to consider that 'policy' embraces the following points for each map or series individually, as each head has a bearing on the maintenance question:—

(*a*) What is it for?

(*b*) What shall we show on it?

(*c*) How should hills be shown?

(*d*) What shall be its limits?

(*e*) What do we intend to do as regards maintenance and reissue, having regard to the particular map?

(*f*) What technical processes shall we employ, having regard to the maintenance policy decided on?

(*i*) Compilation. (*ii*) Drawing. (*iii*) Reproduction.

Any general overhaul of our policy for the maintenance period would have to deal as explicitly as possible with the above points. The main principles should be (*i*) that we should omit all information not likely to be of particular value and which cannot be kept reasonably up to date, (*ii*) where we do want to keep information up to date, and can do so, we should make special efforts to that end.

Decisions on such points of policy, as well as on general policy, should, I think, be made with more deliberation than those on points of detail which are often of little interest to the map user. A study of the files makes it very evident that, whilst general opinions are invited on the most trivial questions in connection with, say, symbols on topo. maps, decisions on infinitely more important questions of policy, particularly regarding small scale maps, are made in Calcutta without any reference at all. This is I think very undesirable, in the interests of efficiency, and perhaps more especially that of continuity. See para. 80, regarding methods of correspondence.

38. The following examples under the heads in para. 37, illustrate my meaning:—

(*a*) The 32-mile map has always been mounted as a wall-map, but in its preparation it was never treated as one. Names are quite illegible at any distance. If we intended it as a wall map we should have said so quite clearly, and proceeded to try and turn out the best possible example.

Province maps were previously treated as ordinary maps. Recently most have been re-drawn in wall-map style. This I consider to have been a definite change in policy. Most pro-

* An approximate figure, as only the period since the reduction in price to that of the political edition has been considered.

vinces publish road maps. Do we or do we not intend our province maps to compete with these and supply up to date road information?

(*b*) This question hinges on the above, *e.g.* it was decided to cut out all minor roads on the new 40-mile map for two reasons (*a*) that we cannot issue it as frequently as other maps and thus cannot hope to keep roads reasonably up to date (*b*) that a wall map need not be expected to show such information. This I consider an example of a definite point of policy.

(*c*) The new map "The Highlands of Tibet and surrounding regions" is specially intended to illustrate the formation of the mountain system. A question arose whether to omit layers on permanent snow, as is done on most of our maps. It was considered that this would defeat the main object of the map. The result was to sacrifice the depiction of details of snow and glaciers which was thought not to be necessary on a map on this scale, particularly as such features appear on all our other maps from ¼-inch downwards.

(*d*) This requires no special comments, except that no series should be extended beyond limits of its usefulness, in view of the desirability, already proved, of cutting down the number of our maps. Practical effect has already been given to this as regards Arabia and elsewhere.

(*e*) This is the most important point of all. It is perfectly useless to treat all maps alike, as we do at present. If we intend to try and keep a map or series up to date as regards particular items such as roads, aeronautical information, &c. we must have a definite policy as regards reissues directed towards that end. An outstanding example of want of a policy is the Aeronautical edition of the International 1/M series. We have published some sheets under our usual plan of sitting down and waiting for stocks to be exhausted, which they never will be. Various firms in India are doing a very good business supplying strip maps made by combining parts of our 1/M sheets, brought up to date by hand, an example of treating a special map in a special way. We have now dropped these maps until we can think of a way of delivering the goods. (See also para. 44).

(*f*) Here again we should adapt our methods to maintenance requirements. Maps should be clear and neat, but we should not sacrifice the essentials, for superfine drawing and reproduction. This subject is dealt with at greater length elsewhere in this paper.

INDIVIDUAL MAPS & SERIES.

39. To turn to individual maps and series:— It is not necessary to comment on all our genera maps:—

(*a*) *The 40-mile map* is being prepared to replace both the 32 and 50-mile maps, after consultation throughout the Department. This is an important map and it is hoped the new map will be permanent.

(*b*) *The 64-mile map* might be an important one, but is hopelessly out of date. It is in abeyance for this reason, but may be revived later, probably by direct reduction from the 40-mile map. It serves as a small wall-map or a table-map, and should perhaps show the same as the 40-mile map with possibly some deletions. The insets would be too small.

(*c*) *The 80-mile tourist map of India.* This map is practically identical with that published, up-to-date, at very frequent intervals in the Indian Bradshaw, certain information for tourists being added. We grossly over-estimated sales in 1929, and have so large a stock still in hand that Government of India sanction is required to write it off. Under our present policy, such items as the new Provinces and State Agencies and the important railway connecting Raipur with the East Coast at Vizianagaram, will not be shown for 20 years, the period for which stocks are estimated to last.

(*d*) *Radius and manœuvre maps.*—These have been the subject of a good deal of thought and correspondence during the last year and a definite policy has now been laid down, *vide* M. P. O. No. 3560, dated 18-3-37.

(*e*) *Province maps.*—We have until lately prepared these maps by combining print originals from 1/M series plates. The Census Commissioner recently asked for province maps and we had to prepare some *de novo*. The new style maps are intended to be wall-maps, are rather coarsely drawn and have very few names—rather fewer than the 32-mile map, which is on about half the scale. In my opinion, even if it is admitted that wall-map

style is required, names are in some cases unnecessarily large and we could show more. The maps show all roads.

It has been decided to complete the series of maps in this style. Most provinces now prepare maps of their own with which ours have to complete, I consider that these maps may be of great importance, especially if we can prepare and maintain them in consultation with provinces. They could easily be converted into good road maps and it should be especially easy to keep them up to date. If provinces become interested, we should make special efforts to do this, and thereby recover some of our lost touch. Under the new constitution, provinces will become more separate entities.

The Surveyor General's comment on these maps is as follows :—

"The present (wall-map) style of these should be continued with possibly a few but certainly "not many more names. I do not consider that names on the U. P. and Delhi maps are "too large. I agree that in the case of province maps, above all other small scale *general* maps "(excluding road and railway maps), the keeping up to date is all important especially as re- "gards roads and railways. The edition interval of the more densely populated provinces "should probably be not greater than 4 years. The possibility of surprinting or insertion "by hand of *major* changes of roads and railways on these roughly drawn maps is perhaps "worth consideration. In any case neatness of drawing must be sacrificed to speed."

40. Geographical series—General.—There are no maps about which greater thought is required and about which it is more necessary to clarify our ideas than the 1/M and 1/2M series. The origin of the former has been described in para. 11 and it has been pointed out how the geographical series have been added to and multiplied.

The difficulties of producing and maintaining so many series simultaneously are so formidable and the present situation is so chaotic that I represented to the Surveyor General last year that we ought to give the subject our very serious consideration.

It is perhaps not realised how few of our published 1/M and 1/2M maps are yet entirely based on modern survey. To illustrate this, I attached an index to my previous note showing areas of such survey which are completed and which have and have not been incorporated.

The Surveyor General commented on this index as follows :—

"I am most definitely of opinion that we cannot successfully maintain both the I. & A. C. and "International series. Experience has proved this conclusively and the time has come to "give up the attempt. The indexes in your App. K indicate our failure clearly. In these "indexes red represents areas of modern survey not included in published sheets, purple "those which are included. Taking the area for which International maps have been pro- "duced, I find that in the case of the I. & A. C. sheets the proportion $\frac{\text{purple}}{\text{red and purple}}$ is 53 "per cent.; in the International sheets it is 34 per cent. These figures are a measure of "(*i*) the delay of production of 1/M sheets generally and (*ii*) the relative "out of dateness" "of International sheets. The ideal percentage is 100 (*i.e.* no red areas) and though this is "of course unattainable, one might at least expect 70 per cent."

41. The original suggestion of the International Committee was that we should adapt our I. & A. C. Series to the International one. The then Surveyor General suggested that we should publish both series, the I. & A. C. mainly as a political, and the International mainly as a physiographical map. The Government of India agreed to the suggestion, on his recommendation.

I repeat below some of the arguments used in my previous note against the continuance of all our present geographical editions and series. The difficulties are mainly technical ones, in connection with compilation and drawing, which are increased by two factors—(*i*) that fresh material is continually becoming available (*ii*) In the case of the 1/M, that the two series have to be drawn, re-drawn, corrected, and largely even compiled, entirely independently. The arguments against a 'political' and a 'physiographical' series, or two such editions of the same series, are not nearly so strong if at any rate the basic plates can be made common to both, independent compilation, drawing, and correction not being entailed.

Some of the technical difficulties referred to above are:—

(*a*) In order not to delay the compilation of a small scale sheet we often do not wait for the component ¼-inch maps, but compile direct from 1-inch or ½-inch. These big jumps in scale much increase the difficulties of compilation and the time taken. It takes about five years to produce an engraved original or revised sheet of the 1/M, India and Adjacent Countries series, see para. 59. I am going into the question of how this can be reduced, but for the present we must accept this time.

(*b*) The preliminary work done in connection with a sheet of one series does not necessarily serve for the corresponding sheet of another, as, owing to date of taking up revision depending mainly on exhaustion of stocks, further modern survey or other information may have to be included. Hence we have sheets of different series continually rendering each other out of date, a necessary result of trying to keep up so many series at a time, during the transition period.

(*c*) Sheets come up for reissue on exhaustion of stocks. If only major corrections are required the reissue is comparatively simple, but sufficient new information—possibly in the form of modern survey—may have to be incorporated in a sheet to necessitate re-engraving or re-drawing. Even this is not final, as the sheet may again have to be brought up to date from further modern survey at the next issue, involving the same result. This is bad enough for one series only, but I consider that it leads to an impossible situation when it has to be done for several series simultaneously.

(*d*) Apart from the slowness of the engraving, there is no question that the very slow progress made by draftsmen in our drawing offices in preparation of mosaics and patterns must be taken very seriously into consideration when deciding our programme.

42. To take the geographical series individually—

(*a*) 1/2M—*S. W. Asia Series.*—This is being prepared in two editions, political and layered, outline being identical. At first it seems that these two editions can be considered as one from the maintenance point of view. Actually, under present reissue policy, this is only so in the case of sheets both editions of which are published simultaneously and the stocks of which approach exhaustion at the same time, which is impossible to ensure. We may thus at any moment, have the layered edition less up to date than the political, an important railway, say, being shown on the latter and omitted on the former. (This objection, of course, disappears if we ignore stocks in hand and always supersede both editions when one is reissued).

There is now no question of the abandonment of this series.

The Surveyor General's comment on the above points is:—

"I do not consider that two editions are necessary. To have two editions of the same map "must always introduce complications when one edition but not the other, approaches "exhaustion;" (see note in brackets above) "moreover it seems an unnecessary luxury. To "decide which to abandon is not easy. The actual issues of the political edition are nearly "double those of the layered and though this may be partly due to the recently abandoned "difference in price it points to the abolition of the latter. An additional argument for "retaining the political edition is that the 1/M series will in future probably have only a "layered and not a political edition. On the other hand the 40-mile map, which will be "the nearest in scale to the 1/M series, is not to be layered nor, except for the Highlands "of Tibet map, will there be any layered map on a smaller scale than 1/M, opinions should "be invited on this point; my own view is that the political edition only should be main-"tained. If this is decided, we can abandon contours, which I consider to be unsuitable on "an unlayered map on so small a scale; and indicate relief by vertical shade and liberal "spot heights." This question will be aired shortly and further comment is unnecessary in this paper.

43. 1/M series.—The Surveyor General's decision that we should abandon the attempt to produce two independent 1/M Series will necessitate much further correspondence and consideration of details, and Government of India sanction may be required to drop out

altogether the political edition, which is now provided by the I. & A. C. Series. Such sanction would probably not be required if we decided to maintain a political series on the 'International' lay-out, without independent drawing. In the following paras., when referring to the retention of the International, and the abandonment of the I. & A. C. Series, I do not rule out the retention of a political edition on the above lines, nor, in view of the latitude we have as regards the International Series, do I rule out the possibility that it may be based mainly on our present I. & A. C. originals.

(*a*) *Transfrontier.*—(*i*) First to consider the Army. The only 1/M maps required to be gridded—including those shown under the head "need not be gridded until a demand arises"—are those falling in the 100% and 50% grid areas, *i.e.* on or beyond the Frontier. Hence it appears that the Army is not interested in the 1/M maps in other areas and that they are no longer required as a complete strategic series. The Army presumably do want the 1/M as a strategic map in the 100% and 50% gridded areas and now also in connection with aviation in war, and would therefore have to be consulted. If the series we wish to adopt fails to meet Army needs on the Frontier and beyond, we have the alternatives of modifying it to meet them or of issuing special 1/M maps in the 1/M sheet grid areas. As the Army usually prefer special symbols, it is quite possible that the latter would be the best course. The C. G. S. is already considering preparation of such maps, on the 1/M scale, to replace the present map of Afghanistan on the scale of 24 miles to the inch.

(*ii*) *Transfrontier areas where 1/M maps are not required to be gridded.*

The idea behind the International series is that the whole world should be somebody's pigeon. Hence we are called upon to produce maps extending beyond the Indian frontier in what may be described as India's area of mapping responsibility. We should not, I think, interpret this too liberally, in view of India's comparative poverty and enormous internal mapping commitments. We are, I think, quite justified in substituting the 1/2M in sparsely inhabited countries beyond the Indian frontier.

(*b*) *General.*—The abandonment of the I. and A. C. series, or its adaptation to the International series, may seem a drastic step but I believe it to be the right course. The subject of aeronautical maps is much to the fore and, sooner or later, we will be obliged to take it up seriously. The only alternatives seem to be a special series, or overprinting on the International series, flying being essentially an International concern. I have recently discussed these points with the officer from the office of the Director of Civil Aviation, who is specially concerned with map questions, and the above views are his. The only disadvantage of the International series seems to be that heights and contours must be in metres. Is this really a serious disadvantage for maps on this scale? We can have a comparative scale of feet and metres. The Surveyor General's orders on these points are as follows:—

"Having then decided not to maintain the two independently drawn series, we have to decide "the style of the series which is to be maintained. On this general point I consider that "Departmental opinion should de invited. Before doing so, certain decisions can be made.

"(*i*) Series should conform to International sheet limits and numbering. We must however "retain our own 1/M numbering also, and this could be added thus:—

"N. G. 42 (40 & 35 East' / 45 & 54 West') or N. G. 42 (40 A to P 35 I to P)."

"(*ii*) Heights and contours should be in metres.

"Though there may be disagreement over these, I am certain that, committed as we are to "participation in the International Series, we are bound to adopt them. Metre heights are "it is understood being increasingly used in aviation and as our 1/M series is likely to be "the basis of aviation maps for many years it seems inevitable that we should have them. "Except possibly in gridded areas I do not consider that a series with contours in feet is "necessary.

"In my view we are not bound slavishly to conform to all the Carte Internationale symbols "and style and it is here that opinion should be invited by you. In particular the contour "intervals and layer colouring of the International map are perhaps not very suitable for "India; the former are perhaps too small for lower altitudes and the brown layers begin "too low. Contours at say 300, 600, 1,000, 1,500, 2,000, 2,500, 3,000, and thereafter by

"1,000 metres would enable us to carry the lighter green layer up to 600 metres. On the "other hand to scrap all existing contour plates may not be worth while."

This question is further discussed in para. 75 (*i*) to (*k*) under present problems.

44. Aeronautical maps.—(*a*) We have not yet considered a special series, the only aeronautical maps we have issued being in the form of overprints on sheets of the International 1/M series. A serious though in some respects misinformed criticism appears in App. D, in the form of a copy of a letter, dated 24th July 1933, from the Chief Instructor, Delhi and U. P. Flying School, to the Director of Civil Aviation. The officer concerned does not know our difficulties, but nevertheless we cannot altogether afford to ignore such criticisms.

(*b*) I have heard of three firms in India who specialize in the preparation and sale of strip maps made up from our 1/M sheets, with aeronautical information, new roads, railways etc., added by hand. I have seen one such map made by a Karachi firm on which several railways have been thus added. This has become the recognized source of flying maps, a position in which we cannot but acquiesce until we can find some way of providing up-to-date maps. A copy of a letter in "Indian Aviation", which appears as App. E, is of interest in this connection.

(*c*) The Director of Civil Aviation is interesting himself in the subject of flying maps, and, as already referred to in para. 43 (*b*), I recently discussed it with the officer of his Department who is chiefly concerned, who shares any opinions I express. There have also been recent enquiries from the R. A. F. and the matter cannot be shelved indefinitely.

(*d*) Up-to-dateness, in case of flying maps, has two aspects (*a*) that of the map itself (*b*) that of the aeronautical information. Of these two, (*a*) is far the most important, especially as regards prominent landmarks, such as railways, canals, roads, large rivers etc. Information as regards (*b*) is readily obtainable by any pilot from publications issued by the Director of Civil Aviation, and provided we make it clear on the map up to what date the information is corrected, the user should be in a position to bring it up-to-date himself. See reference to this point in App. D.

(*e*) If we intend to maintain an aeronautical edition of our 1/M International series, it affords the strongest possible argument for concentrating on this series and for bringing at least the Indian portion of it up to date as quickly as we can. See also para. 75 (*j*).

45. The following extracts from the Report on the Progress of Civil Aviation—1934, is of interest in connection with the general question of aviation maps. Note the edition interval, *vide* first sub-para.

"Revised editions of the Aviation Maps of Great Britain were issued by the Ordnance "Survey Office during 1934. Notifications of corrections by means of Notices to Airmen have "been continued to enable possessors of aviation maps to keep them up to date, and amended "editions of the various map sheets are to be issued in future at intervals of not more than six "months.

"Co-operation with the Home Office has enabled structures exceeding 200 ft. in height "above ground level situated outside the boundaries of cities or towns, to be marked on the "Aviation Maps as obstructions to air navigation.

"The existing Aviation Maps still remain, in essentials, maps adapted for air use from "the standard type of Ordnance Survey map; while this is of only slight disadvantage in the "case of the series on the four-miles-to-the-inch scale, in the case of the ten-miles-to-the-inch "scale, serious shortcomings are unavoidable. It is hoped that it will be possible to put in hand "shortly the production of an air map of Great Britain, probably on the 1/500,000 scale, which "will be drawn with special regard to the requirements of air navigation, instead of merely "being adapted from existing plates.

"Sheet M. 30 (the 'London' sheet) of the International Million Series, specially over-"printed with air information, was prepared for examination by the Maps Sub-Committee of the "International Commission for Air Navigation, in accordance with the resolution to adopt the "sheets of this Series as local aeronautical maps. It is hoped that preparation of another of the

"sheets for which Great Britain has accepted responsibility, will be undertaken during 1935. "The Sub-Committee has also actively pursued the question of the preparation of the first basic "sheet of the International Aeronautical Map of the World on a scale of 1/10,000,000 at the "Equator. This sheet, A. IV., extends in latitude from the Equator to 47°N, and in longitude "from the meridian of Greenwich to 90°E. It is being produced by the French Government "and has already reached the proof stage. It is hoped that publication will be effected during "1935."

46. Topo. Series.—1-inch and original ½-inch.

(*a*) Topo. series afford another difficult problem, not so much for technical reasons, but mainly because of the number of sheets involved. There are 7870 1-inch, ½-inch and ¼-inch sheets in our programme including Burma. Such of our smaller scale maps as are entirely based on modern surveys are not likely to change very materially with each edition and can usually be brought up to date without survey in the field, which is not the case with topo maps. In the following sub-paras., I discuss the substitution of ½-inch for 1-inch maps in many areas. My view is that this will be forced on us unless we are satisfied with a very long interval between editions, and also that, in certain areas, it is desirable on its merits.

(*b*) Maintaining only ½-inch maps where we now have 1-inch may seem a retrogade step. In my opinion, it is preferable to the only possible alternative of allowing our topo. sheets over large areas to become permanent back numbers. It must be remembered that we would not be substituting ½-inch maps for 1-inch equally up to date. We can, area for area, with the same effort and expenditure in connection with publication, reissue ½-inch maps four times as often as 1-inch. Further, to bring 16 one-inch maps up to date and then not sell them is a wasted effort. To bring 4 half-inch sheets up to date and then try and push their sale is a less wasteful policy if it does not succeed.

(*c*) Provinces vary greatly in the maps produced by their own agency, and arguments in favour of 1-inch maps are much less cogent in such provinces as have an elaborate mapping system of their own. In any case, the question arises whether we can be expected to keep up 1-inch maps for provinces which do not contribute, unless required by the general public. These questions cannot be answered until someone decides what are the functions of the Survey of India in future; a question, which, under the new Constitution, will be bound up with that of the relations, financial and otherwise, between the Central and Provincial Governments. If we do keep up maps for official purposes, on a larger scale than is required by the general public, we must have some guarantee that they will be purchased. This question is dealt with at greater length in para. 79.

(*d*) No doubt, especially if they have not got to contribute, the P. W. D., Forest Department, Geological Survey etc. will prefer 1-inch to ½-inch maps in certain areas. But, by not keeping 1-inch maps up to date, we are not depriving these of the main information they require regarding natural features, boundaries etc., which appear on earlier editions. Railways, roads, etc., are quite adequately shown on the ½-inch scale and minor detail in India such as cultivation boundaries, minor tracks and paths, &c., is generally so impermanent as not to be worth surveying or revising on the 1-inch scale. See also para. 28.

(*e*) There are certain areas where I have personally no doubt that, from all points of view, ½-inch maps are adequate, and, in these, I definitely suggest the abolition or indefinite postponement of reissue of 1-inch maps. (See also para. 75). Actual areas would have to be recommended by Circles concerned. It might be necessary, at the next edition, to improve the ½-inch maps and add more names.

(*f*) From the point of view of the public, the main consideration seems to be whether all, or most, names can be shown on the ½-inch scale. Officials have always access to provincial maps, showing all village names. This criterion conforms to the adoption of a population standard, as laid down in Chapter I, para. 20. I have scrutinised all published maps and indicated, on an index map attached to my previous note, the areas in which ½-inch may suffice. All 1-inch maps in gridded areas are shown as for maintenance on that scale, even if falling in ½-inch areas. The same principle would be adopted in case of sheets which are especially important on other accounts.

(*g*) On account of the difficulties involved, I am not putting forward any detailed recommendations, and my index map must merely be considered as forming a basis for the broad examination of the effect of dropping 1-inch maps on general grounds, where ½-inch maps would seem to be sufficient for the public. I have left the detailed investigation to the Circles concerned, if ordered by the Surveyor General, see para. 75(*f*). I have prepared a separate index on a population basis, by surprinting an enlargement of the map in the 1934 Census Report on one of our indexes. This index map has been distributed with my No. 1159S, dated 21-4-37. As is to be expected, there is a considerable agreement between the two indexes.

(*h*) Consideration of sales leads to the conclusion that ½-inch maps are just as popular as 1-inch.

CONCLUSIONS.

47. To sum up, I consider that the general considerations which pointed to the cutting down of the total number of our maps in the interests of maintenance are strongly supported by the conclusions based on examination of particular series. The decision to cut down geographical maps has been approved, and I strongly recommend for consideration the maintenance of ½-inch maps, as the largest scale, in selected areas now covered by 1-inch maps. This need not involve correction in the field on the ½-inch scale, which I do not advocate in all cases. (See also para. 75(*f*) and (*g*)). The dropping of maintenance of 1-inch maps would be merely an acknowledgment that we cannot maintain them efficiently. I prefer the term indefinite postponement of reissue to abandonment. If we correct on the 1-inch scale, maintenance could always be resumed. Isolated important 1-inch sheets, or groups of such sheets, could be maintained in ½-inch areas, and maps for gridding would always be so maintained. The dropping of compiled ½-inch maps has often been discussed. This measure would not be very effective if it were the only step taken to reduce topo. maps, as, area for area, it would only result in a 20% reduction as against the 80% achieved by substituting ½-inch for 1-inch. It is not, I think, to be recommended on its merits in all cases, as the preparation of ½-inch maps is a useful stepping stone between the 1-inch and ¼-inch. Moreover there are great advantages in having the whole of India covered by maps on the ½-inch scale, so that sheets can be mounted together to cover particular areas.

FUTURE REISSUE POLICY.

48. Edition interval.—While recommending that a systematic edition interval policy should be substituted for the present one, I recognise that this is a difficult subject.

I stress very strongly the desirability of keeping our small scale maps up to date because:—

(*a*) The smaller the scale the wider the circle interested in the map.

(*b*) Our small scale maps compete with similar maps prepared by other agencies.

(*c*) There is generally a mass of information on larger scale maps relating to unchanging physical features, which may be of great value whether the map is up to date or not regarding artificial and changing features. Small scale maps are chiefly used in connection with administration (involving boundaries etc.), place names, and means of communication. If these are wrong, the maps are of little use.

(*d*) Sale figures show that small scale maps are the most in demand.

49. Small scale maps are easier to keep up to date systematically because:—

(*a*) The plates, being few, can be, and are, kept standing, meaning we can risk smaller editions. (This is a factor under our present system of reissues and subject to there being objection to writing off stocks.)

(*b*) The smaller the scale, the smaller the number of sheets to be maintained in each series.

(*c*) Office copy corrections are usually accurate enough for inclusion without verification in the field.

(*d*) The main foundation of small scale maps is not in most cases subject to great change. It should be comparatively easy to evolve a method of keeping changing features, *e.g.* roads, up to date by using a separate plate or original, as discussed elsewhere.

50. The factors which may govern edition interval are:—

(*a*) *Popularity, i.e.* demand, as reflected by sales. The demand for individual sheets is the only outside factor that is taken to some extent into consideration in our present system, *e.g.* stocks of popular sheets do exhaust earlier, and consequently edition intervals tend to be shorter. The principal reason for this is that the tendency has been to standarise the size of editions at a constant figure, 500 in the case of topo. sheets. Indeed, if demand for the individual sheet is the only factor to be taken into consideration, the printing of a fixed number of copies and reissue on exhaustion of stocks is a fairly reasonable policy. It actually was our policy up to 1921, *vide* App. A, and was superseded by our present theoretical one, which is to multiply the expected sales by ten and print the number of copies thus arrived at, which policy if it actually worked, would result in the demand for a particular sheet having no shortening effect at all on its edition interval. The popularity factor can be considered from the point of view of series as a whole or of individual sheets. Figures show that normal sales (leaving out special bulk cases such as sales to the army) tend to increase inversely with the scale, down to the 1/M, and then decrease. See paras. 35 and 36.

(*b*) *Out-of-dateness*, as apart from age. This is an uncertain factor. An extreme case would be that of maps of irrigation areas, where previous maps may be rendered completely useless in a very short time by the introduction of new irrigation. This factor only affects individual sheets, or groups of sheets, but never a series as a whole.

(*c*) *Possibility of having a short average edition interval.*—This is a factor which cannot possibly be ignored when framing a maintenance policy, *e.g.* supposing there are 50 maps in a series, and, owing to its popularity, *i.e.* the average sales being high, or for some other reason, we wish to have an average edition interval of 5 years, we can probably do it, as only 10 average annual reissues are involved. If we wished to do the same thing with our topo maps, average annual reissues would be in the neighbourhood of 1000.

51. I think we should aim at a definite average edition interval for different classes of maps and series as a whole, varying this for individual sheets in accordance with factors (*a*) and (*b*) of para. 50. I admit, as qualification, that the transfrontier portion of a series need not be considered from the same point of view as the Indian portion. The remarks in this para. may be taken to apply with most force to accessible areas. Transfrontier portions of each series might be dealt with as a separate whole, but, in their case, consistency is not so important, and 'demand' and new information are the main factors.

In case of Indian sheets, I am against too much stress being laid on the 'demand' factor as applied to individual maps. The reputation for up-to-dateness of a series as a whole is an important consideration, and, in my view, individual sheets not in demand merit nearly as much attention as others, especially in case of smaller scales. They may not be wanted by so many people, but may be more wanted by some! An aviator, for instance, is not consoled for being led astray, by the fact that a sheet has not been brought up to date, because of want of general demand. This point was brought up during the discussions referred to in para. 43 (*b*), and the opinion was expressed that, had we an aviation series, complete and with a reputation for up-to-dateness, there would be a ready sale of complete sets to aviation organisations abroad. This question of up-to-dateness of a series as a whole is further referred to in para. 78.

52. In para. 26, I have divided correction into (A) and (B), as a result of which we should have two kinds of reissues:—

(A) To incorporate results of revision or correction in the field.

(B) To incorporate office copy corrections; whether or not verified in the field. I shall hereafter refer to these as (A) and (B).

It is the dovetailing of these two which will, I think, present one of the difficult problems during the maintenance period. (A) will be very important as regards Topo. sheets, especially in military areas. The importance of (B) as compared to (A) will increase as the scale decreases. (See also arguments in my paras. 48 (*c*) and 49 (*d*)). The edition interval under (A) will be governed by the field programme, though incorporation in maps may lag behind its completion. That under (B) will be largely independent of it.

53. Practicable edition intervals.—In order to calculate what edition intervals are within our resources we must assume some definite average intervals, however little we may believe in the possibility of working to them. The ideal would be to have a field programme which would enable us to correct topo sheets at the desired interval entirely under (A).

Our theoretical asumptions as regards small scale sheets must be on a different basis, and the edition interval must be largely independent of (A), although, in practice, reissues may be held up, in certain cases, until (A) is completed.

54. As a theoretical programme, we might assume a general revision or correction of all topo sheets in the field every 20 years and of important sheets, *e.g.* those in grid areas, every 10 years, to be immediately followed by incorporation in reissues. If we could do this, reissues of 1-inch or ½-inch sheets under (B) might be very rare indeed, or non-existent. Combining this with suggestions for edition intervals of the more important small scale maps, I tentatively suggest the following average edition intervals for the more important cis-frontier sheets:—

(*a*) Original 1-inch, ½-inch and ¼-inch, and compiled ½-inch, in gridded areas, or otherwise of special importance, all ¼-inch and manœuvre and radius maps.	10 years.
(*b*) Original 1-inch, ½-inch, and compiled ½-inch elsewhere	20 ,,
(*c*) Guide maps	10 ,,
(*d*) 1/2M and 1/M all series	5 ,,
(*e*) Province maps	4 ,,
(*f*) Wall map and 64 mile map	6 ,,
(*g*) 50 mile road map	2 ,,
(*h*) 67 mile railway map, as at present	1 ,,

55. It must be clearly understood that I am not suggesting the automatic reissue of all sheets within the above intervals. What I suggest is that we should organise so as to be able to do so, and that at any rate all sheets, especially those on small scales, should be reissued within such intervals if there are major office copy corrections, such as new railways, roads, etc. In case of certain maps, such as the road map, or any other which is intended to give absolutely up to date information, the edition interval must be much more rigid.

56. Practicability.—To consider the practicability of these intervals—Figures below indicate the effect on the number of regular topo sheets for maintenance, of dropping 1-inch and substituting ½-inch, in accordance with the index map referred to in para. 46(*g*), and of dropping compiled ½-inch.

Figures are given for four schemes:—

A. The final maintenance position in accordance with present programme.

B. Ditto, dropping compiled ½-inch.

C. The final maintenance position, substituting ½-inch for 1-inch in areas indicated in my index.

D. Ditto, dropping compiled ½-inch.

Scheme A.

	1-inch.	½-inch.	¼-inch.	TOTAL.
India	4,354	1,545	746	6,645
Burma	869	276	91	1,236
TOTAL ...	5,223	1,821	837	7,881

Scheme B.

	1-inch.	½-inch.	¼-inch.	TOTAL.
India	4,354	457	746	5,557
Burma	869	34	91	994
TOTAL ...	5,223	491	837	6,551

Scheme C.

India	2,665	1,545	746	4,956
Burma	77	276	91	444
TOTAL ...	2,742	1,821	837	5,400

Scheme D.

India	2,665	936	746	4,347
Burma	77	271	91	439
TOTAL ...	2,742	1,207	837	4,786

I have also prepared Tables A and B, which appear as Apps. F and G. These tables show, by categories, the number of map sheets resulting from schemes A—B above, and the average annual numbers which would have to be issued, and revised or corrected in the field, respectively, to maintain the edition intervals suggested in para. 54. Table A deals with all sheets, whereas B deals only with sheets which are accessible for systematic revision and correction.

Regarding reproduction, schemes A, B, C, and D, above, involve average annual reissues of 519, 434, 392, and 344 topo. sheets in India and Burma, to which must be added an annual average of about 40 other sheets (reduced from about 55 by abandoning the 1/M, I. & A. C. Series), *vide* App. F. We thus confirm the conclusion already arrived at that we must be satisfied with much longer edition intervals, or abandon 1-inch maps in many areas, as being the only course which will reduce the total number of maps on a sufficiently drastic scale.

As regards field work, it is convenient to convert the number of sheets for revision or correction to terms of 1-inch sheet areas, as has been done in para. 33. The approximate number of such areas in India/Burma is:—gridded, 1913/115; non-gridded, 4918/890. To maintain the suggested edition intervals for accessible topo sheets, the number of 1-inch sheet areas corrected or revised annually in India/Burma would have to average 437/56, with about 150/20 surveyors available.

If a surveyor can turn out 3 such areas per field season, the suggested intervals are about right from the field-work point of view.

57. The Surveyor General has commented as follows:—

"*Para. 46 generally.*—The more I study this question the more certain I am that you are "right.

"First I am sure that over large areas the half-inch scale is perfectly adequate for all map "users except specialists such as geologists, for whom you allow. By abandoning one-inch "therefore we are not giving worse service, apart from any question of maintenance.

"Second whatever success we may achieve in speeding up reproduction it is clear that the first "reissue of sheets from corrected originals will have to go through the whole process of "colour separation. In other words any speeding up will have very little effect on "the earlier years of maintenance of topo sheets, the great majority of first reissues of which "will be from old corrected originals." (This is not quite in agreement with my assumption "in para. 30 that a large proportion will require redrawing).

"We cannot reckon on more than 400 sheets per annum at the very outside with colour "separation of which about 40 will not be standard topo. sheets. Consequently reissues of "standard topo. sheets will for years be limited to a maximum of 360 sheets per year or an "average edition interval of $\frac{5223+1821+857}{360} = \frac{7900}{360} = 22$ years, minimum. Since probably at "least $\frac{1}{4}$ of these sheets *e.g.* gridded areas, will obviously have to be issued at much shorter "intervals the average edition interval for other sheets will be greater. (Say 1900 topo. "sheets have to be issued at 10 year intervals *i.e.* 190 sheets per year. This leaves "(7900-1900) 6000 to be issued at (360-190) 170 per year *i.e.* an edition interval of "$\frac{6000}{170} = 35\frac{1}{4}$ years *an intolerable figure*).

"Your scheme C reduces number of topo sheets for maintenance by 1765. This gives an edi- "tion interval for ordinary sheets of $\frac{6000+1765}{170} = 25$ years which is long enough in all cons- "cience. With scheme D we have a further reduction of 851 sheets (total reduction 2616) "of which say, 200 sheets are in the 10 year category *i.e.* 20 per year. This gives an edition "interval for ordinary sheets of $\frac{7900+2616+1700}{170+20} = 19$ years."

TECHNICAL PROCESSES.

58. It remains to consider technical processes and how they affect the maintenance problem. I divide these under the heads compilation, drawing, and reproduction.

The following remarks refer especially to geographical and other small scale sheets prepared in No 1 D. O. The drawing of topo. sheets, especially primary ones, presents no particular problem. Field parties are accustomed to draw what they survey and, although drawing is slow, on the whole it keeps pace with requirements. This is not so in the case of small scale maps. Here the draftsman has not the incentive of working to a programme which he is expected to finish in a given time and I believe the psychological effect of that incentive to be immense. There is not sufficient superiority of the finished result in case of our 1/M sheets, say, to justify the entirely different standard of time taken. If there were such a difference, it would not compensate the map user for the lack of up-to-dateness which results from the slowness of production.

59. The figures below are given me by No. 1 D. O. for the time taken to complete an engraved original or revised edition of a 1/M sheet of the I. & A. C. series, entailing drawing or engraving:—

(*a*)	Compilation (direct from ¼-inch*)	6 months.
(*b*)	Obtaining print reduction from P. L. O. for mosaic	1½ ,,
(*c*)	Inking up mosaic	3 ,,
(*d*)	Obtaining print for pattern	½ ,,
(*e*)	Drawing pattern, outline	6 ,,
	,, ,, , names	6 ,,
(*f*)	Examination of pattern	6 ,,
(*g*)	Engraving	15 ,,
(*h*)	Examination of proofs and correction of plates†	3 ,,
(*i*)	Publication, including proof correction and preparation of colour guides etc.	9 ,,
	TOTAL ...	4 years 8 months.

The long time taken would be bad enough if we were preparing a map with some finality, but, as pointed out in para. 41 (*c*), the whole process may be repeated more than once as new material comes in during the transition period.

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*May be considerably longer if compilation is direct from 1-inch or ½-inch.

†Head Engraver's estimate is 6 months.

60. Compilation.—I make the following suggestions regarding compilation :—

(*a*) The work in No. 1 D. O. is, I consider, more than can be controlled efficiently by one man. Further, compilation is usually done by officers with no local knowledge, which must tend to increase the difficulties, to lengthen the time taken, and possibly to make the result less satisfctory, however carefully the work is done, as I know it is. Matters will improve when the number of geographical series is reduced, but I think the decentralization of compilation should be seriously considered.

(*b*) For the above reasons, I put forward the following, which is only one of many possible solutions but which has, I think, considerable possibilities :—

(*i*) That we should concentrate on province maps, which are roughly drawn and can be got out much quicker, and which we hope to publish at frequent intervals, using the compilations as a basis for sheets of the engraved geographical series.

This plan of doing our rough compilation for India proper on a provincial basis and publishing results frequently, in the form of quickly prepared province maps fits in with my previously expressed view that such maps should be kept well up to date, as they have to compete with maps prepared by other agencies.

(*ii*) A natural development, which appears to me to have so many advantages that I strongly recommend it for consideration, is that Circles and Independent parties—the areas of responsibility of which closely follow provincial limits—should be responsible for rough compilation of province maps, as well as keeping up to date of originals, applying their local knowledge and profiting by their being in close touch with provincial governments. We could even go further and suggest that parties should take an interest in the small scale maps of the areas in which they operate.

(*iii*) These basic compilations should be kept up to date continuously, at any rate as regards inclusion of modern surveys so that they would be available at any time when it is required to take up a new edition of any general map, or sheet of a geographical series. Sheet compilations could be made by mosaicing from prints of the province ones. Thus all overlapping of compilation would be avoided, and Calcutta would, for maps completed there, be merely responsible for preparation of mosaics, and patterns to guide draftsmen or engravers, for drawing or engraving, and for publication.

Indian States or groups of States would have to be dealt with by the Circles in which they mainly fall.

(*iv*) Compilations, though on a provincial basis, need not be in the exact form of provincial maps, especially as regards number of names. They might include the maximum number of names and amount of detail required for any of the general maps, province maps, or geographical series; and the necessary modifications could be made to adapt them in each case.

(*v*) An objection that I foresee is that Calcutta collects all office copy information, and should therefore do the compiling. Admittedly, No. 1 D. O. has all the up-to-date information regarding roads etc., but even if it is necessary for this arrangement to continue, I do not think that it should be difficult to arrange for frequent periodic communication of information to circle D. Os.

(*vi*) I think that anyone who has seen the congestion in 1 D. O. can hardly fail to see some attraction in these proposals.

61. Mosaics, patterns etc.—

I have done my best to introduce changes which will speed up the presentation of the compiled map to the draftsman or engraver for final drawing. The patterns which have been prepared in 1 D. O. have been as elaborate as fair sheets, which they should be, seeing that they take a year to make. In some cases, patterns have been found to be good enough to publish as the final map. If the Engraving Office require such elaborate patterns, I can only say that engraving is an entirely unsuitable way of drawing a map. Another flaw in 1 D. O. procedure seems to me to have been that so much examination has been done after the preparation of this elaborate pattern, resulting, in some cases, in a great part of it having to be corrected. Examination should be completed at mosaic stage as far as possible.

62. Drawing.—There is considerable doubt whether engraving is suitable for maps in India. It is rarely used elsewhere, and other countries turn out very satisfactory examples of maps such as the International 1/M without it. The crux is the question of names. Our defence of engraving is apt to take the form of insistence that Indian draftsmen cannot hand-print, and yet we are prepared to admit that it takes 7 or 8 years to train an engraver. Have we ever spent as many months on the intensive training of a hand-printer? The patterns prepared in 1 D. O. have one merit, in that they prove that we have men who can hand-print quite sufficiently well and fairly fast. We could perhaps get pupils from say the Calcutta School of Art who have quite a fair proficiency in hand-printing already. Another point is that engraving tends to tie work to Calcutta, whereas I think that decentralization of drawing as well as compilation is very likely to be the ultimate solution, especially as regards the International 1/M series. We should not only consider hand-printing, but also keep an open mind as regards other possible methods of name production. An extract from "The Standard Mapping Method of the Geographical Section G. S. Canada." which appears as App. H. deals with one solution.

The Admirality, which has adhered to engraving for charts, uses an engraving machine which has been seen recently by our Head Engraver, and about which he is preparing a report. The process of producing names is really more die stamping into the copper than engraving. It is claimed that, with this machine, names can be produced in approximately 75% less time than by hand-engraving. The result appears very satisfactory, though it is not known how soon the dies begin to wear and whether they can be easily replaced. Any style of lettering can be used, the dies being made specially in accordance with any pattern submitted. The machine is said to cost about £ 700, with £ 60 extra for each disc on which the dies are mounted. There are no machines anywhere in stock, but one can be built within 2 years on receipt of an order.

63. Reproduction.—The system by which we produce maps in colours by separating the black, red, and blue, by duffing on negatives from a combined original, has become the accepted one. It is not that followed by other surveys, and as it has a very definite bearing on the maintenance problem, we should not accept it is the final method without examination.

The disadvantages of the present system from the maintenance point of view, are as follows:—

(*a*) That already pointed out, that the Duffing Section is a bottle-neck in our reproduction system which cannot easily be expanded in a wholesale way. It is the factor in the whole process of map production which imposes the biggest limitation on possible annual output of sheets.

(*b*) It means that, for every reissue which is not a reprint or where corrections cannot be made on the plates (plate correction is another difficulty and it is not desirable to increase it), the whole process has to be gone through again and all existing plates, if standing, have to be scrapped.

(*c*) Where corrections are so heavy that re-drawing is neccessary, even if such corrections are mainly to be done in one colour, the whole sheet has to be re-drawn.

(*d*) A single worn plate cannot be easily replaced.

(*e*) Elaborate colour patterns have to be made as guides to the duffer.

64. An advantage of the present system is that bad registration due to relative displacement of detail on originals which is to be appear in different colours is avoided. Other sources of bad registration remain, *i.e.* misplacement of paper in printing, or paper distortion arising between the printing of one colour and that of another. The last is a source of great trouble in Calcutta, where humidity varies tremendously from day to day. Incidentally, we face errors of registration due to relative displacement of the black, brown and green as drawn on separate originals. Presumably it is considered that as exact registration is not required. Is this really the case? Certainly not for all maps.

65. A necessary accompaniment to the drawing of separate originals from different colours is that such originals should be initially of identical dimensions and should remain so.

(Here again we do not insist on this in the case of the brown and green originals.) This entails drawing on paper mounted on some material not liable to distortion, such mounting being done before blue prints are made. It is very desirable, quite apart from the question under consideration, that originals should be thus always true to dimensions, enabling plates of true dimensions to be prepared from them at any time.

66. It is also desirable that the same should apply to plane-table sections, though for a different reason, in that mosaicing, especially as now carried out on glass, enables absolutely correct blue prints to be prepared from distorted plane-table sections. Undistorted plane-table sections are chiefly desirable in order that the work of mosaicing may be facilitated and speeded.

67. The extract from the pamphlet "The Standard Mapping Method of the Geographical Section, G.S., Canada", which appears as App. H, to this paper, is of general intrest in this connection. Relevant accounts also appear in the Report of the proceedings of the Conference of Empire Survey Officers, 1935, *vide* paper on map printing in Ceylon. From the above, we learn that separate originals on mounted paper are drawn in Ceylon, Nigeria, and Malaya, as well as in Canada. The Surveyor General got the impression that delegates in general were surprised that we go in for colour separation by duffing. It must be remembered that, when our system was introduced, drawing was done on blue detail transferred by hand, under which circumstances the transfer to several originals would have obviously been very undesirable, and registration would have been very difficult to ensure. Now that we can at least start with identical blue detail as the basis for all originals, even those engraved on copper plates, the whole position is altered, at any rate as regards the original drawing. Formidable difficulties might still remain when making extensive corrections.

68. It is interesting that, in Ceylon and Nigeria, paper is mounted on Venesta boarding. The following are extracts from the Proceedings of the Empire Survey Conference.

Ceylon.—"Various methods of mounting were tried out for the "original drawing", in-"cluding metal-mounted paper, on zinc and aluminium. A new mounting of three-ply wood, "generally known as "Venesta boarding", ¼-inch thick, was found to give the best results, both "sides being covered with drawing paper, which keeps the board perfectly flat and smooth. "This Venesta mounting proved to be far more easy to handle, both in the drawing office "and on the copying board, and to be much less affected by climate, temperature and humidity "than any other form of mounting."

Nigeria.—"First of all I should like to say that the Nigeria Survey Department have "used Venesta mounting certainly for the past seven years. We started using Venesta first "of all for large-scale cadastral sheets of townships. The sheets are on the scale of 100 feet "to the inch, 200 feet to the inch, and 88 feet to the inch. The latest sheet is now about "seven years old, and there is no indication whatever of any distortion in the Venesta or "alteration of the scale of the drawing. The sheet are never taken off the Venesta mount-"ing. They require somewhat more extensive storage accommodation, though they are very "thick, but storage accommodation can be easily arranged."

69. I do not advocate that we should consider at the moment the wholesale change to separate originals. We have to feel our way cautiously, I do advocate that we should have an open mind and should not let minor disadvantages and inconveniences (see next para.) weigh against the major consideration of improved maintenance and more up-to-date maps. There may be special difficulties with regard to topo. sheets, in that detail is not always inked up exactly as on the blue print, *e.g.* main roads have to be widened; railways drawn by single lines on the plane-table sections, have to be drawn wider, etc. Initial experiments should be carried out with simple sheets, starting with the rougher maps, such as the road map, railway map, province maps, etc., which we particularly want to keep up-to-date.

70. Disadvantages of separate originals.—

(*a*) An inherent disadvantage would be, of course, that as they have to be on mounted paper, originals could not be superimposed for mutual examination on the tracing glass. Canadian

opinion on this point appears in App. H. I have never, personally, set much store on this examination, and I consider that the little that is required can be more effectively and just as quickly done by the use of a sheet of tracing paper, *e.g.* the check as to whether contours agree with heights etc.

(*b*) Another disadvantage would be that we have not so far discovered any pliable material on which to mount paper. 'Correctostat' paper, prepared by the Agfa Company, has all the necessary qualities, has answered admirably in the field for the field-work done on air-photo enlargements, and has not shown the slightest liability to disintegration or change of any kind. It has not, however, got a drawing surface, and will not stand much erasure. The Agfa Company have been approached, but are unable to co-operate in providing a similar combination of drawing paper and foil, nor do we know that such a combination is possible. We have interested the Venesta Company representative in Calcutta, who is asking the firm in England to investigate whether foil and drawing paper can be mounted together, in the machine which is used for joining the different plies of wood. The adhesive used is said to stand 6 hours boiling. Experiments are being pursued, but, in the meantime, the disadvantage of want of pliability remains.

71. Advantages.—The advantages of drawing separate originals are the converse of the disadvantages of the present system described in para. 70(*b*). To take an example.—

A 1/M sheet, layered edition, has about 12 plates (the normal). The plates are standing. We have to reissue the sheet in order to incorporate considerable corrections, but mostly in one colour, say the black, with the addition of a few roads which can be added on the red plate.

(*a*) *Under present conditions.*—The procedure would have to be to correct the combined original and go through the whole colour separation process de novo. It is usual to have to scrap all the existing plates, because they are not of the same dimensions as the new plates, owing to change in the original.

(*b*) *With separate originals on mounted paper.*—We would correct the black original and might add the roads to the red plate. All the remaining plates would stand unaltered, and a new black plate would be prepared quite simply from the corrected black original.

With separate originals, we would save all colour pattern work except the yellow for cultivation.

The picture before my mind is that of some 60 1/M sheets reissued under method (*b*), as compared to 150, or so, which we now have to deal with under (*a*).

72. Print originals.—Another process worth consideration is the use of print originals. The only case where these are used for original issues of Departmental maps is that of engraved maps, as plates are prepared by photography of chromo prints pulled from the copper plates. We used to engrave separate originals for different colours, but the procedure was abandoned owing to unequal relative distortion of the different pulls. There are technical difficulties in printing from copper plates on to paper mounted on metal. This is another disadvantage of engraving, as it might be impossible, in the case of engraved maps, to apply the method of separate originals.

73. There are ways in which the use of print originals might provide an alternative way of producing separate originals for maintenance. The map might be initially drawn as at present, but thereafter prints on mounted drawing paper from the separate colour plates used as originals. The process results in a certain deterioration in quality, and would probably be unsuitable for the finer class of map. An alternative, in case of sheets drawn for reduction, would be to do the colour separation on the scale of drawing, prepare a set of plates on that scale, and use pulls from them on mounted drawing paper as separate originals for maintenance. Thus colour separation would only be required once, at the beginning and not at each reissue. This would probably do away with a great deal of the deterioration in quality.

An important consideration is that print originals can be mosaiced, so that one map can be prepared from another without re-drawing, this being the method by which we prepare

our manœuvre and radius maps. The principle might be useful when changing from the 1/M I. A. C. series to the International, the latter being partially based on mosaiced print originals of the former.

74. There are a few other points which have a bearing on reissues, which must be referred to in order to cover the whole ground. These are:—overprinting on stock copies, adding corrections by hand, and keeping plates or negatives standing.

(*a*) *Overprinting.*—Owing to distortion of printed maps, this is not a practical policy when exact registration is required. It is however a possible method when this is not of importance, *e.g.* in case of overprinting aeronautical information on an already existing series. It is also a method which might be useful for correcting the more roughly drawn maps. As overprinting can only be done easily on untrimmed copies, it is advisable to look to the future and to leave a portion of stocks untrimmed when there is a likelihood of such overprinting being required.

(*b*) *Adding corrections by hand.*—This method is only applicable to correction of a few copies at a time, but might be used under special circumstances for maps which must be kept up-to-date but are only required by a few individuals.

(*c*) *Keeping plates and negatives standing.*—This, of course, has no bearing on the correction of maps, except where corrections can be made on the plates or negatives. This is only desirable within small limits, as to do it as a regular policy would be to add another 'bottle-neck'. Its main use is to tide over the interim period when a further stock has to be printed and the new edition is not ready. It is also a necessary policy where bulk demands are expected. It is one of the points which O. C. P. L. O. should keep in mind, with a view to keeping in line with our general policy.

(*d*) *Ordnance Survey.*—It may be useful to touch on the methods now being tried out in the Ordnance Survey, Southampton. Experiments are being carried out with drawing on zinc plates sprayed with white enamel. The surface is not, I understand, liked by the ordinary draftsman, being more suited to the litho-draftsman. These plates are used in conjuction with home-made 'varnish paper' for transferring, the image on which can be easily transferred to the plate.

An 'original' on the coated zinc plate may thus be obtained by one or a combination of the following:—

(*a*) Direct drawing.

(*b*) Transfer as above.

(*c*) Photography, the surface of the plate in this case being coated so that the image is in the form of a bromide print. The image formed in any of the above ways can be easily removed by light friction, so that the method affords a ready means of correction. Printing cannot, of course, be done from these enamelled plates, which are simply stored as originals and photographed for publication. The formulæ for coating of the plates and 'varnish paper' have been obtained.

The process described is not an aid to the avoidance of duffing, unless we can have separate originals on the enamelled plates. In case of (*a*) above, direct drawing, the problem would be the same as that already considered for mounted drawing paper. In case of (*b*) or (*c*), it would depend on whether the different originals could be identically true to scale.

PRESENT PROBLEMS.

75. I have dealt with the whole problem in what I consider to be the only way possible, *i.e.* from the point of view of our policy at maintenance stage. Having decided this policy, we would have to do what we could during the next 10 years to pave the way. The following appear to be the more immediate points affecting the present transition period.

(*a*) *Topo. maps.*—Any great increase in our annual reissues has been shown to be likely to cause embarrassment in the P. L. O. We have also shown that, during the maintenance period, the number of our draftsmen may have to be double that of our surveyors.

Assuming that we shall be in a position to provide the required number of draftsmen, it has not been necessary to consider the limits imposed by the difficulty of correcting originals. The position would be very different were we to try and improve the edition interval of our topo sheets now.

(*b*) The Reissue Section of No. 1 Drawing Office, which deals only with reissues of topo. sheets not entailing re-drawing, consists of 26 draftsmen. It is estimated that these cannot deal with more than an average of 185 sheets per year. The Section is considerably in arrears, and there is a head of 93 sheets requiring correction. Of these 93, 49 are fresh plate cases. (See para. 20). It should be remembered that this Section only has to deal with the inclusion of office copy corrections, and not with the heavier ones likely to result from correction surveys.

(*c*) An analysis of the sales data referred to in para. 35, shows that the average stock last year of the 400 1-inch sheets was 260, the average age of current edition 16 years, and the average annual sale during the last 3 years, 4 copies. Hence, if sales continue at the same rate, which is unlikely, the stocks may be expected to last for an average period of about 65 years, and the average age of sheets on exhaustion of stocks may be about 80 years! These are typical unimportant sheet, *i.e.* those not required by the Army.

(*d*) It is evident that the negative side of my policy of 'indefinite abandonment of reissue' of many 1-inch sheets is in full operation, but on a basis of absence of demand and not as a definite policy. As the Reissue Section is more than fully engaged dealing with sheets as stocks exhaust, it is manifestly impossible to add to the number of reissues by reissuing sheets of which stocks remain, merely to bring them up-to-date, unless we increase the strength of the section or abandon 1-inch maintenance in certain cases.

(*e*) If we do not provide more draftsmen, we have two courses—

(*i*) To go on as we are doing, which we can do as long as annual reissues do not increase, as they should do if we sell our maps, (*vide* para. 20) and as it seems almost certain that they must do to some extent, in spite of want of demand. Cutting down the number of 1/M sheets should free draftsmen for other work eventually.

(*ii*) Deliberately to decide not to bring up-to-date certain 1-inch sheets of which stocks do exhaust, substituting ½-inch. This might enable us, during the transition period, to make a beginning with our maintenance period policy, without the great increase of draftsmen which will be a necessary part of it.

(*f*) As a preliminary to a decision regarding dropping of 1-inch maintenance, Circles and Independent Parties might be asked to prepare index maps showing in what areas they consider ½-inch maps would suffice on general grounds. These might be divided into (*i*). Areas about which there is no doubt, and in which future maintenance can definitely be on the ½-inch scale, from every point of view. Sheets in these areas might continue to be revised or corrected on the 1-inch scale, though it would be logical to treat them in every way as though the areas had been originally allotted to ½-inch.

(*ii*) Areas in which ½-inch maps seem to suffice, but in which, should there be a demand, or should the maintenance position become easier, 1-inch maps might be maintained. In such areas, ½-inch map maintenance should be given preference over 1-inch, but revision or correction should definitely be on the 1-inch scale.

In both the above cases, if 1-inch maintenance is dropped, permanently or temporarily, a small reserve of 1-inch maps should be kept in stock against possible demand in connection with some special requirement. These copies should not be sold to the public. Within the ½-inch areas, 1-inch sheets required by the Army would continue to be maintained on that scale.

(*g*) The following may help in preparing the index maps referred to above. Chapter I, para. 20, lays down that the ½-inch scale should suffice in areas with a population of less than 150 to the square mile. We have entirely departed from this criterion. From comparison of the index maps referred to in para. 46 (*g*) and (*h*), I have concluded that we shall probably find that ½-inch maps will certainly suffice in the above areas on general grounds, a possible exception being areas with very small population but very intricate forest boundaries. We

shall probably have to retain 1-inch maps in areas where the population is over 300 to the square mile. The doubtful areas are those where the population is between 150 and 300 and these should be carefully considered. My index map shows ½-inch for the greater part of them.

(*h*) We shall not be able to go in for wholesale correction in the field during the transition period for the same reason, *i.e.* lack of draftsmen. The Frontier Circle is already finding a difficulty in incorporating the results of correction survey.

(*i*) *Geographical maps.*—The question of how best to reduce to one 1/M series will require a lot of consideration, which cannot be deferred. The International series is catalogued in the International 1/M Report for 1935, sheets which do not conform to the regulations of the International Committee being shown in italics. Actually, in case of certain countries, sheets shown as conforming only do so to the minimum degree laid down by the Surveyor General, *vide* para. 43 (*b*).

(*j*) I question whether a gradual supersession of one 1/M series by another is drastic enough and is the right course, at least where India proper is concerned—especially in view of the remarks in para. 44 (*e*) regarding the aeronautical edition. I would like to see special arrangements made to deal with the Indian sheets as a whole as quickly as possible, in order of usefulness in connection with aviation, without regard to existing stocks. There are only 24 such sheets of the International series. This I regard as our most urgent problem.

(*k*) The R. A. F. recently enquired as to our progress with the aeronautical edition of the 1/M series, and a conference has been suggested on this question within a few months between the R. A. F., Civil Aviation Department, and ourselves, with a view to deciding a policy. This is one of the problems for the near future, linked, as it is, with that of the 1/M International Series.

SELLING MAPS.

76. I have so far dealt only with policy from the point of view of how to produce and maintain good up-to-date maps. Apart from sales to the Army—which are automatic and can be taken for granted—the number of maps used is a measure of the success of our policy, and it is obvious that no maintenance policy, however perfect, is of any value unless the resulting maps reach the officials and the public who want them. It has been argued that the pushing of sales is of more importance than keeping maps up-to-date, and that we have never failed to sell maps because they were not so. Perhaps we can liken the two necessities of keeping maps up-to-date and pushing their sale to a cart and horse, opinions differing as to which is the cart and which the horse. No-one can deny that, in the difficult conditions in India, we have to make special efforts to bring our maps to notice and it is, I think, certain that no business concern could hope to survive if it were to spend proportionately no more than we do on publicity and distribution. It may well be that, when we reorganize for maintenance, we shall have to adjust our budget and personnel so as to be able to deal effectively with the publicity question. In the meantime, opinions are invited as to how we can improve matters within our budget resources.

77. Failure to use the maps which we provide may be due, in varying degree, to the following causes :—

(*a*) That there is no general demand for maps at all, *i.e.* absence of map-mindedness.

(*b*) That the particular map or series does not meet a demand.

(*c*) That it is too out-of-date to be worth buying.

(*d*) That there is another map in the market which better serves the purpose, or is more up-to-date.

(*e*) That officials, or the public, want it, but either dont know of its existence, or if they do, where to buy it.

78. It is our duty to remedy each of the above as much as is in our power.

(*a*) This can only be remedied by education, and I recommend every possible concession when selling our maps to bona fide students and to educational establishments in India.

An important step has lately been the inclusion of reproductions of four of our maps, and of our Table of Conventional Signs, in a text book on geography to be used in all colleges in India, together with an account of our work, and instructions how to buy maps. This might have far reaching results.

(*b*) The only remedy here is to change it or abolish it.

(*c*) & (*d*) These form the main theme of this paper and need not be referred to again.

(*e*) has two entirely different aspects.—

(*i*) Sales to the public.

(*ii*) Sales to officials.

(*i*) is outside the scope of this paper and my only reference to advertising here is that the better the map, the more convincingly can it be advertised.

It is obviously easier to advertise a series all maps of which are reasonably up to date than one in which some are and some are not. Statements such as "The roads on this map (or series) are brought up to date at least every—years", "The maps of this series are brought up to date as regards—at least every—years" would, if true, be strong advertising lines.

Our catalogue affords a means of advertising, and, as soon as we have a settled policy actually in operation, we should, I think, give as much information in it as possible as to what that policy is, especially as regards the object of each map or series and the steps we take to keep it up to date.

79. Sales to civilian officials.—

(*a*) Sales to officials are on a different footing, as they largely depend on provincial policy, budget provision for purchase of maps, etc. Sooner or later, these points will have to be officially discussed, together with the rest of the relations between the Survey of India and Local Governments, see para. 46(*c*). In the meanwhile, the problems seem to be in case of small scales to make better maps than theirs, keep them as up-to-date, and then persuade them that to buy them is preferable to making their own. The temptation to Local Governments to employ their own Survey Departments on making such maps must always be great, as they thus dictate and control their own policy. They are in a far better position than we are to assess local needs, to collect information systematically, and to sell and distribute their maps.

(*b*) The extent to which discussion with Local Governments is a present problem depends on whether and, if so, when, the Committee will be formed to deal with the whole question. The last Survey Committee addressed questionnaires to officers of various Departments, which, with selected replies, were published in the Committee's report. Similar questionnaires will, no doubt, be put by the next Committee. In the meantime, the difficulties of advertising do not prevent us reaching officials, as we have all the usual channels of correspondence open to us; there is no impediment, therefore, to our meanwhile enquiring from Local Governments what is their policy as regards, and attitude to our maps.

(*c*) Where officials do not use our maps because they do not know of them, the remedy is surely in our hands? That there are such cases is abundantly proved by the following letter just received from the District Magistrate, Howrah, which speaks for itself (sub-para. (*d*) below). This is an outstanding case, as the officer concerned has had long service in many of the districts of Bengal and is now in charge of a district with headquarters in Calcutta; yet he did not know our maps existed. Moreover the Howrah district officials have been making shift for years with maps produced by the Bengal Survey, these particular ones, which I have seen, being wretched productions, not comparable with the comparatively good touring maps produced elsewhere.

(*d*) Copy of letter dated the 3rd April 1937 from the District Magistrate, Howrah.—

"When I got in touch with you because the maps on which I had to rely for my "administrative work were so defective I had no idea that I should find in the Survey of India "such magnificent maps as the 1 inch and ½ inch maps of the district and the 3 inch and 6 inch "map of Howrah town.

"I have been over to my Record Room and I find that there are no copies of these maps "in the Map section which is perfectly amazing to me as, apart from the fact that they should be "being used by District Officers, it seems to me quite essential that in a District Record Room "there should be at least one copy for permanent record of every map of the district that has "ever been produced.

"I shall be much obliged if you will send me for retention in my Record Room 2 copies "of every sheet of the inch map of Howrah district and 2 copies of every sheet of ½ inch map "and also 2 copies of every sheet of the 6 inch map of Howrah Town and one copy of the "12 inch map of Howrah Town and one copy of the 3 inch map of Howrah Town."

(*e*) When a Local Government policy is the deliberate preparation of maps to the exclusion of ours, the position is more difficult. The extreme case is, I think, Madras, where Taluk maps are prepared on the 1-inch scale. The procedure is for these Taluk maps to be first prepared by reduction from Madras Revenue Surveys, the results, if we so wish, being compiled into sheets on payment and utilized by us as a basis for our surveys. As soon as our maps are published, the Madras Survey Department brings out 1-inch Taluk maps, with hills, based on them, I have before me a map of the Coondepoor Taluk, published in 1920, with hills, with an inscription "Compiled under the superintendece of —, on the topographical basis of the 1″ Standard sheets of the Survey of India of 1912 and 1913".

These maps are rough compared to ours, but are quite adequate, and the Local Government, having prepared them, quite naturally utilises them to the exclusion of Survey of India maps.

FILING.

80. My last point on policy is the question of filing. I find that it is extremely difficult to discover the origin of some of our maps and series, as questions of policy are buried under masses of correspondence regarding detail. Important decisions have often been recorded in the form of entries on note sheets.

I propose to start policy files, both general and in connection with each map and series, the general policy file to be divided into three parts under the following subheads:—

'General', 'Maintenance', 'Technical'; and all further correspondence on general policy should be headed "General Policy", "General Policy, Maintenance" or "General Policy, Technical", only one of these subjects being dealt with in one letter. Maintenance is as defined in para. 1.

Each map and series will have a separate file, divided into two parts—'Policy' and 'General'. Letters regarding policy as defined in para. 37 should always deal exclusively with that subject and should be headed "40 mile map, Policy", etc. Letters regarding conventional signs or other questions of detail will be headed as "40 mile map, General", etc.

SUMMING UP.

81. To sum up, I have pointed out the problems and difficulties as I see them and indicated some lines on which our policy will have, in my opinion, to develop if we are to maintain our position as the source of map supply in India. It is not possible to suggest the most opportune moment for opening the question of our relations with Provinces, bound up with that of the Government of India, but the example of Madras shows how easily a provincial policy can be developed so as to utilise our surveys, but exclude us from the production of the actual map which reaches the map-user. Initiative taken by us at the right moment, while the new provincial policies are in the making, might save us from being relegated to the background by other provinces.

In spite of uncertainty as to the future, there are lines on which we can safely develop, and the more able we are to keep our maps up-to-date, the more likely are we to maintain our position. We will no doubt submit questionnaires to provinces, but they will also be in a

position to submit them to us, and among such may well be that of what we can do with regard to maintenance. Hence the desirability of clear cut ideas as to what is possible and what is not, and of constant consideration of possible improvements.

We must, I think, have continuity of thought, and a settled policy which looks to the future, in place of our present haphazard one. This paper should at least serve to air the question.

82. I have not touched on the following points :—

(*a*) *Maps for War.*—The question of maps stored for use in war raises separate problems as regards maintenance, which are, I think, best excluded from the general discussion in this paper.

(*b*) *Village boundaries.*—The decision not to show these on our ordinary topo. maps was based on the recommendation of the last Survey Committee. It may have had considerable bearing on the utility of our maps for Administrative purposes, and have given provinces their first incentive to prepare their own maps. The question may possibly come up again for discussion by a future Committee.

(*c*) *Vernacular maps.*—There have been many enquiries regarding vernacular maps, mainly in connection with education, and map-mindedness appears to be increasing in this direction. We have never contemplated publication of such maps, but it is not impossible that we might do so. Separate originals for names would facilitate their preparation.

APPENDIX A.

MAP PUBLICATION OFFICE,

SURVEY OF INDIA,

Calcutta, the 11th November 1921.

Office Order No. 5 (Professional).

SUBJECT:—*Press order for the original editions of modern maps.*

In future the number of copies of original editions of modern maps required on publication should be governed by the number of copies likely to be sold within ten years following publication and the existing general order for 500 copies of each map should not in future be adhered to in every case.

For the purpose of carrying out the above principle, in publication instructions below will be found a rough guide as to the number of copies of maps on various scales likely to be disposed of within ten years of publication when a reprint would probably in most cases be required:—

	Important areas such as those containing large Cities, N. W. Frontier.	Rural Districts containining Smaller towns, etc.	Thinly populated areas, Trans-frontier, Persia Baluchistan.
$\frac{1}{M}$ Layered	250	100	100
$\frac{1}{M}$ Political	1,000	250	100
$\frac{1}{M}$ International	250	100	100
Degreee (Layered) ...	250	100	100
Degree (Political) ...	500 to 1,000	250	100
Half-inch	500 to 1,000	250	100
One-inch	500 to 2,000	250	100

These rules will not apply for General, District, Cantonment, Cities and other special maps for which particular press orders are necessary.

APPENDIX B.

Copy of Circular Memo No. $\frac{1116}{S}$, at 26-4-26, from D. M. P. to all Directors.

SUBJECT:—*Item X of Publication Instructions.*

Refce:—D. M. P's. Professional Order No. 5, dated 11-11-1921.

The importance of Item X of the Publication Instructions is apt to be lost sight of, but a correct appreciation of the likely demands for any sheet is a most important factor in the economical administration of the reproduction offices. The executive officer responsible for the preparation of a map is the person who should be in the best position to judge what the likely demand for that particular sheet will be but unfortunately such officers have usually little knowledge of the workings of the reproduction and distribution offices. This note is written with the endeavour to help them is this respect.

2. The chief expense of reproduction is the preparation of the printing plates. When these are ready, the actual cost of the paper and of the printing is very small in comparision. This expense, naturally, varies to some extent; but, for an average map on scale 1-inch to 1-mile, it is safe to say that the cost of preparing the plates and putting them in the machine is about Rs. 400/-, the actual cost of printing 100 copies is Rs. 15 approximately, (*i.e.* the pay of the men, the cost of the ink, overhead charges etc;) while the cost of 100 sheets of rag-litho paper is approximately Rs. 10. Therefore the cost of reproduction of an average sheet may be:—

100	copies	Rs.	425	or Rs.	4	as.	4	per copy
200	,,	,,	450	,, ,,	2	,,	4	,,
300	,,	,,	475	,, ,,	1	,,	9	,,
400	,,	,,	500	,, ,,	1	,,	4	,,
500	,,	,,	525	,, ,,	1	,,	1	,,
1000	,,	,,	650	,, ,,	0	,,	10	,,
2000	,,	,,	900	,, ,,	0	,,	7	,,
5000	,,	,,	1650	,, ,,	0	,,	5	,,

3. As the sale price for each map, whether 100 or 2000 copies are sold, is the same, it is easy to see that the larger the number sold, the more advantageous to the Survey is the reproduction.

But the question of storage has to be considered, and also the fact that in the course of years, corrections to the map are desirable, if not necessary. Paper deteriorates in this country, and is also liable to attack by insects of all kinds. It is therefore necessary to reprint the maps periodically, and experience show that a period of 10 to 15 years is the best on an average.

4. Excluding the question of revised editions, a map is only reprinted when the stock of it is exhausted.

If the policy adumbrated above, *viz.* a new edition every 10 years, were working ideally, the reproducing offices would be instructed to print a first edition of exactly the number of copies that would meet all demands during the 10 years, and at the end of that time not a single copy would be remaining in store.

It is quite needless to say that the system has never yet worked ideally, for even a single sheet. There are many sheets, printed in 1910, or earlier, of which the greater part of the original edition is still in stock; while there are many cases in which the original edition has been exhausted within the first year of publication.

It is realised that the ideal can never be attained but if the executive officers would give more thought to item X of the Publication Instructions better results should be obtained.

APPENDIX B.—Concld.

5. D.M.P.'s Professional Order No. 5, quoted in the reference to this note, was issued with the object of getting improved results, but this object has not been attained and therefore this order is cancelled.

Experience in the Map Record and Issue Office shows that the demand for $\frac{1}{4}''$, $\frac{1}{2}''$, and 1″ sheets, for the average sheet is about 500 copies in 10 years (*vide* item X of Publication Instructions). It should be remembered that about 100 copies of every original publication are issued as "complimentary copies", and this number is included in the 500 mentioned above. In important areas the demand may mount up to 2000 copies for 1 inch sheets and 1000 for $\frac{1}{4}$ and $\frac{1}{2}''$ sheets: while for areas remote from large stations an edition of 500 would suffice for 30 years or even longer.

As however the plates of the maps of the areas shown in the index issued with this office No. 465/S dated 18-2-25 (C. G. S. index for maps to be meshed) are not cleaned off, as is normal for other sheets, but kept in the Photo.-Litho. Office, and as this index covers practically every important sheet, it is rarely necessary for sheets shown on this index, to print, in an original edition, as many as the upper limit quoted above. It only costs about Rs. 20/- to prepare the plates kept in store for printing another edition; therefore, if an original edition of an important sheet of 1000 (cost Rs. 650/-) is soon exhausted and a reprint of another 1000 is required, the cost of this second edition would be Rs. 270/-; or a total of 920/- for the 2000, as opposed to Rs. 900, the cost of an original edition of 2000. Whereas, if an original edition of 200 of an unimportant sheet is exhausted, (cost Rs. 450) the cost of the reprint is exactly the same, *i.e.* Rs. 900 for the two separate editions of 200 each, as against Rs. 500 if an original edition of 400 had been printed.

6. It is hoped the above explanation will make the situation understandable by executive officers. It is impossible to lay down any definite instructions but the following conclusion may be of some help:—

An original edition of less than 300 or more than 1500 for 1″ sheets, (750 for $\frac{1}{4}''$ and $\frac{1}{2}''$ sheets) is rarely justifiable, and if an executive officer recommends such an one it would be as well if the reasons for the recommendation were given. Should there be any doubt about the wisdom of reducing the number of any sheet below 500, it is probably better to recommend a larger edition than may be required for sheets the plates of which will not be kept, rather than to run the risk of the necessity of very early reprint of a sheet.

APPENDIX C.

The approximate capacity of the P. L. O.—

PHOTO. BRANCH.

Negative Section.—Assuming 4 cameras @ 4 negs a day on an average of 20 days per month = 320 negatives a month.

Each sheet has 5 or 6 originals *i.e.* Outline, Contour, Trees, Yellow, Shade (2 negs), Grid, requiring on an average 6 negatives, therefore outturn per month about $\frac{320}{6}$ = 54 sheets, say 650 a year.

Allowing for 50 special sheets, P.Ts., &c. = 600 standard sheets a year.

Powder Section.—After allowance for other work, 35 standard sheets per month, *i.e.* 420 a year. Could be easily expanded.

Retouching Section.—At present strength could work up to 30 sheets per month, *i.e.* 300 per year, allowing a little other work.

Zinc Printing Section.—Up to 900 standard sheets per year less extra work.

LITHO. BRANCH.

Litho. Drawing Section.—40 sheets per month plus some other work *i.e.* 480 sheets per year.

Proving Section.—60 sheets per month plus other work *i.e.* 720 sheets per year.

Printing Section.—Assuming 6 flat bed and 4 rotary machines working (this allows a margin for repairs and other work &c.) and editions of 500, and 10 colours, can do 70 standard sheets a month, *i.e.* 840 a year. Other work could be done on the remaining machines.

APPENDIX D.

Copy of a letter, dated 24th July, 1933, from the Chief Instructor, Delhi and U. P., Flying School, to the Director of Civil Aviation. (See para. 44 (*a*)).

With reference to Notice to Airmen No. 25 of 1933 I have recently purchased one Map Sheet No. N. H. 43 (Delhi) which I enclose herewith, together with Sheet No. 44 Lahore) and another No. N. H. 43 non-aeronautical.

You will notice that I have marked the aeronautical map with dotted blue lines with a cross where railways should be indicated. I have also enclosed a small group of hills in a red circle about lat. 28° 50′ N. long. 75° 55′ E. I think you will agree that the hills as marked on sheet No. 44 are of more useful information to a pilot than the one rather indistinct mark on sheet No. N. H. 43.

I think you will also agree that it is essential that as far as possible all railways should be marked. On comparing the two sheets N. H. 43 you will see that they are identical with the exception that on the Aeronautical map landing grounds, aerodromes and wireless stations are marked and an isogonic chart provided. You will also observe down in the left hand bottom corner of the non-aeronautical N. H. 43 that the revised price is now rupees two and that the Aeronautical map is rupees three. It appears that as this Layered edition is out of date an attempt has been made to sell the surplus stock by adding to the old editions, information which every pilot should know before starting on a cross country flight.

You will also observe that all railways, regardless of gauge, appear to be marked the same. This is apt to be misleading, as for example the Shahdra (Delhi) Saharanpur Railway is actually a very small light railway and hardly noticeable from the air.

I would suggest that unless aeronautical maps are compiled from the latest editions Survey of India sheets, pilots should not be advised to purchase them.

(*Note.*—The latest editions were, of course, used, but they were out-of-date.)

APPENDIX "E".

Copy of a letter appearing in "Civil Aviation." (See para. 44 (*b*)).

I think it may serve some useful purpose, and be of assistance to any of your readers who are anticipating an aerial tour or flight over India, to know the position with regard to Indian maps.

In the first place, the usual scale is sixteen miles to the inch, and although this may seem to present a difficult problem to those accustomed to flying on four inches to the mile from my own experience the scale offers no difficulty.

Secondly, every precaution should be taken by the pilot to check the aviation information which may be printed or subsequently inserted on the maps he is using. If the map concerned has been printed in 1935, it will be reasonably up to date, but in all probability there will be a number of landing grounds or aerodromes which have been constructed since the publication, which do not appear. On the other hand, if the map has been published some, years ago, as, for instance, the 1930 publications, it may be immediately assumed that much important aerial information is missing, and that in some cases landing grounds will be shown which in actual fact do not now exist.

From my own experience of flying in India, which is now quite extensive, I would offer the following suggestions to the prospective flier: any maps required for use in India should be obtained from Messrs. Aero Stores, of 170, Napier Road, Karachi. who make a special work of maintaining the maps they supply up to date, not only with the fullest aviation information as to landing grounds and aerodromes, but in addition, they ink in any railways. This last service is of the utmost importance to the flier as a number of railways have been constructed in recent years and do not appear on the maps at present.

Anybody proposing a flight to India would save themselves endless worry and possibly the risk of an accident, if, when selecting their maps, they wrote in advance to Messrs. Aero Stores, asking them to prepare maps for the route they proposed to follow, and have these maps ready at Karachi or to await their arrival at their place of entry into India.

Messrs. Aero Stores supply maps at the usual charges, plus a small fee for bringing them up to date, and I can assure pilots that it is well worth while to expend this small amount of money so as to be in the possession of maps which they can rely upon.

APPENDIX F.

Table A. Maintenance. Showing number of sheets for reissue annually, if we maintain edition intervals of 10 and 20 years for topo. sheets, according to category, and various edition intervals for smaller scales, in accordance with schemes A, B, C, D, para. 44.

	INDIA.									BURMA.							
	Scheme	A.		B.		C.		D.		A.		B.		C.		D.	
	Edition interval Years.	No. of sheets.	Average annual No. for reissue.	No. of sheets.	Average annual No. for reissue.	No. of sheets.	Average annual No. for reissue.	No. of sheets.	Average annual No. for reissue.	No. of sheets.	Average annual No. for reissue.	No. of sheets.	Average annual No. for reissue.	No. of sheets.	Average annual No. for reissue.	No. of sheets.	Average annual No. for reissue.
	a	*b*	*c*	*b*	*c*	*b*	*c*	*b*	*c*	*b*	*c*	*b*	*c*	*b*	*c*	*b*	*c*
1. Original 1-inch in gridded areas	10	1040	104	1040	104	1040	104	1040	104	75	8	75	8	75	8	75	8
2. ,, ,, elsewhere ...	20	3314	166	3314	166	1625	81	1625	81	794	40	794	40	2	.....	2	.....
3. ,, ½-inch in gridded areas	10	148	15	148	15	148	15	148	15	10	1	10	1	10	1	10	1
4. ,, ,, elsewhere ...	20	309	16	309	16	788	39	788	39	24	1	24	1	261	13	261	13
5.* ,, ¼-inch in gridded areas	10	339	34	339	34	339	34	339	34	10	1	10	1	10	1	10	1
6. ,, ,, elsewhere ...	10	23	2	23	2	23	2	23	2	.....	.....	.....	.....	.....	.....	.....	.....
7. Compiled ½-inch in gridded areas	10	350	35	.....	.....	350	35	.....	.....	23	2	.....	.....	1	.....	.....	.....
8. ,, ,, elsewhere ...	20	738	37	.....	.....	259	13	.....	.....	219	11	.....	.....	4	.....	.....	.....
9. ,, ¼-inch in gridded areas	10	180	18	180	18	180	18	180	18	17	2	17	2	17	2	17	2
10. ,, ,, elsewhere ...	10	204	20	204	20	204	20	204	20	64	6	64	6	64	6	64	6
TOTAL—Topo maps ...	.....	6645	447	5557	375	4956	361	4347	313	1236	72	994	59	444	31	439	31
GRAND TOTAL, India and Burma...	.....	7881	519	6551	434	5400	392	4786	344	.....	.....	.....	.....	.....	.....	.....	.....

In addition to the topo. maps listed above there are some 300 sheets, including manœuvre and radius maps, guide maps, geographical series, province, general and miscellaneous maps. Giving these the edition interval suggested in para. 54, the average annual reissues would be about 55, reduced to about 40 by abandoning the 1/M, I. & A. C. Series

*Including Trans-frontier sheets.

APPENDIX G.

Table B. Maintenance. Showing number of sheets for revision or correction in the field, and average number which must be revised or corrected annually to maintain the reissue interval shown in column *a*.

	INDIA.					BURMA.			
	Scheme.	A or B		C or D		A or B		C or D	
	Revision interval years.	No. of sheets.	Average annual No. for revision or correction.	No. of sheets.	Average annual No. for revision or correction.	No. of sheets.	Average annual No. for revision or correction.	No. of sheets.	Average annual No. for revision or correction.
	a	*b*	*c*	*b*	*c*	*b*	*c*	*b*	*c*
1. 1-inch sheets for gridding ...	10	1037	104	1037	104	75	8	75	8
2. ,, ,, elsewhere ...	20	3314	166	1628	82	794	40	2	...
3. ½-inch ,, for gridding ...	10	71	7	71	7	10	1	10	1
4. ,, ,, elsewhere ...	20	309	15	788	40	24	1	261	13
5. ¼-inch ,, for gridding ...	10	37	4	37	4	...	...	...	...
6. ,, ,, elsewhere ...	20	23	1	23	1	...	...	...	...
7. Guide maps	10	30	3	30	3	Not worth showing separate from India.			
TOTAL sheets on all scales, for annual correction or revision in the field.	...	...	300	...	241	...	50	...	22
GRAND TOTAL, India and Burma.	...	...	350	...	263	...	...	...	...

NOTE:—Sheets included above are only those falling in India or Burma.

Trans-frontier sheets which are inaccessible for systematic revision are excluded.

The number of 1-inch sheet areas is—

	India.	Burma.	TOTAL.
10 year interval	1913	115	2028
20 ,, ,, ...	4918	890	5808
GRAND TOTAL ...			7836

APPENDIX H.

Extract from "The Standard mapping methods of the Geographical Section, G. S. Canada."

Chapter VII.—The Reproduction of Standard 1" to 1 Mile Maps.

23. First Compilation.—As mentioned above, planetable sheets, or plots from air photographs are photographed to the scale of 2" to 1 mile, and are assembled (with rubber solution) on a metal backed sheet, on which a grid has been printed. They are fitted to grid intersection, the grid having, of course, been used for the plotting of the control of the planetable sheets or air photo plot.

24. Draughting Copy.—This compilation is then photographed down to the scale of 1½" to 1 mile and a helio-zinc plate is made. Prints in non-actinic blue are made on metal backed sheets; one for each important printing colour of the finished map—black, dark blue, brown (contours), green and grey. (Road colour plates, light blue plates are made from offsets.)

25. Size of Sheets.—The standard sheet of the Canadian National Topographic Series is ½ degree in longitude by ¼ degree in latitude, which is about 25" by 17". Occasionally this size is exceeded; where it is more convenient to join a small area to a standard sheet than to draw a separate sheet for it. The size of the sheet on which the original drawing is made (at 1/42240) is thus about 30" × 40". It is not the practice to divide up the work on a sheet by giving a separate area to each of several draughtsmen. But the colours which are easier to draw (contours, woods, etc.) are done by junior personnel, the more experienced men drawing the black plates; one man, as a rule, completing each colour. As there is no subdivision of sheets, we do not meet with difficulties of joining up sheets for photography.

26. Metal Backed Sheets.—The metal-backed sheets are made by mounting bristol board on grained zinc or aluminium sheets. They are mounted with fish glue, under pressure on a proving press. The bristol board is mounted front and back, and each side may be used for a colour drawing. If it is not desired to draw on both sides, chart paper should be mounted on the back, to counteract possible warping, due to shrinkage, of the bristol board. Alminium has lately been taken into use instead of zinc, being lighter and cheaper and otherwise just as suitable. These backed sheets should be made up several months before it is required to use them, so that they will have time to season, and defects in mounting, if any, will become apparent.

27. Stability in Dimensions.—Original drawings have been made on metal-backed sheets by the Geographical Section, G. S., Canada, since 1915. They have retained size comparatively well, and though there is some shrinkage shown, it is practically uniform. A table is attached, showing the result of a series of measurements just made. (Reproduced on page xi).

28. Celluloid Coating.—Draughting follows the ordinary methods. Some sheets have been drawn on paper which was first sprayed with cellulose dissolved in acetone. This was rubbed with fine powdered pumice before drawing, in the same way that tracing cloth is usually treated. Some difficulty was experienced with ink chipping off; this was got over by adding a little glycerine.

29. Lettering type and Photo Process.—Hand-lettering when skilfully done produces a more æsthetically satisfying result than any mechanical process. It is however, very costly in draughtsmen's time. For maps of the Canadian National Topographical Series, the style of lettering on the Ordance Survey Fifth Edition was selected as the model. The type nearest in appearance to Caslon Old Style for vertical lettering, and recut Caslon italics for sloping lettering. Names were set up in suitable sizes of these types, printed on thin "Bible" paper and stuck down on the drawing with cellulose cement. While the result is fairly satisfactory, there is a "typy" look about it and sloping names are sometimes not easy to read. For these reasons it has recently been decided to use photo-lettering. Alphabets in sloping and vertical style were made up, following

APPENDIX H.—Contd.

the Ordance Survey Roman old style and italic alphabets. Negatives of each of the letters and figures were made up on process film. Names are set up from these letter negatives in a special photographic printing frame. The name is printed on a bromide paper in a special small reducing camera. This system is the same as used by the National Geographic Society of the U. S. A. in producing their well known maps, and was devised by Mr. A. H. Bumstead, cartographer of the Society. A junior photographer can set up the names needed for an average 1 inch to 1 mile map in almost a day. The complete names are stuck on the drawing the same as the printed names were. The results are very satisfactory in legibility, appearance and suitability for further reproduction by photography.

30. Legend, etc.—As the legend and index map at the bottom are the same for a number of sheets, drawings to a larger scale were made and photographed, and the necessary black line prints made when needed.

31. Comparison of Different Colour Plates.—One objection to the method is that it is not possible to check the map for interference between detail and lettering in the different colours by superimposing and examining as a tracing, which can be done if the original is on paper. For maps on which the detail is no closer than the sheets mentioned above, this is not found to be a real drawback, but for maps such as the ¾" BELLEVILLE-KINGSTON, the blue and black detail were drawn and the lettering stuck up on one sheet; two negatives were made, and the colours were separated by duffing out. It is usually necessary to make a tracing of the position of contour numbers, to ensure that these do not conflict with trees, or lettering.

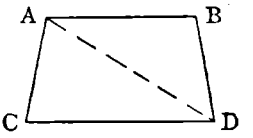
32. Photography.—After proof reading, the originals are photographed to the 1" scale. Correct scale is ensured by carefully plotting four grid intersections near the corners of the sheets, (or for the old sheets in the Polyconic Projection, the four graticule corners) on the camera ground glass, and focussing the camera so that the corresponding marks on the originals coincide. For 1" maps, focus and size is checked for each separate plate, by the above means. Originals are tacked to the copy board, to keep them quite flat. The copy board is rotatable about two axes, so that small adjustments for fit may be made by tilting it.

33. Offsets.—Indelible offsets, of the same kind as used in the Ordnance Survey, are made from the black plate and from the dark blue, and plates for the colours indicating the classification of roads, and the light blue water areas are made from them respectively.

34. Military Grid.—This is made by printing the grid lines in black on a backed sheet. A faint blue impression of the black plate is then printed on this grid in the offset proving press, using the "Macleod bars" to get accurate registration between the grid and the cutting marks drawn on the margin of the black plate. A draughtsman then paints out the part of the grid which extends beyond the margin, and sticks down notes and grid numbers, which are printed beforehand by offset litho in stock sheets.

35. Conclusion.—Using the methods outlined, and with careful photography, no difficulty in registration is encountered. The only limits to accuracy are in the draughting, and in the photographic process.

APPENDIX H.—Concld.



MAP SHEET.	Year.	Sides.	Measurement at the time of drawing.	Present measurement.	Shrinkage.	Distortion.
STRATFORD	1926	C-D	37·851	37·845	−·006	+·001
		A-C	25·888	25·880	−·008	−·002
		A-D	45·790	45·780	−·010	±·000
MUSQUODBOIT	1921	C-D	36·906	36·890	−·015	−·003
		A-C	25·894	25·880	−·014	−·005
		A-D	45·018	45·010	−·008	+·007
UNIACKE	1922	C-D	36·905	36·890	−·015	+·001
		A-C	25·894	25·875	−·019	−·008
		A-D	45·018	45·005	−·013	+·007
PARKHILL	1926	C-D	38·004	37·990	−·014	+·001
		A-C	25·887	25·870	−·017	−·007
		A-D	45·918	45·905	−·012	+·005
WARWICK	1924	C-D	36·264	36·250	−·014	−·001
		A-C	25·898	25·890	−·008	+·001
		A-D	45·496	45·480	−·016	±·000
ARTHABASKA	1923	C-D	36·102	36·075	−·027	−·005
		A-C	25·899	25·880	−·019	−·003
		A-D	44·360	44·340	−·020	+·007
BATH	1915	C-D	37·380	37·335	−·045	−·004
		A-C	25·890	25·870	−·020	+·007
		A-D	45·405	45·350	−·055	−·007
MEMPHREMAGOG ...	1915	C-D	36·747	36·730	−·017	+·007
		A-C	25·895	25·880	−·015	+·002
		A-D	45·889	45·850	−·039	−·009
PORTNEUF	1918	C-D	35·775	35·760	−·015	+·002
		A-C	25·900	25·890	−·010	+·002
		A-D	44·100	44·075	−·025	−·004
RICHMOND	1917	C-D	36·424	36·400	−·024	−·004
		A-C	25·897	25·885	−·012	+·002
		A-D	44·628	44·605	−·023	+·002

The figure for distortion is arrived at by multiplying the figures in column 5 (present measurements) by the reciprocal of the mean shrinkage $\left(\frac{CD + AC + AD}{CD' + AC' + AD'}\right)$. This represents the photographic enlargement of the drawing to get the best fit. The distortions then are the difference between the figures so arrived at and the correct dimensions, given in column 4.