REPORT

to the

MINISTER FOR THE DEPARTMENT OF THE ARMY

COMMONWEALTH OF AUSTRALIA

From

Major-General R. Ll. Brown C.B., O.B.E, F.H.I.C.S.

Director-General Ordnance Survey of Great Britain

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Report

Terms of Reference

I was invited to visit Australia so that you might obtain constructive opinions and advice upon the functions and program of the Royal Australian Survey Corps, and on the task of co-ordinating all aspects of national development. The terms of reference under which it was proposed that I should report to you are given in the letter at Appendix A. These terms pose three different questions:

(a) What is the best programme of work for the Royal Australian Survey Cops for defence purposes;

(b) To what extent can the Corps co-operate with civilian survey authorities;

(c) To what extent can the civilian survey authorities co-operate with the Royal Australian Survey Corps.

Wide though these terms of reference are I find it necessary to comment on matters that lie outside them in order to achieve your purpose

Investigation

2. I have inspected the establishments of the Royal Australian Survey Corps; visited the States, consulted with their Surveyors-General and seen their mapping organisations; visited the mapping organisations of the Department of the Interior; consulted with the Commonwealth Surveyor-General, and consulted a number of officials and public persons. See Appendix B.

Present Position

3. The present position of the survey and mapping in Australia is one of transition. Until recently the size of the country, the sparseness of its population, the limitations of resources and of technical methods, have placed any comprehensive survey of the country beyond the bounds of immediate practicability. In consequence most surveys of the past have been aimed at meeting particular rather than general needs.

4. The war gave a great impetus to mapping. Considerable parts of Australia were mapped under the threat of invasion and, in general, great advances were made in the “know-how” of mapping extensive areas in a short time.

5. Since the war the surveyors and airmen of Australia have made great efforts to improve its general mapping. In spite of this Australia is still largely unmapped (see Appendix C) and, at the present rate of progress, it will be many generations before the habitable parts of Australia are mapped, even at the scales and standards of accuracy and completeness now thought to be the least that can suffice. A higher rate of progress is obviously desirable; the question is what particular measures can be taken to increase it.

6. There seems to me to be two factors which particularly militate against an increased rate of mapping at the present time and which would be worth examination.

(a) The lack of an authoritative assessment of what mapping is worth to the nation;

(b) The organisation of Commonwealth mapping.

Need to Assess the Value of Mapping.

7. The increasing population of Australia and the improvement in technical methods have rendered a comprehensive survey practicable and substantial progress towards its completion within a reasonable time entirely possible. Moreover it is becoming increasingly necessary from many points of view and the neglect of it may prove costly.

8. It is axiomatic that maps are an essential basis of effective planning; that they are needed by a variety of private and public undertakings; that for defence they may be vital; and that it is a function of governments is to provide them. A balance has, nevertheless, to be struck between what is desirable and what is expedient. To strike the right balance is both difficult and important.

9. The difficulty arises for various reasons. The making of maps is not an end in itself. It is useful only in so far as it helps some other activity. A map, like a dictionary or any other work of reference, takes time, skill and money to make. It contains an immense amount of typographic knowledge which cannot easily be reached by any other means. Seldom can anyone afford to make one for his own particular use or contemplate stopping his own activities whilst he does so. If it is not already there he must do the best he can without it. A great variety of people need to refer to it, in varying degrees of urgency and frequency. The penalties for not having one are sometimes self-evident, but more often unrecognised even when severe, and one need look no further than the Snowy Mountain Project for an example of this - see Appendix “D”. When a map is to hand its existence is usually taken for granted and the evils that its guidance has avoided seldom come to mind at all.

10. All the evidence of the value of maps is thus not easy to assemble and much is a matter of opinion and therefore requiring each rude judgement. Although it may therefore be difficult to assess the value of national mapping, it is nonetheless important that it should be assessed. The trend of modern opinion is that the supply of suitable maps at the proper time brings advantages out of all proportion to the efforts required to make them. (#)

11. The advantages of mapping Australia have often been put forward by surveyors and similar professional men but, so far as I can ascertain, no assessment of the need for national mapping in the general interest has ever been made by an authoritative and independent body after due enquiry. I recommend that this should be done. I believe that at this stage in Australia's history it would be of great value to politicians and administrators. If a commission is set up for this purpose it should be one commanding public confidence and surveyors themselves should not sit upon it except in the capacity of technical advisers.

(#) See United Nations publication, sales number 1949.I.19, Report of the Committee of Experts on Cartography, 1949.

Organisation of Commonwealth Mapping.

12. The responsibility for surveying and mapping Australia is divided. The Department of the Army is responsible for mapping for defence. The Department of the Interior is responsible for mapping for civil flying and for mapping Commonwealth administered territories. Neither department is responsible for mapping in the general interest. The Governments of the States have the widest responsibility of general mapping of their own territories but are not responsible for the mapping required for the performance of the functions of the Commonwealth Government. Air photography for survey purposes is carried out principally by the Royal Australian Air Force but also by civil firms under contract.

13. There are two co-ordinating bodies, the Commonwealth Survey Committee and the National Mapping Council (see Appendix E).

(a) The Commonwealth Survey Committee is a departmental committee which recommends action to co-ordinate the mapping activities of the Commonwealth Government Departments.

(b) The National Mapping Council is a joint Commonwealth and States body. Its principal function is to co-ordinate Commonwealth and State mapping on a national basis.

Commonwealth Mapping Agencies

14. The Royal Australian Survey Corp is the mapping agency for the Army and the RAAF. It is well established and most of the surveys and mapping of Australia that are national in character have been done by it. Its main function is to provide the surveys and maps used by the ground and air forces in war. These will not necessarily be confined to Australian territory, see para. 30 below.

15. The National Mapping Section of the Property and Survey Branch of the Department of the Interior is the mapping agency of that Department. It was established after the late war and has carried out a considerable amount of small scale reconnaissance mapping and mosaicing, mostly for aeronautical charting.

16. Between these two agencies there is considerable friction which is almost inevitable so long as there is substantial overlapping in their respective spheres of territorial and technical activity.

Survey Resources of the States.

17. The surveying resources of the States are chiefly occupied in surveys for land title and settlement and in special surveys for particular projects. The States have undertaken very little systematic mapping, so that their contribution to national mapping is at present very small.

18. Under the Survey Co-ordination Acts, which most States have enacted, the records of all surveys made within the State for whatever purposes are available to the State. This enables the records of all surveys to be assembled and compiled into a single map, and many such compilations have been made. But, useful though these compilations are, they are not a general survey and, by the nature of their composition, they are incomplete both in respect of

the area covered and in respect of the kind of information available to show. Moreover, the information available is most abundant where most development has already taken place and least abundant, indeed often quite absent, where future developments are to be planned. The contribution made to national mapping by these acts is not as great as might at first appear.

19. Surveys for special purposes, such as land-title and engineering programs, on which the survey resources of the States are now principally engaged, will continue to be necessary for those purposes indefinitely. A general survey of the whole country will not replace them, though it can assist them.

20. The States are extremely sensitive to any incursion by the Commonwealth into their province of mapping for the State. Nevertheless, I gained the impression that they would welcome almost any Commonwealth surveys which would assist the mapping of their States, provided that they themselves remained free to use those surveys as they wished and to continue their own State mapping activities unimpeded. I believe also that, subject to agreeable arrangements, they would like to participate more than they used to do in Commonwealth mapping of the kind which would be of use to the Commonwealth, since this would also be of use to the State.

Need for a Single Mapping Authority Capable of Devolution.

21. The general mapping of Australia for the benefit of the many activities of the community, including defence, needs to be treated as a whole. It is a single problem which cannot be divided or treated piecemeal without disadvantage.

22. Divisions are of course possible, but they are not advisable. They could be drawn along functional, geographical or departmental lines. A functional division could be drawn, for instance, between the geodetic control and the subsequent parts of the survey. But though this would be practicable, the parts so divided are intimately related and their technical methods and their progress need to be co-ordinated at many points. They are better controlled under a single responsible head.

23. A geographical division could also be made, as for instance between the States, or between the spheres of primary interest of government departments. But the problems of the geodetic control and of certain aspects of topographic mapping transcend such geographical frontiers, and ought not to be limited by them. If such frontiers are allowed to interfere, difficulties like those caused by the national frontiers in Europe will arise in Australia.

24. Perhaps the least satisfactory form of division is that towards which Australia is now tending, that of each government department are fulfilling its own needs without regard to geographical frontiers or to the survey functions involved. A much higher degree of central direction than at present obtains, or lies within the power of any existing authority or advisory body, would be advantageous. This could be accomplished by a considerable degree of devolution of executive performance and authority. It would be a truism to say that goodwill and co-operation of all parties would be necessary for any change in the present arrangement, or that arrangements between sovereign states and federal governments are matters of facts and persons and not of paper projects. Nevertheless I believe that better arrangements than those now obtaining could be made and could be simple, practicable and acceptable.

An Objective

25. Iit may be helpful if I outline an organisation that I think would be suitable as an objective towards which it would be advantageous to work. Most of the necessary elements for it already exist.

(a) A single authority would be responsible for all geodetic and topographic surveying and mapping of Australian territory required for all the general purposes of the Commonwealth;

(b) The authority would have a separate parliamentary vote; and would be under a minister able to foster its general progress and efficiency, but having no departmental reason to need it services special purposes - see Appendix F;

(c) All general mapping and aeronautical charting of Australian territory needed by more than one section of the community would be included in the national programme;

(d) Should any part of the national programme be an immediate requirement of one department only e.g. defence, and not obtain the priority thought necessary by that department, the department would be required, rather than do the work itself, to get it done by the Authority, finding if necessary the money and manpower allotment from its own resources;

(e) The Authority would not undertake, except by special arrangement, any surveys that was not required to meet the normal and general mapping needs of the nation. Specialised surveys, e.g. engineering surveys, land-title surveys, irrigation surveys, presentation of civil maps in special military form, etc, would normally be undertaken by the Departments and organisations requiring them, although close liaison would be maintained with the Authority to ensure that full use was made of its national surveys and that unnecessary duplication was avoided.

(f) The Authority although primarily a civil organisation on a civil vote, would employ, in addition to civilians, offices and survey technicians on the active list of the Royal Australian Survey Corps. The number of such military personnel would be determined by mutual agreement between the Authority and the Army, and for that purpose the overall active and reserve requirement of the Army would be laid down as a factor of paramount importance.

It would be essential that the military personnel should be acceptable as individuals to the authority and it would probably be desirable that they should be employed by the Authority in rotation for specific periods of their colour service. It would be in the interests of the Authority to offer such men further employment as civilians on some preferential basis of admission after termination of active military service.

(g) The Authority would be empowered to invite the Royal Australian Survey Corps to undertake agreed parts of the national survey program. Such surveys might be conducted, for example, as military training exercises or as extended military

operations. Any financial considerations which this might involve should be easily capable of adjustment.

(h) The States would be encouraged to undertake parts of the national programme. This encouragement might take the form, for instance, of reimbursement for work done to specification of the Authority.

(i) A Committee of the Department of the Treasury, with technical assistance from the Authority, would assess the other surveys of the States and allot to them funds in proportion to the value of those surveys to the national programme;

(j) The Royal Australian Air Force would be the Authority's first source for photography, so long as the Royal Australian Air Force desired it and could provide the necessary photography. It might become necessary later for the Authority to supplement this source, either by its own means or by contract, and this should be allowed for.

(k) Advisory Committees, at which the needs of public and private users and other interested parties could be represented, would be set up to advise the responsible minister on the work for the Authority.

Effect of Reorganisation.

26. Such a reorganisation need take no more manpower and money for mapping than that at present variously allotted, and could use them more economically. Subsequent increases are to be expected in any case and these could be kept under as good or better control than at present. The essential change from the present arrangement is the formation of a single authority, divorced from sectional loyalties and special interests, to direct all national surveys and mapping. I believe this would be of advantage to the community. It would leave specialised surveys, which have little use outside their own spheres such as those for land tenure, engineering, and certain defence projects, where they can most easily be handled and financed by those directly concerned. It would not encroach on the sovereignty of the States. It would bring the vote for national surveys under annual review so that money and manpower could be allotted according to the Government's view of the national need. The connection with the Royal Australian Survey Corps and the Royal Australian Air Force is an essential feature of the proposal because the defence services have in any case to maintain military surveys in peace and the best possible technical training for them is on productive work which is submitted at once to user criticism.

27. In my opinion it would be advantageous to reorganise the Australian national surveys along these or very similar lines. If that were desired it would be necessary to make a detailed examination of ways and means, and this should be undertaken at a level, above that of present departmental tensions, where the interests of the particular apartments could be seen in relation to those of the nation.

Evolution of Military Surveys.

28. In the absence of any general survey for national purposes, the Defence Services must themselves undertake surveys of Australian territory for defence within the limits of money and manpower which they find necessary to allot to that purpose. Surveys for defence,

however, are not limited to those necessary for the repulsion of invaders, but extend to those necessary for any general developments of the country which sustain the defence effort. These merge gradually into surveys of general civil use. No firm dividing line can be drawn between the two, and indeed, the problem of surveying Australia for national purposes is a single problem, one aspect only of which is the defence aspect; and this problem cannot be divided, either functionally or territorially, without difficulty and without detriment to which use all as ultimate solution.

29. Up to the present most of the surveys and maps of Australia that are suitable for general national use have been made by the Royal Australian Survey Corps and it would clearly be possible to charge the Royal Australian Survey Corps with the responsibility for national mapping and with the functions of the Authority proposed in para. 25. To do so might indeed be a practical first step. Many national surveys have sprung from defence surveys in this way, but as the need for maps for more general purposes has grown the burden of the work has usually passed to the civil votes and often to entirely civil organisations. In my opinion it would be advantageous both to Australia generally and to her Defence Services, to follow this natural course of development and to encourage the growth of a strong National Survey working in close harmony and partly integrated with the defence survey organisations but responsible to a civil minister.

Function of the Royal Australian Survey Corps.

30. The main function of the Royal Australian Survey Corps is to provide the maps and surveys needed in war by the ground and air forces. It will seldom be possible in war to provide maps that are as complete and as good as could be desired. The provision of maps, like that of other needs of war such as roads and railways, depends very much on what has been done beforehand, usually by other people for other purposes. The strategic mapping that can be done beforehand by the defence services is limited by consideration of cost, manpower, accessibility of terrain and the predictability of theatres of war. Not much of the world is mapped. (#) Perhaps 25% of the land area is covered by small reconnaissance maps, and less than 2% is mapped as scales as large as 1/25,000 with the accuracy desirable for predicted fire and precise bombing. In consequence complete dependence on prior mapping is not possible. It will certainly be necessary to make surveys and maps in wartime, and though these will be limited to meeting the necessities of a particular campaign or a particular battle, they are likely to tax the available resources to the utmost.

31. Preparatory measures consist in building a Survey Corps and planning its expansion, in collecting and reproducing other people's maps, and in making new surveys in advance when conditions permit. These measures are now reasonably co-ordinated between most nations of the British, Commonwealth and the U.S.A. and further within NATO. In the last two of them Australia has accepted certain general obligations, the fulfilling of which devolves principally upon the Royal Australian Survey Corps.

32. In order to perform its main function of providing maps and surveys in war the Royal Australian Survey Corps must do certain things in peace.

(#) See diagrams in UN document quoted on page 2.

(a) Train enough survey staff officers, survey commanders and survey technicians;

(b) Study and practice all modern technical methods, and study the possible uses in war;

(c) Study the needs of all arms of the Army and Air Forces and cooperate with them at all levels;

(d) Maintain liaison with all civil survey organisations which might come under military control in war or be the source of survey recruitment;

(e) Collect and prepare for military use map and survey date of possible theatres of ground and air operations;

(f) Survey and map such areas as the General Staff consider vital and to which there is access in peace and of which surveys cannot otherwise be obtained.

Answers to the Main Questions.

33. I come now to answer the questions posed in the main terms of reference. First, what is the best programme of work to be undertaken by the Royal Australian Survey Corps for defence? I think that it should be such that it will help the Corps in doing all those things listed in paragraph 32 in due proportion. In particular it would be such that within it the Corps can exercise its offices and men, either as individuals or as formed bodies, in all the main branches of geodetic and topographic surveying. No main branch should be excluded, since all must be thoroughly understood if they are best use is to be made of existing surveys and maps in war, but particular attention could be given to the kinds of survey most likely to be carried out in war and the technical processes to be used. These include radar techniques, field astronomy, topographic triangulation and mapping by ground and air methods, map drawing, reproduction and printing. I would attach great importance to officers and men being individually competent in their technical duties without which their military duties and corporate military and technical actions cannot be satisfactory. To have its greatest training value the programme of work should produce surveys that are of immediate use and so come immediately under the scrutiny and criticism of users. Such work is found in peacetime mainly in the civil field.

34. I cannot with advantage formulate such a program in detail, for this would be better done by those with more intimate knowledge of what is possible, but I suggest that the above principles would guide its formulation.

35. As regard the areas in which the Corps should be active although there are extensive and accessible areas which it would be advisable to survey as soon as possible for strategic reasons, there does not seem to me to be many of such strategic importance and so likely to become theatres of operation that the mapping of them is more important to defence than the general mapping of the country for its general development upon which its defensive effort is founded. This matter should, however, be further examined by the General Staff.

36. Secondly and thirdly to what extent can the Corps co-operate with the civilian survey authorities and vice versa? The extent to which co-operation is possible depends under the present organisation largely upon the personality of the individuals concerned. This variable

factor will always affect co-operation to some extent, but it can exert a great influence in some forms of organisation than in others. The fullest co-operation between the civil and military survey authorities is of course necessary, and the form of organisation ought to be such that it encourages co-operation and limits the occasions in which a genuine difference of outlook can affect matters of common interest. The chief factors which make co-operation difficult at present are (i) the lack of a clear definition of respective duties, and (ii) an organisation which tends to create overlapping of responsibilities and friction. I have suggested in paragraph 25 an organisation which I think would overcome the difficulties. In my opinion reorganisation is necessary and I believe that a suitable organisation acceptable to all parties could be worked out in detail. I think the best way to do this is to have the subject examined by an independent commission of sufficient standing to command confidence and, if necessary, to override objections.

Special Items in Terms of Reference.

37. I deal next with the special items in the terms of reference relating to technical matters which it is particularly desired that the report shall cover.

Item (a), incorporation of the main Army triangulation in a national system.

Incorporation of Army Triangulation

38. The main army triangulation is good enough to be worth incorporating into a national system of geodetic triangulation and ought not to be neglected when a national system is being built. Indeed it is probably of better quality than most existing triangulation. But at present there is no national system; though it in my opinion one is badly needed. The problem building one is as much a problem of organisation, manpower and finance as is of technical method. There are certainly no technical problems which Australia does not possess the necessary skill to solve, but here again a balance has to be struck between what is desirable and what is expedient.

39. The National Mapping Council has examined this problem and it appears that a satisfactory national geodetic framework would require about 12,000 miles of primary triangulation chains, of which about 3,000 miles already exist, including the army chains, leaving about 9,000 miles to be done. This estimate seems to me quite sound and I think it is about the minimum necessary to construct a system that would not be liable to subsequent alteration.

Purpose of a National System of Triangulation.

40. A geodetic framework has two objectives, one practical, the other scientific; and there is no clearly defined boundary between them. On the practical side it is analogous to the foundation and [unreadable] framework of a modern building, though the analogy should not be pushed too far. It is strong and rigid. It is of little use until it is complete. It enables other parts of the structure to be made in less strong, and therefore less expensive ways, thus affecting a [unreadable] economy. It enables the other parts to be made in small portions and at a time when and where most needed, with the assurance that they will fit exactly to the neighbouring portions when those too come to be made. Its aim is consistency; and its method is to accept the small inexactitudes of individual measurement, technically called "errors",

which are inescapable even with the great et refinements, and to distribute them evenly over the whole field, thus preventing them from accumulating in any one place to form a large discrepancy. Thus distributed, "errors" are innocuous; and it is possible to distribute them only through a geodetic framework.

41. It is of course, quite possible to proceed without a geodetic framework, and circumstances may sometimes make this the wisest course for a time. The practical drawbacks of doing so, however, even when foreseen and accepted, do not become fully apparent until surveys that were originally self-contained and isolated begin to have neighbours and working from one to mother across the join becomes necessary. The more that self-contained surveys are allowed to grow up unco-ordinated by a geodetic framework, the more difficult does it become to face the act of co-ordination. Ultimately, when the drawbacks at last become unbearable, the only remedy is to tear down the whole structure and rebuild it. Perhaps a fair example of the difficulty of this is the immense cost of adjusting the European triangulations and re-aligning its military mapping, which are now being undertaken and which are little more than palliative. It is problems such as these with which Australia will he faced if the critical moment for preventive action is allowed to pass.

42. On the scientific side a geodetic framework helps to provide knowledge of such matters as the size and shape of the earth and the variations of the vertical. Although this knowledge has some obvious bearing on practical affairs, as for instance on geophysical prospecting and long-range weapons, and could be considered as one the needs of defence, it is primarily a contribution to the general advancement of science, the effects of which are quite unpredictable.

Control of National System of Triangulation.

43. It will be clear from what I have said that a national geodetic system needs to be controlled by a single authority, although the planning and execution of much of the work could be delegated to other agencies. Authority is necessary to effect co-ordination and to secure executive action. Co-operation is also highly desirable and perhaps even essential, but it cannot replace authority in this matter. Of this Europe again provides an example, where the action necessary for the comprehensive adjustment of the triangulations of autonomous states into a single system, although constantly advocated, has been extremely difficult to obtain and is perhaps now only due to the welcome "authority" of the American dollar.

Item (b), the implications of the adoption of Radar triangulation on the national system.

Application of Radar to Surveying.

44. Radar has three principal applications to surveying, and all depend upon the ability to measure distances by means of radio waves. First, the height of an aircraft above the ground can be measured by means of radio echo-sounding, and from this can be deduced the height of the ground above sea level. This measure of height is not very precise, but is sometimes the only one that can be made. Next, the distance of an aircraft from a ground station can be measured by radio waves, and thus it is possible (i) by choosing suitable ground stations whose positions are known, to determine the exact position of an aircraft at the moment of exposure of a surveying camera carried in it, and so without visiting the ground to control a map made from a series of air photographs, giving internal consistency, true scale, and orientation; and (ii) to measure the distance between any two ground stations, whose positions

may not be known, and so to measure the length of the sides of a triangle, and of a series of triangles, and thence to deduce the relative positions of their apexes. This is known as radar-triangulation or trilateration.

Uses of Radar for Surveying in War.

45. All these three techniques are likely to be used in war and the Royal Australian Survey Corps needs to be acquainted with all of them. The apparatus required is available only in the Services, and the R.A.A.F. is the only agency in Australia that has the aircraft and personnel to operate them. There are therefore some advantages in doing work of this kind entirely through Service channels, but it would be equally possible for the R.A.A.F. to co-operate in them with a civil survey authority if that were necessary.

Value of Radar in the Geodetic Framework.

46. The foregoing remarks give a background to the implication of using radar-triangulation in the national geodetic system, follow directly upon the considerations in paragraph 40. Radar- triangulation can fix the positions of points that are as much as 300 miles apart, which is about ten times what is possible with ordinary visual triangulation. In this way great distance can be covered much more quickly than formerly.

47. Much experience of radar-triangulation has been gained recently in Canada. The results show that the technique is likely to be valuable in some circumstances. The accuracy is not yet up to that of visual triangulation, and the natural variables are such that a large improvement does not seem likely. Full details are already available in Australia.

48. It is possible that a network or radar-triangulation covering Australia would be sufficient to hold geodetic triangulations in place, and so enable the building of parts of' the geodetic framework to be postponed without detriment to the whole structure. But it is equally and perhaps more likely that, when the parts of the geodetic, framework come to be built later, it will be found necessary to move the radar positions. There is no certainty at the moment and more experience is needed before there can be. It would be advantageous to gain that experience in Australia as soon as possible.

49. It seems fairly certain that radar-triangulation could span the uninhabitable parts of Australia sufficiently for most practical purposes that can be foreseen, but it should not be confined to these areas even in the first instance, because a comparison with existing triangulations in Australia is also needed.

Continuing Need for Geodetic Triangulation

50. It does not seem likely that radar-triangulation will ever be able to replace geodetic triangulation altogether. The spaces between its points will have to be filled sooner or later, and being so large as 300 miles this necessitates a triangulation of geodetic accuracy. The present radar technique is unable to measure short distance. Furthermore it cannot be related with sufficient accuracy to astronomical observations for azimuth. It should not therefore be allowed to delay any projects for geodetic triangulation.

Item (c), alignment of activities in the production of national map series at medium and small scales.

Alignment of Map-Production Activities.

51. The choice of the duties to be allotted to various agencies in the production of the national map series depends upon certain factors:

(a) If the various map series will cover the same territory, all the series ought to tell the same story about the terrain;

(b) All ought to be derived, either directly or through intermediate scales, from the same basic survey of the terrain, though this is less important as the scales grow smaller;

(c) The basic survey should be at the largest scale necessary in the locality under survey (which may vary from place to place); and when this scale is very large or when the survey is incomplete, there may be another basic survey at much smaller scale superimposed upon it;

(d) Basic surveys that provide the information for the construction or revision of map series, whether they be surveys of different areas or of the same area at different scales, ought to be co-ordinated so as to be of most use to most map aeries and not undertaken indiscriminately for different series.

(e) Draughtsmen get accustomed to work at a particular scale and when there is a sufficient volume of work at one scale it is economical to keep them working at that one scale for considerable periods;

(f) A drawing office needs certain photographic and lithographic services readily available to it, viz:

i. For changing the scale of the basic data to the scale of the compilation;
ii. For making copies of the compilation on which to make the fair drawings;
iii. For making printing plates from the fair drawings;
iv. For making proof copies of the map;
v. For printing the map.

When these services cannot be provided economically from elsewhere, it must possess its own plant and provide them itself.

(g) The economies of (f) depends both on the volume of the work and upon the accessibility (distance, transport etc.) of the agency which could provide the services.

52. It is clearly easier to allot the duties to suit these variable factors, and to keep them continuously aligned, when the agencies are all under the control of a single authority in close enough contact with them, than it is when they are autonomous. When they are autonomous the problem is principally one of agreeing mutually upon how much work, if any, one agency shall do for another and upon what terms of financial adjustment, allocation of manpower, priorities of work, etc. This agreement can mutually be reached on basis of mutual advantage when the respective responsibilities of the agencies do not overlap both territorially and functionally and are so defined as not to present undue occasion for one authority to wish to grow at the expense of another. For instance, as will be seen from paragraph 65 below, the

Colonial Survey of U.K., though it has a considerable volume of map reproduction work to be done finds it more economical to have it done by the Ordnance Survey on repayment than by establishing its own reproduction plant for the purpose; or again, though the Ordnance Survey and the Military Survey both have fully equipped reproduction plants of their own, it is convenient, and economical for the Military Survey to have a considerable quantity of work done for them on repayment by the Ordnance Survey.

53. In Australia the alignment of activities is difficult because responsibilities overlap and I do not think the present alignment can be much improved while they continue to do so. Some change might nevertheless be useful. The principal map scales being used in Australia are:

1/31, 680 or 40 chains to 1 inch, or 2 inch to 1 mile
1/63, 360 or 80 chains to 1 inch, or 1 inch to 1 mile
1/253, 440 or 4 miles to 1 inch
1/1, 000, 000 or about 16 miles to 1 inch

I suggest that the allocation of the duties might be as follows for the following reasons. It should be noted that the scales in use in Australia are not fully in line with those agreed for standardised military use, see Appendix "G".

Scales Larger than 1/50,000.

54. The only military scale in which standardisation is mandatory is the 1/25,000, and Australia has no extensive military mapping at so large a scale and is not likely to have any in the near future. I therefore think that the production of map series at scales larger than 1/50,000 could well be done by the States, The work has to be co-ordinated with that of Commonwealth mapping agencies because it ought to be used in producing smaller scale maps, and the Commonwealth ought to have some say (perhaps by means of financial grants) in the completeness, scale and reliability of the work. Since the States' Survey Departments are likely to grow, they should be responsible for the whole production of the maps, setting up their own plant when that is economical and convenient, or using the facilities of other agencies when it is not. The Royal Australian Survey Corps is the most appropriate agency to provide such facilities.

The Scale of 1 Mile to 1 Inch.

55. The 1 mile to 1 inch (1/63,360) map is the most important military map in the country and is also the best general map for civil use. The whole production of it should remain the responsibility of the Royal Australian Survey Corps, since it is of general value the civil departments should have some say in the priority of the work perhaps by means of contributions in money or manpower allotment.

The Scale of 4 Miles to 1 Inch.

56. For similar reasons the 4 miles to 1 inch (1/253,440) map should be the responsibility of the Royal Australian Survey Corps on similar terms. This presents no difficulty when the basic survey is at the1 mile to 1 inch (1/63,360) scale or larger. When, however, the basic survey is at about the 4 mile to 1 inch (1/253,440) scale there are conflicting interests. Basic surveys at about this scale are being made by the Department of the Interior, chiefly for the

purpose of producing civil aeronautical charts at the scale of 1/M. The surveys are not sufficiently complete for standard military mapping at the 4 miles to 1 inch (1/253,440) scale nor could they be so without considerable delays in production. Nevertheless, I think it would be advantageous if one or other of the two agencies were made responsible for all aspects of the basic ground and air survey at the 4 mile to 1 inch (1/263,440) scale, even though the priorities at the completeness of the initial productions would have to be decided by a superior body. In my opinion the Royal Australian Survey Corps is at present the most suitable agency for this responsibility, but were it charged with it, it would need the relevant money and manpower.

57. The reproduction and printing of maps at the 4 mile to 1 inch (1/253,440) scale can at present best be done by the Royal Australian Survey Corps, which is the only agency fully equipped to do it.

The Scale of 1/1M.

58. At the 1/M scale the maps concerned are principally aeronautical charts. It is the duty of the Royal Australian Survey Corps to provide aeronautical charts to the RAAF and this duty which is in line with the practice in other countries of the British Commonwealth, ought not to lapse in peace- time. I deal further with this question in paragraph 71 below. It is the duty of the National Mapping Section to provide aeronautical charts for civil aviation to the specification of the International Civil Aviation Organisation. During the war a 1/M aeronautical charts series covering Australian territory (and extending beyond it) was produced and is still supplied to the RAAF by the Royal Australian Survey Corps. A new 1/M civil aeronautical chart series covering Australia is being produced by the National Mapping Section, and it is planned quite rightly that the RAAF shall take this new series into use, perhaps in a modified form, as soon as it covers a sufficiently extensive area.

59. The reproduction and printing or the civil charts is done by the Royal Australian Survey Corps. It may be desirable for the National Mapping Section to have some reproduction equipment at its direct disposal locally, but the volume of work is hardly sufficient yet to justify setting up a complete independent plant to do the whole of the reproduction and printing. When the volume of work increases as it may at some future date, an independent plant might be justified but so long as the resources of the Royal Australian Survey Corps, which have to be maintained in any case, can deal with all the work, the present arrangement ought to continue.

60. Although the design of military aeronautical charts tends to diverge slightly from that of civil charts, the fundamental concept of both is very similar and the fundamental data from which both are compiled is the same. There are, therefore, advantages and economies to be gained from both being made by the same agency when that is practicable. At present the National Mapping Section is responsible for making both, the Royal Australian Survey Corps doing the reproduction and printing for the Section on an agency basis. It would appear much more satisfactory on balance for the Corps to be responsible and to be given the necessary money and manpower to do both; but if the National Mapping Section retains the responsibility in peace, steps should be taken to ensure that the control of the Section and the responsibility for all aeronautical charting pass to the Royal Australian Survey Corps in war.

A National survey Needed.

61. The whole question of the alignment of activities in the production of national map series would, of course, be much easier if a national survey were set up as suggested in paragraph 25. The basic surveys and maps of Australian territory serving all sections of the nation would then be provided from a single source, and of the various government departments and other sectional interests would only have to undertake for themselves those specialised surveys which are peculiar to them and serve no general purpose. This would not only remove the cause of an unhealthy rivalry, but would also promote a function of government; for, as Abraham Lincoln wisely observed, "the legitimate object of government is to do for a community of people whatever they need to have done but cannot do at all or cannot do so well for themselves in their separate or individual capacities".

Item (d), advice on the function of joint advisory or executive bodies in the light of experience on the Joint Advisory Survey Board, U.K.

Joint Advisory Bodies.

62. The joint advisory and executive bodies concerned are the Commonwealth Survey Committee and the National Mapping Council mentioned in paragraph 13. Their composition and terms of reference are given at Appendix "E".

63. The Commonwealth Survey Committee, which contains representatives from all the map and survey producing departments and most of the user departments of the Commonwealth, is sufficiently representative to be able to give well founded advice and to stimulate executive action. It suffers, however, from certain drawbacks. It is evidently handicapped by the overlap in the responsibilities for surveying and mapping mentioned in paragraphs 14 et seq. Since this overlap concerns its own members, the committee cannot itself resolve any real conflicts about it. The Committee officially reports only through the Minister for the Interior. This restriction would in theory limit the opportunities for directly obtaining executive action elsewhere, but it is perhaps not the only channel in actual use. The Committee has no duties in respect of States' surveys so it cannot influence their contribution to the national surveys although the Commonwealth departments need the national surveys as much as anyone. I understand that the Committee formerly gave advice on the allocation of funds to the States for national surveys. This duty has now been transferred to the Commonwealth Mapping Council.

64. The National Mapping Council is primarily a consultative body. Its purview is specifically limited in certain aspects of Service mapping, which forms the greater part of the national mapping. Since there is overlapping between surveying responsibilities of the Commonwealth members, which also overlap those of the States' members it can only procure executive action with certainty in matters that are not controversial and can only resolve differences by persuasion. It has little executive power and its principal business is consultation. In that field it does valuable and necessary work.

65. I am asked to advise on the function of these bodies in the light of experience on the Joint Advisory Survey Board. I do not think that the pattern of organisation which has been gradually evolved for Great Britain will necessarily suit Australia, but the principles underlying it should be applicable. The composition and terms of reference of the Joint Advisory Survey Board, together with the surveying and mapping responsibilities of its

members, are shown at Appendix "H". It will be seen that the relative responsibilities of the members are arranged so as to avoid unnecessary overlapping. In consequence unresolved conflicts are few. The Board is consultative and advisory. It does most of its day-to-day work through sub-committees. It procures executive action by inviting its members to take it through their own ministries. Most action is procured in this way, but matters of policy affecting more than one ministry and requiring more than the agreement of the technical heads of Services may need to be formalised and finally settled directly between the Permanent Secretaries of the departments concerned or, in important cases, may be referred to an ad hoc inter-departmental committee or even to a Royal Commission for further examination and advice before a final decision is taken. The most recent example of this is the Inter-departmental Committee on Survey Staffs 1949.

66. I think that the most important organizational problem to be resolved in this field in Australia is that of the overlapping of responsibilities. If the activities of different survey authorities have to take place in the same territorial area, they should not overlap functionally; and if different authorities have the same functions, they should not overlap territorially. I believe the best solution is to establish a single Commonwealth authority for the geographic and topographic surveying. (##)

67. Overlapping with the work of the States, which is an important problem and will be more so if the state starts extensive work in this field, could I believe he avoided without any real or apparent regimentation of them, indeed with their willing to operation, by giving them grants from the centre in return for work done to a particular standard within the national programme.

68. Until the problems of overlapping have been solved and satisfactory spheres of activity agreed upon and defined, advisory and executive bodies will have difficulty in functioning. I have suggested an organisation in paragraph 25, of which advisory bodies would be an essential part. The Commonwealth Survey Committee and the National Mapping Council would be an excellent nucleus for them.

Item (e), advice on other matters relevant to co-ordination of activities or to the potential of the Army Survey Service in peace with due regard to its functions in war.

Hydrography.

69. I have not raised the question of Hydrography in this paper because the responsibilities of the Hydrographer are quite clear and do not overlap with those of other surveying organisations. For landward surveys he relies principally on the work of other organisations and only conducts them himself if he cannot get the data thus or if his surveys ashore relate only to seaward observations.

(##) There appears to be sufficient mandate for this on the ground of defence and of the existing international obligations regarding the mapping of Australia which Australia has undertaken and owes to other nations of the British Commonwealth, to USA, to ICAO, and to IMW Convention which is shortly to be transferred to UNO.

Air Photography and Radar Techniques.

70. As will have been seen from paragraph 30, in a future war it is likely to prove essential to make surveys under active service conditions. The needs of the future may, of course, be somewhat different from those of the past, but it does not appear that modern developments, such as precise bombing and a long-range weapons will in any way decrease the call for surveys and maps - rather the adverse. The surveys required will of necessity have to be made principally from air photographs and often with the aid of radar techniques. It is therefore desirable that the present co-operation in this kind of work between the RAAF and the Royal Australian Survey Corps should be maintained and even expanded, and that in peace they should be given as much productive work in these techniques as can be found for them, since that provides by far the best form of training even though the peace-time application may not be precisely the same as the one to be expected in war-time.

Aeronautical Charting.

71. As has been noted in paragraph 58, the National Mapping Section is making aeronautical charts which will in due course be used by the RAAF. I understand it is planned that in war the RAAF shall take over the aeronautical charting branch of the National Mapping Section and form it into a separate Aeronautical Charts Service for the RAAF. If this is so, the project ought to be carefully considered in the light of the British and the American set-ups, which differ.

72. In the UK the RAF became a separate service shortly after the first world war and at that time it was clear that the Army Mapping Service, which had up till then served the Royal flying Corps while it was part of the Army, could continue to serve the independent RAF; and that, in so small an undertaking as a mapping, in which both Services would withdraw their basic topographic information from the same sources, it would be wasteful and undesirable to set up a separate mapping agency for the RAF if that could be avoided. Accordingly the duplication of mapping agencies was avoided and the Directorate of Military Surveys still has a joint and equal responsibility to the Air Ministry and the War Office, see Appendix “H”. Considerable economies and an additional link in the liaison between the two Services have resulted.

73. In the USA, on the other hand, the USAAF remained as part of the Army until quite recently, and there was considerable controversy until it became an independent Service. Meanwhile circumstantial is had led it to set up and aeronautical chart service independent of the Army map service. The duplication involved in this arrangement is more justified in a country having a large population and greater resources than in a small one, and on balance of advantage the USA prefer to retain the arrangement though it is not without its drawbacks.

74. In Australia, where the population is small and the mapping resources meagre, the American arrangement would, in my opinion, be wasteful and less efficient, and ought not to be followed unless other considerations make it essential to do so.

Surveying Reserve Potential.

75. There is no large body of geodetic and topographic surveyors in civil life, as in other professions is generally the case, from which skilled men can be drawn in adequate numbers to take their place in military survey units in war with little further technical training.

Moreover these particular skills require a fairly intelligent type of man and a considerable period of training. The trades of cartographic and topographic draughtsmen are somewhat similarly placed, except that so long a training period is not essential. The reproduction and printing trade, on the other hand, are more extensively used in civil life, and reorientation of the tradesmen in military mapping techniques do not take unduly long.

76. The surveying profession, as represented by its professional institutes, does not provide the reserve for military survey units of the size and kind which at first sight it might be thought to do. Surveyors wishing to practice in land transfer are required to be licensed and are controlled by law in order to meet the needs of the excellent system of land-title used in Australia, and the Surveyors Boards require a high degree of competency from the candidates before a licence is issued. The professional institutes cater almost exclusively for the licensed surveyor, and in consequence most of their members are engaged entirely on surveys for land transfer and land development, which are specialised in character, and very few of them have in the course of their civil practice acquired experience of extensive trigonometrical or topographical surveys, such as are needed in war and such as are the principal duties of a National Survey.

77. The laws and regulations furthermore, which are specifically drawn up for the protection of land title, make it necessary for a professional man to carry out in person many of the technical process of surveying which might in other circumstances be done by a technician not having professional qualifications. While such arrangements are necessary for the proper conduct of the established system of land title, it would be impractical in extensive geodetic and topographic surveys, either in peace or war, to have so much of the technical work done by professional men, both because there are not enough of them and because it is cheaper and more efficient to sectionalise the work, employing in each particular process technicians who are specialists in it and using a limited number of men with white professional knowledge and training to plan, direct and supervise the work of technicians. This is therefore the practice in the Army and in most large trigonometrical and topographic surveys.

78. The surveying profession is, nevertheless, the best source of skilled civilian surveyors. Most of them would need reorientation and training before they could take their places in military survey units, either as offices or as technicians. This would take time and how far the consequent delays could be curtailed would depend on what training could be given in peace-time.

79. Outside the profession (#) also there are no large sources of skilled civilian surveyors. Some are to be found in engineering undertakings and in the States and Commonwealth survey organisations, and these are mostly technicians working under the direction of engineers or of licensed surveyors.

(#) The 1947 census showed about 1700 surveyors throughout Australia including quantity surveyors and students; the professional licensed land surveyors number about 1000.

80. The establishment authorised for the Australian Survey Corps is 237 and the present strength is about 200. I have not enquired into the expansion of the Corps in war or seen a calculation of the probable requirements. Such a calculation might be based upon the principle of providing a balanced force of all arms; or upon that of meeting some particular foreseeable surveying operation; or upon Australia making the best contribution to the common military survey effort that she can manage within the limits of her normal peace-time surveying resources. Whatever way the calculation is made the question of reserve potential remains important. Taking into account the Army's need for engineering surveyors and artillery surveyors, and for a mapping organisation at the home base in war, it is evident that there will be difficulty in expanding the Corps quickly. It also seems certain that at its present strength the Corps will be totally inadequate to fulfill all the duties it may be expected to undertake in war. I believe these questions have been under consideration. I wish here to do no more than call attention to both the importance of reserving, and if possible training, the limited survey potential of Australia in peace-time, and to the help that the creation of a National Survey would give to the solution of this war-time problem.

Summary of Recommendations.

81. My principal recommendations are as follows;

My principal recommendations are as follows:

(a) That the need for mapping Australia be examined by an authoritative and impartial Commission (paragraph 11).

(b) That the fundamental geodetic and topographic surveys of Australia be reorganised as a national undertaking, (paragraphs 24 and 25).

(c) That the reorganisation should include arrangements that ensure close and friendly relations between the Royal Australian Survey Corps and the civil survey organisation, (paragraph 36).

(d) That the Royal Australian Survey Corps partake corporately or individually, in all forms of survey that may be met with in war, (pararaph 33).

82. My recommendations in subsidiary matters are as follows:

(a) That the Army triangulation be incorporated in a national system, (paragraph 38).

(b) That a national system of triangulation is necessary (paragraph 38) and should be controlled by a single authority (paragraph 43).

(c) That experience in radar-triangulations be gained within Australian territory as soon as possible (paragraph 48) and that geodetic triangulation be not delayed on that account (paragraph 50).

(d) That some realignment of map production activities is desirable within the present framework (paragraph 53) but that a satisfactory alignment would entail a reorganisation of surveying responsibilities (paragraph 61).

(e) That surveying responsibilities which overlap functionally ought not to overlap territorially, and vice versa (paragraph 66).

(f) That, if advisory and executive bodies are to function without difficulty, spheres of activity that do not overlap will have to be laid down (paragraph 68).

(g) That co-oporation with the RAAF in surveying techniques be fully maintained (paragraph 70).

(h) That the British organisation for providing aeronautical charts be retained if possible (paragraph 74).

(i) That the civil survey potential be reserved for war duties (paragraph 80).

(j) That the control of national surveys should be vested in a Minister whose Department has no special mapping requirements (Appendix “F”).

(k) That in deciding the scales of national maps due regard be paid to standard military scales (Appendix "G”).

Concluding Remarks

83. In conclusion I wish to thank all those who have so generously placed their time, their knowledge and their advice at my disposal, and to express my appreciation of the remarkable hospitality and kindness that have been shown to me during my stay in Australia. In return I can but hope that this report may be of some help to you, and indirectly to all who may be concerned with the task of surveying Australia. If it is has been written with that object.

(SGD) (R. Ll. BROWN)
Major-General,
Director-General, Ordnance Survey

Chessington,
Surrey, England
December 1951.

Appendix "A",

Letter giving Terms of Reference.

Commonwealth Relations Office,
Downing Street,
London, S.W.1.

D.2800/22 27th September, 1950.

Sir,

I am directed by Mr. Secretary Gordon-Walker to state that the Government of Australia have approached the United Kingdom High Commissioner in Australia with a request that Major-General R. Ll. Brown, the Director-General of the Ordnance Survey of Great Britain, should visit Australia for one month at the close of the Conference of British Commonwealth and U.S.A. Survey authorities to be held In New Zealand in November which, it is understood, General Brown will be attending.

The Australian Minister for the Army is anxious to obtain constructive opinions and advice from General Brown in regard to the functions and programme of the Royal Australian Survey Corps, on the task of co-ordinating all aspects of national development.

If General Brown were able to visit Australia for about one month for this purpose, the Australian authorities suggest that his terms of reference should be as follows:

"To report to the Minister for the Army on the best programme of work to be undertaken by the Royal Australian Survey Corps for defence purposes, the extent to which the Corps can co-operate with survey authorities, and what reciprocal assistance the civilian survey authorities can render to the Corps".

The Australian authorities desire in particular that investigation should cover the following technical matters:

(a) incorporation of the main army triangulation surveys into a national system;

(b) the implications of the adoption of radar triangulation on the national system;

(c) alignment of activities in the production of national map series at medium and small scale;

(d) advise on the function of joint advisory or executive bodies in the light of experience on the Joint Advisory Survey Board, United Kingdom;

(e) advise on any other matter relevant to coordination of activities or to the potential of the Army Survey Service in peace with due regard to its functions in war.

If it were agreed that General Brown should visit Australia, the Australian Army department would meet the cost of his transport, accommodation, travelling allowance, etc., and would reimburse the United Kingdom Government, if necessary, for his salary for the period of his

stay in Australia.

Mr. Gordon-Walker would be glad to be informed whether it will be possible to meet this request from the Australia.

I am Sir,
Your obedient Servant,

(SGD.) J.M.C. JAMES

The Secretary,
Ministry of Agriculture and Fisheries.

Appendix "B"

List of Persons Met and Consulted.

Department of the Army.

The Hon. Jes. Francis, M.P.	Minister for the Army.
Mr. F.R. Sinclair	Secretary
Mr. F. Harding	Asstistant Secretary (A).
Lt. Gen. S.F. Howell	Chief of the General Staff.
Maj-Gen. R.N.L. Hopkins	Deputy Chief of the General Staff.
Col. J.G.M. Wilton	Director of Military Operations and Plans.
Col. L. Fitzgerald	Director of Survey, AHQ.
Major H.A. Johnson	Chief Instructor, School of Survey.
Major P.A. Kennedy	OC, AHQ Cartographic Coy.

(In addition the GOC's of all the military commands were met in their own Headquarters and several of their staff officers including all the DAD Surveys).

Department of Air.

The Hon. Mr. T. White	Minister for Air.
Group Captain I.S. McLachlan	Air Commodore – Operations.
Wing Comd. R.K. Green and Staff	Directorate of Operations.

Department of the Navy.

Commander K. Ocom	OC Hydrographic Branch, RAN.

Department of Defence.

Commander D. Storey	Director, Joint Intelligence Bureau.
Lt-Col. A.S. Smith	Joint Intelligence Bureau.

Department of National Development.

The Hon. Mr. R.G. Casey	Minister for National Development.
Maj-Gen. J.E.S. Stevens	Secretary.
Dr. H.G. Raggatt	Bureau of Mineral Resources.
Mr. G. Ruddock	Director of Regional Development.

Department of the Interior.

The Hon. Mr. Anthony	Minister for the Interior.
Mr. McLaren	Secretary.
Mr. J.N. Rogers	Surveyor-General and Director of National Mapping.
Mr. B.P. Lambert	Deputy Director of National Mapping.
Mr. G.R.L. Remington	Chief Topographical Surveyor.

Department of Civil Aviation.

W/Cdr . Hepburn	Director of Airports.
Mr. A.F. Kurrle	Chief Surveyor.

Other Commonwealth Government Departments and Organisations.

Mr. A.S. Brown	Secretary, Prime Minister's Department .
Mr. J.G. Crawford	Secretary, Department of Commerce & Agriculture.
Dr. L.F. Loder	Director-General, Department of Works and Housing.
Mr. Dunk	Chairman, Public Service Board.
Mr. Pritchard	Chief Superintendent , L.R.W.O. Salisbury.
Mr. Rowntree	Snowy Mountains Hydro-Electric Authority.
Mr. Archer	do.
Mr. T.A. Lang	Associate Commissioner, Civil Engineering do.
I.D.J. Leech	Engineer in Charge, Scientific Services Branch do.
Dr. R.L. Aston	Lecturer in Surveying, Sydney University do.
Mr. J.G. Gillespie	President Elect of the proposed Institution of Surveyors (Australia).

(In addition many of the executive officers and members of the States' Institutions of Surveyors were met, and officers of the various survey and mapping organisations of the Commonwealth and the States.)

Queensland.

Mr. .J.P. Harvey	Surveyor-General, Department of Lands.
Mr. S. Ward	Office of the Surveyor-General.
Mr. Wegner	Office of the Surveyor-General.
Mr. Kemp	Co-ordinator-General of Public Works.

New South Wales.

Mr. Rinshaw	Minister for Lands.
Mr. Arthur Jones	Secretary, Department of Lands.
Mr. D. Mulley	Surveyor-General.
Dr. Upton	Chairman, Met Board of Water Supply.

Victoria.

Mr. C.G. Pearson	Surveyor-General.
Mr. W. Mahon	Office of the Surveyor-General.

Tasmania.

Mr. Reece	Minister for Lands.
Mr. C. Hand	Minister for Forests.
Mr. Colin Pitt	Surveyor-General.
Mr. P. D. Blackwood	Chief Mapping Officer, Department of Lands.
[unreadable]	Chief Commissioner [unreadable]

South Australia.

Mr. T. Playford	Premier.
Mr. C.J. Peters	Director of Lands.
Mr. A. D. Smith	Surveyor-General.
Mr. G.H.C. Kennedy	O.C., Photometric Section, Dept. of Lands.

Western Australia.

Mr. Wood	Minister for Agriculture (acting for Minister of Lands).
Mr. W.V. Fyfe	Surveyor-General.
Mr. H. Paine	Deputy Surveyor-General.
Mr. P. Stanley	Chief Draughtsman, Office of the Surveyor-General.
Mr. W.G. Nunn	Department of Forestry.
Mr. Crimp	Acting Assistant Director of Works.
Mr. Young	Commissioner of Main Roads.
Mr. Leach	Department of Main Roads.

Appendix “C”

State of Mapping of Australia

It is perhaps not generally realised how little of Australia has been mapped. Even maps at so small a scale as 4 miles to the inch, giving only the main features in their true relation to one another and usually without heights, do not exist for more than 12% of the country. More complete mapping, giving heights and contours at 1 mile to the inch and larger scales, do not cover more than 3% of the country.

This is not to say either that the country is unexplored or that all of it need be mapped in detail at the present time. The National Mapping Council has made an estimate of what parts of the country should be mapped at what scales for national purposes. This estimate, which is intended for a long-term programme, is given below:

Basic scale of Survey proposed.	Area in sq. miles considered worth mapping at this scale	Area expressed as a % of the whole of Australia
6 or 8 miles to the inch	360,700	12%
4 miles to the inch	1,790,400	60%
2 miles to the inch	151,600	5%
1 mile to the inch	155,400	5%
2 inches to the mile	536,900	18%
Totals (say)	3,000,000	100%

In my opinion this estimate is reasonable, even though conservative. The need for the larger scales and for a more extensive use of them is likely to increase as time goes on. I would however, draw attention to Appendix “G” and to the possibilities of economy which a rearrangement of the basic scales might offer.

A requirement of this size, however urgent it may be, cannot be met in a short time and it can only be met effectively by proper programming. The speed of accomplishment is a matter, not only for annual review, but essentially also for long-term planning. The National Mapping Council certainly had these considerations in mind when they drew up the estimate.

In stating the progress so far made towards accomplishment, which is given in the table below, I have simplified the arrangement, both to make it clearer and to present it in the most favourable light. In so doing I have disregarded the areas where the basic mapping is to be smaller than 4 miles to the inch, since in these areas nothing more than reconnaissance surveys are needed for which air photography, without the full process of making accurate maps from them, will usually suffice(*). I have also combined in one item the small amount of 2 mile with the 4 mile to the inch scale; and have combined the large amount of 2 inches to the mile scale, in which progress is negligible, with the 1 mile to the inch scale. The most favourable statement of progress can then be given as follows:

Basic scale of mapping	Area req. at this scale sq. miles	Area completed at this scale sq. miles	% of req. completed
4 miles to the inch (#)			
Standard maps	-	20,000	1%
Sketch maps without heights	-	163,000	8%
Air photo mosaics	-	190,000	10%
Total	1,942,200	373,000	19%
1 mile to the inch			
Standard maps	-	95,300	14%
Sub-standard	-	79,200	11%
Total	692,300	174,500	25%

(#) Note: Compilations made from basic mapping at 1 inch to the mile and larger scales are not included in this item, but are reflected in the progress under the next item.

(*) Nearly one half of Australia has now been photographed, principally by the RAAF, and this is of great value for many purposes. But most of the topographic information contained in a photograph cannot be read directly from it by simple inspection, and if this information is to be presented in a form in which it can be used, it must be extracted by technical processes and incorporated in maps. This entails supplementary observations on the ground and the whole time-consuming business of surveying from air photographs.

Appendix “D”

Nature of the Evidence of the Need for Mapping.

The evidence of the need for mapping is by nature elusive. It has to be drawn both from the use made of maps that do exist and from the drawbacks suffered when they do not. Both these will vary under the varying circumstances throughout the world. In the former case existing maps offer an immense amount of information, the information required from them can usually be extracted in quite a short time, their existence tends to be taken for granted and the benefits derived from them tend to pass unaccounted. In the latter case the drawbacks are often hypothetical and therefore not susceptible to positive proof. In both cases the evidence depends principally on the cumulative effect of a large number of small but varied examples, whilst a few striking examples are usually open to the objection that they are never likely to recur. Nevertheless they are worth citing and I will cite two.

2. One came within my personal experience while engaged in typographic mapping in Africa when the railway from Sekondi to Almaai was realigned soon after the first war. It was then calculated that had the new alignment being selected in the first instance the saving in operating costs that would thereby have accrued to date would have paid several times over for the topographic mapping which would have made that selection possible and obvious from the start.

3. The second relates to the Snowy Mountains hydroelectric undertaking. This project has been under discussion for more than half a century. The main engineering works are contained within an area 100 miles long by 50 miles broad. No topographic map was ever made of the area and in consequence the practical possibilities, inherent in the typography, of diverting the waters from east to west were not fully realised until quite recently. As typographic knowledge of the area grew, schemes have been put forward based on an output of power starting at 150,000 Kw in 1920, growing to 250,000 Kw in 1937, and to 700,000 Kw in 1946. It was only in 1949 that it was possible to devise the present scheme, which uses the eastern waters for irrigation to the westward and raises the output to 2,620,000 Kw. Had topographic maps existed the extent of these possibilities would have been apparent from the start.

4. It is true that the opportunities of the Snowy Mountains have not been lost and that the lack of maps cannot therefore be cited as the cause of a loss which did not occur. In weighing the evidence it is now a matter of opinion what loss or inconvenience has been suffered, and whether or not the opportunities might have been discovered too late, and whether or not a similar instance with a less fortunate ending may or may not occur elsewhere.

5. Even now there are no reliable maps of the area and the Snowy Mountains hydro-electric authority is engaged in extensive trigonometrical and topographic surveys which may result in some alterations to the scheme at least in detail. These surveys do not form part of any national system of mapping and are an example of what a large undertaking may be forced to do for itself, often at an unduly late stage in the proceedings, when the Government does not undertake general mapping on a national basis.

6. In considering the evidence of the need to mapping particularly in relation to engineering projects, it is sometimes erroneously urged that the topographic map will provide the engineer with all the survey information he needs. (##) This is not so. Engineers will always have to make the specialised surveys necessary for the detailed planning, setting out and execution of their work whether topographic maps exist or not. So will many others – geologists, foresters, artillerymen, etc. But, if a topographic survey will not relieve them of having to make their own surveys, it may help those surveys in two ways. First by providing starting points and checkpoints for their own surveys, e.g. trig-points, bench marks, spot heights, and even the basic map on which to show their own work. Secondly by showing them what projects are likely to prove practicable and what are not, and where generally to make investigation and to embark upon specialised surveys.

7. It is, of course, evident that the larger the scale and the more the detail of a topographic map, the more it can help other undertakings. But, however large and detailed, it cannot do everything for them. Its value lies in being the foundation on which other work can be built. In this role even small scale maps can be of value and are infinitely better than none.

8. Though it is dangerous, because sometimes misleading, to argue by analogy, the analogy between a national survey and the foundation of a great building is singularly appropriate. The foundation is buried underground, out of sight and often out of mind, only guessed at by the uninformed, catches no votes like the superstructure; and yet without it the superstructure does not hold together. A national survey is the foundation on which many of the activities of a nation rest, indeed there are few that do not rest directly or indirectly on it to some extent; geology, forestry, engineering, defence, development, motoring, flying, taxation, the law, and so forth. In looking at the present state of mapping in Australia (Appendix "C") it is difficult to escape the impression that the foundation now provided for the multiferious activities of the nation is totally inadequate. It is so, I believe, not because the evidence of the need for it is unsound, but because the evidence is elusive - being widespread, and difficult to collect and present - and because those who suffer indirectly from its inadequacy are largely unaware of the fact.

9. What proportion of the nation's manpower and money ought to be devoted to national surveys has ultimately to be decided by politicians. I believe that were the evidence of the need for mapping to be examined by a competent and impartial commission, as I have recommended, it would be found that the present proportion is dangerously low, and that to increase it would be to affect an actual though not obvious economy of great worth. How the provision of national surveys is organised has also to be decided ultimately by politicians. I believe that the establishment of a National Survey would be the most satisfactory method and the method by which expenditure on this object could be most easily controlled. But it will not come about unless the need for it is more widely understood and acknowledged.

(##) I have heard this argument put forward as a proposition supposedly held by the advocates of national mapping, but not in fact held by them, for the sole purpose of demolishing it and so disproving the need for national mapping. It can of course be demolished very easily.

Appendix “E”

Composition and Functions

Commonwealth Survey Committee and National Mapping Council.

Commonwealth Survey Committee.

Originally set up in 1935, but reconstituted with lesser powers in 1947. The organisation and function as approved by Cabinet in October, 1947, are as follows:

The Commmittee to comprise - a representative of the Department of the Interior; namely the Commonwealth Surveyor-General and Director of National Mapping as Chairman, a renreeentative of the Council for Scientific and Industrial Research, and representatives of the Departments of the Navy, Army, Air, Civil Aviation, Post-War Reconstruction (Division of Economic Policy), and Supply and Shipping (Bureau of Mineral Resources) [Now the Dept. National Development]

The function of the Committee to be - to recommend through the Minister for the Interior or his Department, such action as is considered necessary to co-ordinate the activities and requirements of Commonwealth Departments in respect of mapping and ground and air surveys.

National Mapping Council.

Set up in 1945 on the recommendation of a conference between the States' Surveyor-Generals and the Commonwealth Survey Committee and attended also by a number of leading surveyors and other interested persons.

Composition

Commonwealth Surveyor-General - Chairman.
A representative of the Commonwealth Survey Committee (usually the Director of Military Surveys).
The Surveyor-General of each State.

Duties.

To assist in the implementation of the decisions of this and subsequent conferences.
To co-ordinate and correlate mapping on a national basis.
To determine standard methods and minimum accuracy of requirements of trigonometrical surveys.
To determine approved methods and minimum standards of accuracy for photogrammetry and cartography.
Subject to reference to appropriate authorities to recommend mapping priorities where Commonwealth assistance is involved, except in the case of Service requirements.
To recommend the allocation of Commonwealth funds provided for national mapping.

ANNEX B

FORMATION OF NATIONAL MAPPING COUNCIL OF AUSTRALIA

1. The Council was formed in 1945 following a conference in Canberra between the Commonwealth Survey Committee and the State Surveyors General.

2. The following relevant Resolutions were adopted unanimously by the meeting:

"No 2 That this conference is of opinion that a National Mapping Council is essential for the co-ordination of the mapping activities of Australia and recommends to the Commonwealth and State Governments that such Council be established as a permanent body, comprising the Commonwealth Survey-General, who shall be Chairman, a member of the Commonwealth Survey Committee, who shall represent that Committee, and one representative of each State, who shall be its Surveyor General and shall represent the co-ordinated requirements of his State. The expression "co-ordination of the mapping activities of Australia" shall be subject to the recognised policy of the Services to control their respective mapping activities, provided that where practicable the standard of all work shall not be less than the minimum requirements of the National Mapping Council. The functions of the National Mapping Council to be as follows:

(1) To assist in the implementation of the decisions of this and subsequent conferences.

(2) To co-ordinate and correlate mapping on a national basis.

(3) To determine standard methods and minimum accuracy of requirements of trigonometrical surveys.

(4) To determine approved methods and minimum standards of accuracy for photogrammetry and cartography.

(5) Subject to reference to appropriate authorities to recommend mapping priorities where Commonwealth assistance is involved, except in the case of Service requirements.

(6) To recommend the allocation of Commonwealth funds provided for National Mapping".

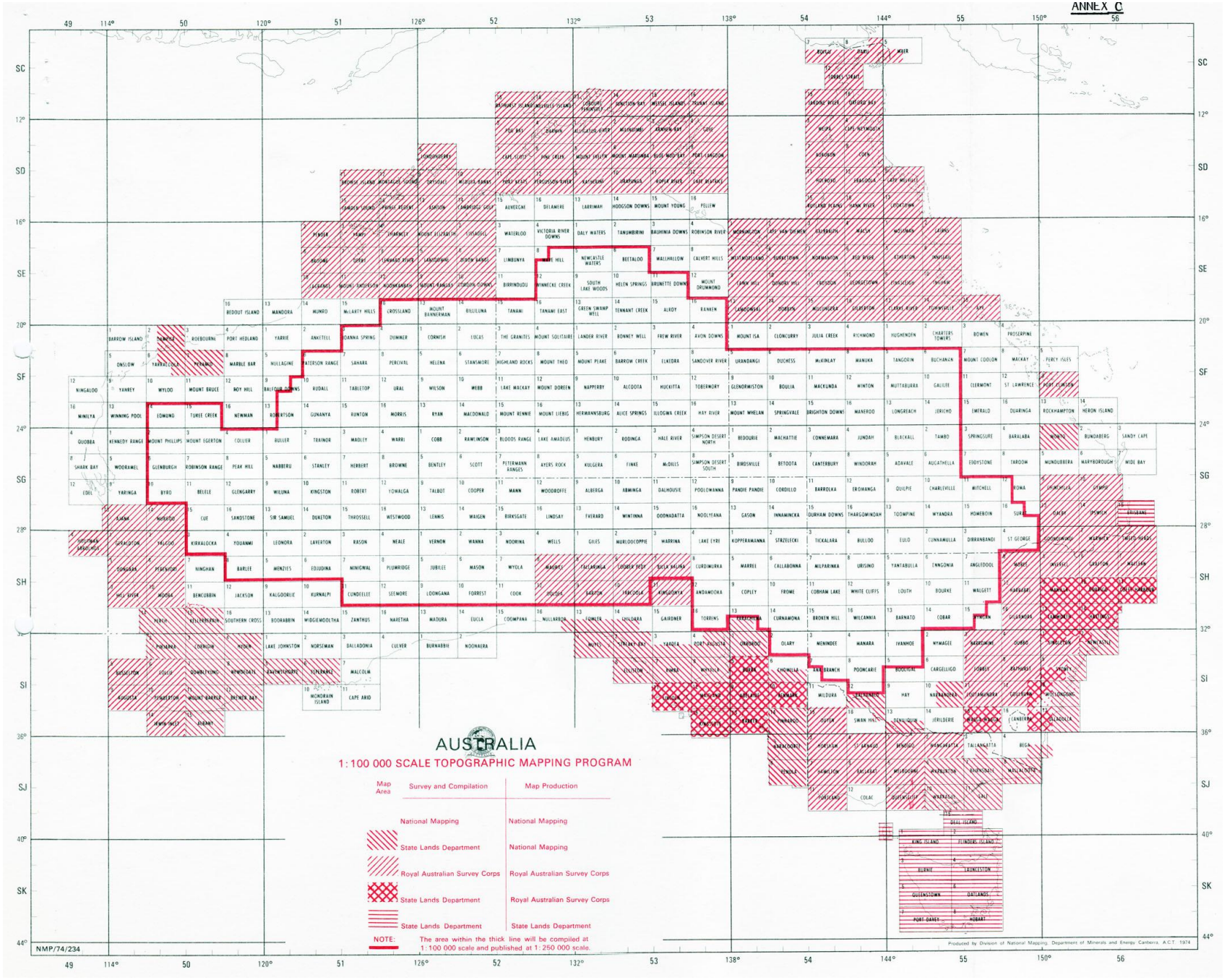
"No 3 That subject to the adoption of the principle of Resolution No. 2, this conference recommends the appointment of the Commonwealth Surveyor-General as Director of National Mapping, who shall be responsible for the co-ordination of the activities of Commonwealth and State authorities in planning and carrying out the national mapping of Australia with full regard to the recommendations of the National Mapping Council; provided that in any case where the Director does not adopt the decisions or recommendations of the Council, he shall so advise all members within thirty days indicating the reasons for any departure therefrom. It is the opinion of the

conference that the additional duties and responsibilities which would be placed on the Surveyor-General by the adoption of this resolution would necessitate the appointment of a Deputy Surveyor-General".

3. The Prime Minister then wrote to the State Premiers informing them that his Government had approved the establishment of a National Mapping Council in accordance with the above quoted Resolutions Nos. 2 and 3 and seeking the concurrence of their respective Governments.

4. This concurrence was given and the first Council Meeting was held in Melbourne during September 1945.

ANNEX C


AUSTRALIA
1:100 000 SCALE TOPOGRAPHIC MAPPING PROGRAM
Map Area
Survey and Compilation
Map Production
National Mapping
National Mapping
State Lands Department
National Mapping
Royal Australian Survey Corps
Royal Australian Survey Corps
State Lands Department
Royal Australian Survey Corps
State Lands Department
State Lands Department
NOTE: The area within the thick line will be compiled at 1:100 000 scale and published at 1:250 000 scale.
NMP/74/234
Produced by Division of National Mapping, Department of Minerals and Energy, Canberra, A.C.T. 1974

Appendix "F".

Departmental Control of National Surveys.

The choice of which Minister should be answerable to Parliament for national surveys is important. A national survey is never likely to be so closely concerned with governmental policy as to warrant its own Minister. It must therefore be part of the responsibility of a Minister in charge of another Department.

2. If it is placed in the Department which makes the greatest use of its services for special purposes, there is a strong end almost irresistible temptation to direct its activities solely, towards filling the needs of that Department to the neglect of those of other Departments or of the public. Even the separation of its Parliamentary vote from that of the rest of the Department does not prevent this happening. The "greatest user" Department is therefore by no means the ideal choice of Department to control a national survey which has to serve the nation as a whole, indeed the disadvantage of bias usually outweighs the advantage of interest. It is evident that the Department of the Array, with its interest in operational defence mapping, and the Department of the Interior, with its interest in mapping the Northern Territories and in aeronautical charting, both suffer this drawback.

3. If the national survey is placed in a Department having the widest supervision of national affairs, such as that of the Prime Minister or the Treasury, the Minister concerned would not have enough time to devote to its affairs nor would its affairs have sufficient influence on broad national policy to warrant his doing so if he had. Some middle course is therefore necessary which will assure that the national survey is under the direction of a Minister who has no sectional interest in its programme but yet has an interest in its general progress and efficient working and can, if necessary, hold the balance between conflicting priorities for particular purposes.

4. In Australia the Department of National Development might be appropriate. It would appear to have more of the necessary attributes than others. The choice needs to be made on the general ground of national interest rather than on the particular needs of one Department however large they may be. In Great Britain, for instance, the national survey was placed under the Board of Agriculture (now Ministry of Agriculture and fisheries) on 1st April, 1890, and at the same time its Director-General was made the accounting officer for its Parliamentary vote, which is thus accounted for separately from that of the Ministry. The Ministry has an interest in the complete mapping of the whole of Great Britain but, while it uses all the general standard map series that are produced for general national purposes, it has itself no particular needs that would divert the survey from its general task.

Appendix “G”

MAP SCALES FOR MILITARY USE

Military Difficulties of Diverse Scales.

During the war the differences between the map scales used by different countries presented the staffs with serious practical difficulties. So important was uniformity in the larger scales used for artillery fire that the Americans changed their artillery scale from 1/20,000 to 1/25,000 at considerable inconvenience and expense to themselves, in order to achieve uniformity with the Britain. The difficulties at other scales, whilst not so acute, were still important and general agreement was reached between the Allies on what scales to use whenever practicable and what existing scales to retain in various areas.

Standardisation so far achieved.

Since the war discussions on standardisation have taken place, and the scales of maps and charts affecting land operations have now been standardised for the armies of the United States, United Kingdom, and Canada. The object of this standardisation is to enable the mapping agencies of the three countries to supply the armed forces with the maps essential for military operations and to simplify map usage. In choosing the standard scales, due regard has been given not only to the intrinsic military usefulness of those chosen but also to the nature and extent of those hitherto used by each country both for domestic and for foreign mapping.

The standard scales agreed are all decimal scales and those of 1/M and larger are as follows:

1/1M
1/500,000
1/250,000
1/100, 000
1/50,000
1/25, 000
1/12,500

The agreement designates these as the scales which shall be used by the three powers for all military mapping whenever the choice is unencumbered by considerations of antecedent mapping in the area, and as the goal toward which they shall urge all other mapping agencies in order to facilitate future military mapping; but it permits the continued use of existing scales where the disadvantage of changing scale outweigh the advantage.

Affect upon Australian Mapping.

The standardisation of military mapping scales by these three North Atlantic powers cannot be without affect upon mapping in other parts of the world, and Australia will naturally wish to take this into account when considering her domestic mapping and her training for war.

One Inch to One Mile Scale (1/63,360).

The one-inch to one mile scale is so well established in Australia that a change to some other scale would be difficult and might be impracticable, at least under existing circumstances.

Nevertheless there appears to be much terrain in Australia now mapped at the, one -inch scale for which that scale is unnecessarily large and the half-inch scale not large enough. There also appears to be some terrain now mapped at 1/31,680 for which the 1/50,000 scale would be sufficiently large. It seems possible, therefore, that by adopting the 1/100,000 and 1/50,000 scales in place of the 1/63,360 and 1/31,680 Australia might ultimately benefit. Moreover the 1/50,000 scale, being an exact multiple of the 1/25,000 artillery scale, can be used for artillery fire with standard equipment where no 1/25,000 map exists, and it has been adopted in Canada largely for that reason.

1/25,000 Scale.

The 1/25,000 was originally chosen as the standard scale for the artillery map because it is the smallest scale on which all the necessary detail can be shown with the necessary accuracy for artillery fire, the limiting factor being the accuracy of the weapon. It is a useful civil scale in well developed country, but rather small, 1/20,000 being perhaps somewhat more useful. There is very little mapping at about this scale in Australia, but, where there is consideration should be given to using the 1/25,000 scale itself or, if that is impossible, to making the basic survey and fair-drawings in such a way that the 1/25,000 map can be made directly from them.

Four Miles to One Inch Scale (1/253,440).

The Four-mile scale is so close to the 1/250,000 scale that for many practical purposes there is no difference. This is true also for many military purposes, but not all. It is particularly objectionable in war to have the two scales adjoining in the same theatre. This does not occur on the Australian continent but does occur in New Guinea. To the north of Australia all the great islands, from Indonesia to Japan, (except part of Borneo), are on the 1/250,000 scale. On the Asian continent China is on 1/250,000, but from Malaysia westward through Burma and India to Iraq the scale is 4 miles to one inch. From Iraq westward through the Middle East and North Africa to the English Channel the scale is again 1/250,000. In Great Britain the scale is four miles to the inch, and here a change is being considered.

The territories neighbouring Australia to the North, and many of those further afield in which she may be interested are thus on the 1/250,000 scale. The American Air Force world approach charts are also on this scale. The balance of advantage seems to lie with using it Australia also. A change in Australia appears practicable, and if it is to be made, the sooner it is made the better.

General Trends.

These considerations have been put forward, more to prevent them from being overlooked when policy is discussed than to urge the intrinsic value of decimal scales. Decimal scales go naturally with the metric system, but can of course be used with any unit other than the metre. The general trend, however, is away from British units and towards the metric system, as may be seen from the recommendations of the Report to the Committee of Weights and Measures Legislation (Obid. 8219). For instance, whereas the metre was illegal in Great Britain not many years ago, it is now used for all the planimetric measurements of the national survey, from geodetic bases to chain surveys; the civil maps are gridded in metres and two further decimal scales have recently been introduced for civil mapping.

This trend may in the end prove irresistible, both because of the increasing disadvantage in a modern world of the lack of uniformity in this matter, and because no system other than the metric system has any chance of universal acceptance. The chance of the metric system itself may seem slight, at present, but it is by no means negligible. If this trend does eventually prove irresistible and the metric system is universally adopted, a change to it will have to be made; and it will be troublesome. The troubles will be proportional to the amount of records and practices then vested in other systems. So far as mapping is concerned, Australia has as yet done little (as compared with older countries), that a change to decimal scales, and even the metre, would be a simple matter now compared with what it will be later when Australia is better mapped.

There are many examples of good maps at these scales and some Australians will remember the 1/100,000 map of Palestine used by them in the late war.

Appendix “H”

Joint Advisory Survey Board - United Kingdom.

Joint Advisory Survey Board.

Composition.

Chairman	Director-General, Ordnance Survey, Ministry of Agriculture and Fisheries.
Members	Director. of Military Survey. Hydrographer to the Royal Navy. Director of Colonial Survey. Director of Navigation, Air Ministry. Deputy Director of Photographic Operations, Air Ministry.
Secretary	Assistant Director of Survey, Survey 1, The War Office.

Terms of Reference.

(i) To consider any Survey matter of common interest to the Ministries concerned and to make recommendations.

(ii) In particular, to consider the following:

(a) To keep under review existing map and chart cover in the light of the current economic, political and strategic-situation.

(b) To keep under review the Survey potential available to meet requirements of peace end war.

(c) The co-ordination of common user requirements in survey maps and charts.

(d) The exchange of information about projected survey work, and arrangements for mutual assistance in survey projects.

(e) The co-ordination of technical methods, technical training and design and supply of technical equipment.

(f) The interchange of technical personnel.

(g) The fostering of liaison with Survey agencies of the Dominions.

(iii) To advise the Foreign Office on the technical aspects of United Nations business relating to maps and surveys and on the administrative problems arsing therefrom.

Survey and Mapping Responsibilities of Departments Represented.

1. The Ordnance Survey surveys Great Britain at all scales; the Colonial Survey surveys the colonial territories; the Military Survey provides maps and aeronautical charts of any part of the world required by the armed forces, and for civil aviation; the R.A.F. provides air survey photography; and the Hydrographer charts the ocean.

Ordnance Survey.

2. The Ordnance Survey is controlled by the Minister of Agriculture and Fisheries who is answerable to Parliament for its actions. Its financial Vote, however, is quite separate and is accounted for by the Director-General who deals direct with the Treasury on all except major policy matters and who is liable to be called before the Public Accounts Committee of the House of Commons for examination on the Vote.

3. The responsibilities of the Ordnance Survey do not extend beyond Great Britain, but within Great Britain it is responsible for all surveying and mapping for national purposes including defence. The basic scales of survey are 1/1250 in urban areas, 1/2500 in rural areas, and 1/10,560 in the moorlands. The maps are published for sale at those scales, and at a variety of smaller scales covering the whole island.

4. The Ordnance Survey meets most of the mapping requirements of other Government Departments from its published series, but it also undertakes separate surveys and produces special maps for government purposes. For civil Departments the services are usually provided free but the requirements of the Service Departments and a few of those for other Departments are provided on repayment. The Ordnance Survey draws, prints and markets the geological maps, the geological data being supplied by the Geological Survey and Museum. The military maps of Great Britain are Ordnance Survey maps bearing a military grid overprint.

5. The Ordnance Survey was originally manned almost entirely by soldiers. Immediately prior to the war it was officered by the R.E. and about 450 of its technical staff were serving R.E., the remaining 2,600 were Civil Servants many of whom were retired R.E. Since the war the military Other Ranks have been required in the Army mostly overseas, and so have not been available. The Ordnance Survey is now officered entirely by regular R.E. officers, and the rest of the staff is entirely civilian. Most of the young civil entry do their national military service in Survey Unite R.E., and there are special facilities for regular R.E. Survey Other Ranks to join the O.S. as Civil Servants at the end of their colour service.

6. On mobilization the O.S., while continuing as a separate administrative entity, is planned to come under the direct operational control of the War Office, the Director-General moving to the War Office, the Director of Military Survey with the current Director as his Deputy. Arrangements have been made which ensure that technicians of the key survey trades will be retained in the Ordnance Survey or go to Military Survey units in time of war, and that soldiers, whether regular or reserve, can be employed as individuals with the Ordnance Survey.

Colonial Surveys.

7. The central organisation for the Geodetic and Topographic Survey of the colonies is controlled by the Colonial Office. It is financed from the Colonial Development and Welfare Fund, i.e. by the UK taxpayer and not from the revenues of the Colonies concerned. It does not supersede or directly control the Survey Departments of the individual Colonial governments, which remain directly responsible to those governments, but it assists them by executing those geodetic and topographic surveys of their territories which are needed for and development and which could not be done either at all or so effectively with the resources at the disposal of the local government.

8. The local governments and their own Survey Departments thus remain entirely autonomous. While their largest concern in most cases is cadastral surveying, which is not undertaken at all by the central organisation, they nevertheless also do geodetic and topographic surveys of their own territories which are, of course, closely co-ordinated with those of central organisation. Co-ordination and assistance is facilitated by the fact that the Director of the central organisation is also Survey Adviser to the Secretary of State for the Colonies.

Military Surveys.

9. The Directorate of Military Survey is a War Office organisation having a joint and equal responsibility to the War Office the Air Ministry for providing geodetic data, maps and aeronautical charts of every part of the world where they may be needed for the armed forces. It is also responsible to the Ministry of Civil Aviation for providing aeronautical charts for civil use. It obtains most of the geodetic and topographic information from other sources. There are arrangements with Commonwealth nations, the USA, and other friendly countries, for sharing and co-ordinating the task of world mapping for military purposes.

10. The Directorate is responsible also for the raising, planning, equipping, training and technical control of military survey units R.E., whether regular, auxiliary or reserve. Most of the regular units are at present with the forces overseas and are making some contributions to world mapping.

11. The Directorate maintains two fully equipped Survey Production Centres staffed by civilians one paid for by the War office and one by the Air Ministry. Both can undertake work relevant either to ground or to air warfare, and, while most of the specialised work relating to air navigation tends to gravitate to the S.P.C. of the Air Ministry, this work does not amount to more than a fraction of that required for air warfare. The remainder is charged to Air Ministry [unreadable] under a lump sum calculation. A large amount of cartographic work is done for the Directorate by the Ordnance Survey on repayment. Mapping is also placed with contractors if necessary to meet additional loads.

Air Ministry.

12. The RAF is responsible for providing the air photographs required for military mapping and aeronautical charting both in peace and war. In addition, as a matter of government policy it has been assigned the duty of providing as much of the air photography needed by other government departments as it can achieve without detriment to its normal duties, and this work provides good training for the photographic units that will have to undertake air photography in war. All the photography needed by those departments cannot, however, be provided in this way and some special kind cannot be provided at all with the equipment available to the RAF. In consequence both the Colonial Survey and Ordnance Survey resort to civil contract to supplement the work of the RAF. In addition the Ordnance Survey has recently made arrangements with the Ministry of Civil Aviation to operate for them photographic aircraft carrying Ordnance Survey cameras and operators.

Hydrographic Department

13. The Hydrographic Department of Admiralty is responsible for providing charts for all the mobility and security of HM ships and the Merchant Navy in all parts of the world. To this end it organises hydrographic surveys, in which it uses available geographic and topographic surveys of land survey organisations. It makes observations on land to adapt this data and to supplement it when necessary for hydrographic purposes. In foreign waters information for Admiralty charts is obtained by internationally agreed arrangements for exchanging material.