POSTWAR PHOTOGRAMMETRY IN THE UNITED STATES*

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THE purpose of this discussion is to consider what the photogrammetric profession in the United States will likely be doing in the postwar period,—what, and how much. The ending of the war will find several thousand people engaged in various phases of photogrammetry, some of sub-professional qualifications trained to do only certain special kinds of work, but many hundreds of fully-qualified professional photogrammetrists, who probably would prefer to continue in the same field of endeavor. Obviously at war's end there will be many more photogrammetrists than in prewar days. Also it must be remembered that most of them will be government employed. All of this large group of people are now so engaged, and all photogrammetric equipment is now completely in use, because of immediate war needs. To repeat the question, what will these people and the equipment probably be doing after the war? Will there be a real need in the United States for so many trained photogrammetrists and so much equipment? No one knows the answer, of course, but it will be a start in the right direction if we list what we now think will be the postwar needs, and try to evaluate the profession's capacity to handle these presumed needs.

Probably ninety per cent of the professional map makers have a firm conviction that the United States is sadly lagging in its basic mapping programs, and similarly that the counties and cities and towns acutely need more and better base maps. Nowadays, of course, when maps are needed, photogrammetrists are also needed. So, if professional map makers had the authority at war's end, all photogrammetrists would immediately transfer their efforts from the making of hasty, reconnaissance-type war maps, to the making of standard-accuracy medium-scale and large-scale maps of the nation, and of the counties and of the cities. But the map makers do not have any such authority, so we should try to discover how the top administrators and the legislators, the disbursing authorities, will feel. Will they recognize, as map makers do, that the needs exist,—that good base maps, or engineering maps, are an absolute economic "must" for any civilized nation or community, and that from a dollars-and-cents standpoint they actually save many times their costs? Or is it going to be difficult to convince these authorities, as it often was in prewar times?

To get down to cases, and taking first things first, it must be demonstrated conclusively to the disbursing authorities, be they federal, state, county or city, that there is a real need for all of these different types of maps. Naturally not too much attention will be given to the opinions of map makers,—the opinions of the map users will carry most weight. But it appears to this observer that the map users are finally coming alive, and will in postwar times be more vocal and more insistent. It may develop that the ultimate question will be not whether maps are needed, the usual prewar question, but rather when, and how fast. There are signs all around that such a more favorable attitude toward mapping will prevail after the war. Some of the more obviously favorable circumstances may be listed as follows:

Better Appreciation of Need for Base Maps

First and probably foremost, the United States' preparations for defense and later for war focussed attention on the startling fact that large strategic areas

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within the nation, including important, densely-populated coastal areas, were not adequately mapped for the nation's defense, nor for rapid development of quickly-needed military establishments and important war industries. The lessons then learned, it is expected, will not be quickly forgotten by those thousands of people responsible for defense plans and rapid expansion of the military and industrial establishments.

Second, the war itself has demonstrated to thousands of staff and combat officers that no war or battle can be well planned or efficiently conducted without maps (in fact, a whole series of maps), and that the better the maps the more efficient and less costly will be the war or the battle. Surely it is to be expected that the lessons being learned in the war by these men will be carried over and applied to postwar activities.

Third, the public in general is becoming much more map-conscious, and much more familiar with aerial photographs and their uses and economy. The whole matter seems to have suddenly caught the public's interest. As evidence of this, we see leading popular magazines, such as the *Saturday Evening Post*, *Life*, and *Popular Science*, carrying feature articles about aerial photographs, how maps are made from them, and how the maps are used. This certainly may be considered on the favorable side.

Fourth, it seems clear to this observer that the country at large, and civic leaders and public authorities in particular, are becoming convinced of the need for intelligent advance planning as a necessary requirement for orderly, economic regional development and public works. It may also be said, without meaning to be sarcastic, that probably a majority of the professional planners themselves are at long last coming to realize that good planning is not feasible unless rooted in and based on comprehensive information that carefully organized systems of base maps provide. It is beginning to be realized that the absence of such basic map information, or failure to have it at hand when needed usually results only in economic waste, and in continual delaying and postponing of planning. It will be a great day for the map makers when professional economists and planners, including the civil engineering profession, finally come to the realization that they will be poor planners, or at best only part planners, until they have been provided with complete basic map information. It seems now as though that day might be not so far away.

Faster Mapping Techniques

Another favorable point is that current war and defense mapping activities are demonstrating that maps can now be completed in relatively short time, and at relatively low costs, mainly because of modern photogrammetric processes. It probably was discouraging to public officials in the old days to be told that the completion of certain urgently-needed maps would take a long time, often a matter of years. It is a common thing now, under pressure of immediate war needs, to complete difficult mapping assignments in a matter of a few months, sometimes even in weeks. This is not to say that the type of map usually produced under time pressure for war use is the type of map which would be satisfactory in peacetime. It probably is not. But war-map projects have demonstrated that the over-all time required for high-accuracy, completely standard maps can be greatly reduced, and their costs further lowered. These claims were at least partly substantiated, incidentally, by the accomplishment on the defense mapping projects of strategic areas in the United States, handled during the last two years by several Government mapping groups and private contractors, for the War Department. These should be impressive talking points in seeking approval of postwar mapping programs.

Mapping in Public Works Program

All of these and many other favorable factors add up to make it seem quite probable that the public and public authorities will in postwar times be more receptive to and enthusiastic for programs of basic comprehensive mapping. But it may be that hard times will come, unemployment will be serious, and the country will turn to a large public works program, for the double purpose of catching up on public works, and relieving unemployment. In view of this possibility, it behooves us to consider whether basic mapping programs properly can find a place in a broad public works program. It would seem so,—decidedly so. It probably should be considered as another favorable point that at different times during the prewar depression certain mapping programs were financed from public works funds, and so the precedent has already been established.

It should be pointed out that there is considerable difference between make-work projects and public works projects. It seems unlikely that there will be another purely make-work setup in the United States. What does seem likely is that there will be scheduled some years in advance a series of useful public works projects, to be undertaken if and when required to reduce unemployment. According to what appears to be the trend, only those projects would be included in such a program as have reached the detailed "blueprint" stage,—in other words, completely planned, designed, and approved. While "blueprints" are not necessary for a mapping project, the counterparts in detailed planning, scheduling, cost estimating, and approval are necessary. Therefore all mapping organizations should be making plans and schedules now for postwar mapping programs, getting them set up in project form and approved, ready to be submitted immediately when called for. It may be too late to have them included in such a program, if the planning and scheduling are delayed until the last minute. This advice, of course, is only in line with what is being advised by many public authorities today, by the technical press, and the engineering profession.

In this discussion it has been assumed that there is a real need for comprehensive base maps of the nation, of the counties and the cities and towns. Lest those who are inclined to doubt condemn this as too general a statement, it would be well to list a few of these urgently-needed map series, especially those maps utilizing photogrammetry in their preparation, and concerning which there will be almost no controversy.

List of Needed Base Maps

First, looking at the nation as a whole, there is the topographic quadrangle series, which has been in process for sixty or seventy years, and which even now covers only about a third of the nation's area. Within this third, many of the maps are on such a small scale and are so out of date and so inaccurate as to be almost worse than no maps at all. Without doubt, among the more advanced, industrial nations of the world, the United States has the greatest percentage of unmapped areas, so far as topographic base maps are concerned. Obviously this is the principal base-map need of the nation at this time,—to complete the topographic mapping of the unmapped and inadequately-mapped areas. In order not to keep on repeating the mistakes of the past, all of these maps henceforth should be made to comply with standard-accuracy specifications, and be published on scales large enough so that they will not be deemed inadequate a few years hence. A program of completing these topographic base maps of the entire United States area should be undertaken immediately at war's end, and completed in the shortest possible time. It is estimated that from sixty per cent

to eighty per cent of this type of map can now be prepared best by photogrammetric processes.

And if it works out that complete topographic base sheets will be too slow in getting done, then let's be prepared to recommend as a stop-gap measure that accurate planimetric maps be immediately prepared and published for those parts of the unmapped regions which, under the topographic mapping program, would not get mapped for several years. Experience shows that part of the money spent for temporary planimetric maps can be salvaged in the later topographic mapping, such as horizontal control, the gathering of place names, political line locations, and much of the field inspection and office editing.

As a follow-up of the original topographic mapping program, provision should be made for periodic revision of all topographic base maps. Up to now most mapping programs have provided only for the making of the original maps. It is time everyone realized that the usefulness of every map decreases with age, and that the benefits from frequent and complete revision far outweigh the relatively small costs involved. In areas where changes are frequent, the maps should be completely revised and reprinted every few years, say every five years. In regions where changes are infrequent, the interval could be every ten or fifteen years. Such revisions can, of course, best be made through aerial photographs and photogrammetric procedures.

Another nationwide mapping program which should be undertaken is the making of quadrangle-size photo-mosaic maps, paralleling in sheet size and scale the standard topographic quadrangles. These mosaics should be of the precise type, laid to specifications which would require any and every point to be in correct geographic position within, say, one-twentieth inch at publication scale. They should carry enough lettering and symbols so that they are a combination of conventional map and photo-map, easily understood by the public. These maps also should be periodically revised and reprinted. They should be reproduced in clear half-tone and made available to the public at a few cents per map. It is predicted that such a series of maps would be more popular with and more in demand by the general public than any other Government-sponsored map series.

Each county in the United States owes it to itself to procure an accurate, large-scale tax map. There are plenty of photogrammetric procedures available which permit preparation of the base for tax maps to be done accurately and at low cost. It is almost certain that in a majority of counties the cost of preparing such tax maps will be recovered in a remarkably short time through discovery of untaxed or insufficiently-taxed land holdings. The county tax map will be self-financing in almost every case, and therefore should not be difficult to get authorized by county officials.

In the same way that quadrangle-type photo-mosaic maps should be provided for the entire nation, larger-scale mosaic maps should be made of each county area, in a sheet size which will be some multiple of the tax-map sheet. Such mosaics are low in cost, and their usefulness is obvious, even to the non-technical county official. As in the case of the nationwide map series, these county maps, both the tax maps and the mosaic sheets, should be periodically revised, principally by means of new aerial photographs flown every few years.

In the field of city maps, photogrammetry at the present time does not offer such startling money savings or other advantages as it does in the fields of national maps and county maps. This is because city base maps are usually on very large scales, such as one inch equals two hundred feet, one inch equals one hundred feet, sometimes one inch equals fifty feet. At these large scales, and in

closely-built city areas, photogrammetric procedures are now usually uneconomical. As new photogrammetric equipment and procedures are developed, however, it is likely that even in the city-mapping field photogrammetry will, in part at least, displace the usual ground-survey methods. And even as things are today, there are in most cities certain areas where stereoscopic plotting instruments could be used with economy in the preparation of large-scale topographic base maps,—hence even now there is a place for photogrammetry in city mapping. It is predicted that in the future it will be the principal method.

Capacity of Photogrammetric Mapping

It is interesting to speculate next on how much work the map-making profession, particularly the photogrammetric branch of it, will be able to handle in postwar years. Will it likely have excess capacity, or will it be overloaded? A casual inventory of the present situation indicates that at this time, exclusive of military personnel, there is probably a minimum of two thousand persons engaged in some kind of mapping compilation requiring some direct use of photographs. This figure does not include another large number of mapping people, engaged in other than photogrammetric work, including such as ground surveys, color-separation drafting, map editing, map reproduction, etc. Nor does it include a large group of photogrammetrists engaged in other than map compilation. The armed services undoubtedly have at least as large a number as the civilians, probably many more. From this we can deduce that today the map-compiling part of civilian photogrammetry is, on a yearly basis, at the least a six-million-dollar "industry." Counting military photogrammetrists, it would probably be a ten- or fifteen-million-dollar "industry." Thus, if at war's end all of these people were to continue in map compilation utilizing photogrammetirc processes, they would be able to handle from ten to fifteen million dollars' worth of work annually. Since direct photogrammetry represents usually considerably less than fifty per cent of total mapping costs, the annual value of maps which could be compiled by the photogrammetrists would be of the order of twenty to thirty million dollars. From this rough calculation it does not seem likely that the photogrammetric profession will be seriously overtaxed in the postwar period, at least not in the beginning. If it does happen to be overloaded, the war-map experiences have demonstrated that the total personnel can be quickly expanded,—possibly could be doubled within a year, if necessary.

It is also interesting to speculate on the amount of high-grade stereoscopic plotting equipment in the United States today, and on its potential annual capacity. Counting only multiplex instruments (both wide-angle and normal-angle) Aerocartographs, Stareoplanigraph, and the Brock-and-Weymouth equipment, it appears, by working operators two shifts on each instrument, that there is available a minimum potential of one hundred thousand square miles per year of topographic mapping on medium scale, such as one inch equals one-half mile. Thus it is easy to calculate that if all of this equipment were to be turned loose to finish the topographic base maps of the United States, with about two million square miles remaining to be done, the job could be done with ease in twenty years, using only equipment now actually available. But the potential annual capacity will undoubtedly be increased, through procurement of additional instruments and also through development of new and better instruments and techniques. Thus this analysis also indicates that the capacity of the photogrammetric profession is not likely to be overloaded, unless the finishing of the topographic base maps is scheduled as a ten- or fifteen-year job.

Summary

In summary, there seems to be considerable evidence to justify the view that the need for base maps will be more readily recognized in postwar times, and therefore basic mapping programs will be prosecuted at a faster rate than in prewar times. In any event, it would be well to be in a state of readiness to have worthwhile mapping projects included in a postwar public works program. Finally, unless there develop unexpected immediate demands for large and rapid mapping programs, the photogrammetric profession is in good shape, and has, or can quickly be expanded to have, ample capacity, in both trained personnel and high-grade equipment.