

control surveys each year in order that we may provide basic control points for the maps of Alaska.

During the past few years projects in surveying and mapping were very properly limited to those areas which were of interest to our military forces, in the promotion of war activities. Some gain in our mapping was made. It is essential now that there be a return to the peacetime needs for surveys and maps and that the work be performed on a more extended scale than ever before. Federal agencies are cognizant of this need.

I would like to recall to you an earlier statement I made in noting that the primary functions of the Coast and Geodetic Survey were to provide geodetic control and to perform coastal charting. To be effective, these functions must be executed in advance of actual needs. Because of its close touch with the many activities making use of these two main functions, the Bureau has a long range program of work which will make use of photogrammetry to an every-increasing extent. In my opinion, there is need for a realization by the public of the inadequacy of the present restricted programs of this and other federal mapping bureaus. It is earnestly recommended that this Society increase its efforts to educate the public on our mapping needs for the economic development of our resources and of the need to provide adequate funds to the various federal agencies engaged in surveying and mapping.

PRESIDENT MILLER: Thank you very much, Admiral Colbert, for a very interesting talk.

Our next speaker will be Rear Admiral G. S. Bryan, Hydrographer of the Navy for the last six years. Admiral Bryan has played a very important part in the war in that to him fell the full responsibility of supplying nautical and aeronautical charts for naval operations. For his outstanding work he has been awarded the Legion of Merit. Admiral Bryan has been one of the Society's best friends and has always had our interests very much at heart. I have very great pleasure in introducing Rear Admiral G. S. Bryan.

ADMIRAL G. S. BRYAN: Mr. Chairman, Ladies and Gentlemen: In this morning's addresses, the inadequacy of the existing maps and charts for global air-amphibious warfare and the great need for trained personnel and equipment for their production was mentioned. The remarkable accomplishments in overcoming a great part of this inadequacy in specific localities and areas was also mentioned. In spite of all that was done during the war, there is still much to be accomplished and much to be desired for world-wide mapping coverage.

Considering the important part that maps and charts played in the war and in the achievement of victory, it is imperative that aerial photography and photogrammetric procedures which are the keys to rapid modern surveying and mapping operations, have a commanding place in our post-war plans.

The Navy is aware of its responsibilities in this particular branch of engineering which is so essential to our security and to our continued national development. These two factors, security and development, indicate that the job before us is one of cooperation and coordination of effort.

We, therefore, are inaugurating a program of photogrammetric research and development which, with similar programs carried out by other branches of the armed forces, federal mapping agencies, industry and educational institutions, should insure that America will continue to lead the world in photogrammetry.

To eliminate duplication of effort, it is essential that coordination be established as the first and most important step which will govern the general planning procedures to be followed by those who are expecting to be engaged in photogrammetric research and development. Although all of us have a common

interest in the advancement of photogrammetry, there are certain phases and applications which are of more interest and value to some than others. Such phases of the work, therefore, could be assigned as a basic responsibility of one or two groups, while leaving to the others special research along the lines which are common to all engaged in this profession. Although a great deal has been accomplished thus far in the improvement of existing equipment and the development of new equipment and procedures, much remains to be done in obtaining full value of aerial photography and in increasing the efficiency and lowering the cost of all operations involved.

Until 1934, we had been content with accepting the research of other nations in photogrammetry. It is a great tribute to the members of this Society that in a little over ten years you have made America conscious of the great potentialities that photogrammetry offers to surveying and mapping in general. You have been responsible for the development of new methods and equipment which were used in the preparation of maps needed in total war and in disclosing the enemy targets that had to be destroyed before victory could be achieved.

The type of warfare we have just witnessed has led to the development of new types of charts and maps. Aerial photography and photogrammetry have played an important part in their development. Some of these maps were extremely accurate, while others were of poor quality and uncertain accuracy. Some covered densely populated cities, others—areas never explored and never mapped. In certain cases, available existing maps and charts were adequate, while in others, entirely new types of charts had to be drawn. In all cases, the key to the accuracy of this mapping was ground control.

The war has given us new navigational methods, notably Radar, Loran, and other electronic and sonic devices. Our maps and charts will have to be revised to apply these developments, just as they were revised to fulfill the special needs of the auto tourist, the aviator, the amphibious troops, and for the sea and air bombardment of enemy territory.

It is not necessary to re-survey all areas as inventions are developed, as long as the essential information is available. Generally, the problem is essentially the cartographer's. But even the cartographer is handicapped if the framework is lacking. With an abundance of triangulation control, the accuracy of the final chart is generally known, whether plane tables or aerial photographs are used for the planimetry and topography. During the war, one of the greatest handicaps to accurate mapping was the lack of well coordinated triangulation nets. Efforts should be made as rapidly as possible to provide this framework and for the free exchange of this information between agencies and nations.

Research in oblique photography for the aerial extension of ground control is highly desired. Photogrammetric mapping with the new procedures and methods developed is rapidly outgaining the speed with which ground control can be obtained.

At present, experiments are being conducted in novel methods for bridging extensive water gaps and other natural barriers to visual triangulation. If these experiments prove successful and practical, the progress of triangulation control will keep pace with other phases of mapping and charting. In the not too-distant future, it is not "crystal ball gazing" to expect that the entire world will be charted on a common geodetic datum. It is the responsibility of world mapping agencies to encourage this research and to establish these nets as rapidly as possible.

Most emphasis in photogrammetry in the past has been placed on aerial photography, with dependence for ground control on the usual land surveying

methods. Terrestrial photogrammetry can successfully supplement and considerably reduce the amount of work and time involved in the field. A great amount of shore detail for nautical and other maps and charts can be obtained and controlled by ground photography. The Hydrographic Office plans to employ these methods more extensively in future surveys and is negotiating with American firms for the construction of photo transits for survey vessel equipment. It is expected that their use, besides saving much valuable time in the field, will materially increase the amount of ground control which is frequently difficult to obtain in both tropical and jungle terrain and rugged country. The Forest Service of the Department of Agriculture has successfully employed terrestrial photogrammetric procedures. Other agencies should also explore this field and if applicable to their requirements, encourage their use in order that mutual benefits in equipment, production, and mapping methods may be obtained.

Although surveyors and cartographers generally prefer verticals to obliques, there are situations in which obliques are the only mapping materials available and other situations in which they are actually preferable. This is particularly true in the case of groups of islands separated by water areas too large to be reached by vertical coverage. In such cases, a few carefully taken obliques will supplement verticals by clarifying their relation to each other. This is also true in the case of any stretch of overlapping verticals in an area where ground control is weak. In this case, a well aimed oblique can provide azimuth lines that will greatly increase the rigidity of control. Whenever a cloud layer renders vertical photography impossible, oblique coverage can at least temporarily fill the gap. In time of war, enemy held territory can be photographed by long-range obliques with much less risk to planes and personnel from hostile interference. The use of high obliques, including the horizon for mapping, has been approached in several ways with varying degrees of success.

Oblique photographic material was so greatly neglected in many war zones, except for specialized photo-interpretation, that the need for further effort is considered justified. Either existing methods should be better understood and taught, or better methods should be developed.

The Hydrographic Office, realizing the value of obliques, initiated a request with the National Defense Research Counsel which in turn contracted for the development of equipment and procedures that would permit a maximum utilization of oblique photography. The work done so far has great promise for the future and will be continued.

The adoption of standard scales in mapping and charting should be encouraged by the members of the Society. Four standard scales were agreed to by the Army and Navy for bombardment and invasion maps and charts in the past war. It is hoped that in the future these will be further limited to two scales for that type of operation. The benefits of common scales are too numerous to mention.

The importance of large-scale mapping can not be over-emphasized, even though publication may be on smaller scales and will adequately meet all normal demands for present requirements. World progress is so rapid that a map which is adequate today, may be obsolete or useless tomorrow. If an area is originally mapped at sufficiently large scale, generally at little additional cost, it may pay dividends in the long run. Who, before Pearl Harbor, realized the importance of the beaches on Guadalcanal, the coral reefs on Tarawa, or the use to be made of Oak Ridge, Tennessee! Our battleships sometimes drawing thirty-five feet, navigated over great expanses of uncharted waters where Position Doubtful

and Existence Doubtful dangers were the common occurrences. The unorthodox enlargement of existing mapping materials that occurred during the last war, should never happen again. It is up to us to encourage large-scale original mapping, wherever possible.

The lessons of the past war, being fresh in mind, have perhaps made me over-emphasize the military use of maps and charts. Yet, this same war has increased the importance of peace-time mapping. We have consumed very rapidly many, many tons of our natural resources before victory was attained. In some cases, the depletion of these resources has been so great that it is no longer practical to mine or work these ores. We must look elsewhere. Today we do not dig for minerals or oil, hoping by chance to find them. We study before hand the geology and formations of the area to determine its possibilities. Without adequate maps and charts, this is impracticable. Our efforts must now be diverted to aid in the development of new resources, with resulting benefit to our national welfare and defense.

Our nautical charts, excepting in the war zones, were greatly neglected during the Emergency. We have emerged from this war with a maritime fleet larger than the combined fleets of the world. It is the task of the Hydrographic Office to give this great merchant marine the best nautical charts available and to see to it that areas of inadequate coverage are surveyed as rapidly as possible. Photogrammetry will help to speed these surveys, and aid in the revision of shore-lines and off-lying reefs and dangers. We already have thousands of photographs in Central and South America and many other regions to speed this task. We will need thousands more.

Among other projects which the Hydrographic Office is planning, I might particularly mention the surveys of the Atlantic and Pacific Coasts of Mexico, which will shortly be carried out. The photography for this survey has already been completed, and the Government of Mexico is extending the triangulation to the coast for use with these surveys. We also have some plans regarding future surveys in the Pacific.

Our plans also include replacement of our present survey vessels by four large ships which will be completely equipped, not only for carrying out the surveys, but for the complete production of charts. These ships will be, when completed, the most modern and best equipped survey ships in the world. While the photography necessary for surveys will have to be made by special photographic planes, we expect to have a small plane on each ship which can be used for reconnaissance purposes, and also for limited vertical and oblique photography.

The Navy has developed some excellent aerial photographers and photogrammetrists, as well as experts in research in optics, camera design, and photogrammetric procedures. It is hoped that our government, schools, universities, and industry will also encourage training in photogrammetry, so that we will always have sufficiently trained photogrammetrists to meet any emergency.

In closing, I would like to pay tribute to the magnificent cooperation and teamwork displayed by the various mapping agencies during the war. Without this, we could never have accomplished as much as we did. I look forward with confidence to a continuance of this cooperation in the post-war era.

PRESIDENT MILLER: Thank you very much, Admiral Bryan.

We invited Dr. Wrather, the Director of the U. S. Geological Survey, to give a talk this afternoon and he accepted, but has unexpectedly been called down to Mexico on business. However, we are very fortunate indeed in having as our next speaker Dr. Nolan, who is the Assistant Director of the U. S. Geological