GENERAL APPLICATION OF PHOTOGRAMMETRY IN THE PRESENT WAR*

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THE program reads that I am probably the current *top-man* in precision mapping affairs in the United States, and adds that my talk will be titled "General Application of Photogrammetry in the Present War." Since there is very little connection between precision mapping and the application of photogrammetry in the present war, I have been greatly tempted to address the meeting on some unrelated subject. It occurred to me that the first step to take in the preparation of this address would be to find a definition of the term "Photogrammetry." Imagine my surprise in discovering that Webster's College Dictionary does not include the word "photogrammetry" in its lists of those things which a college student should know. In glancing further through the book, in an effort to find out what college students are taught in preference to photogrammetry, I discovered considerable space devoted to the lucanus cervus—or Cockroach to you. It immediately occurred to me that by the middle of the second day of your meeting, you might have become thoroughly saturated with photogrammetry and would welcome a discussion on the biological experiences among the lucanus cervus.

Photogrammetry as I understand it has something, or even much, to do with the substitution of photographs for *things*. In determining the dimensions of objects by photogrammetric processes, we stop dealing in miles, yards and inches and work with centimeters, millimeters and fractions thereof. This microscopic measurement of things is interesting and even productive, yet it is not vital in the sense that it is essential to existence. Accordingly, as a race, nation or civilization, we can take photogrammetry or leave it. Consider then the plight of the lucanus cervus, or cockroach, who either deals with microscopic things or perishes. To him precision is essential. To you or to me, the fact that he might perish would be a quite satisfactory solution, but to the cockroach it would not. Since a discussion of the lucanus cervus would only lead us back to microscopic measuring of things, we might as well stick to the original subject and discuss photogrammetry. Much has been said about war being the great destroyer of scientific progress. In the field of pure research, that is, research for research's sake, there is no doubt much to be said concerning the disruptive effects of war. Such research has much in common with the higher branches of mathematics, which the learned professors refer to as "Figuring just to be figuring." Actually, war is a great "expediter" of the practical application of the results of scientific research. It is true that it drags out prematurely ideas which are only half-baked, and casts them from the table as unfit for human consumption; whereas had they been permitted to remain in the warmth of creative contemplation, they might have emerged as "Hot potatoes." To continue this metaphorical menage, we may note also that there are many *cold potatoes* long since consigned to the garbage pail of misplaced endeavor, suddenly injected with a dash of vitamin B_1 and brought to the feast of Mars as a new and stimulating dish.

In contemplation of the ideas and procedures suddenly brought to life, or given new life, by the impact of dire necessity, certain fundamental tests must be applied in judgment. The first of these tests is, "Does it promise results without the application of work?" If so, approach the idea with caution. I can

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think of no more succinct remark on this subject than General Marshall's recent statement in defense of the proposed size of the Army to the general effect that no magic means has yet been discovered whereby one force can be overcome without the application of another force.

The second question to ask is, "Can our boys use it?" We must consider that by and large the war is being fought by the mass of the American people. A machine, instrument, gadget or a method of procedure which can be applied only by a genius or a superman is certain to have only limited application. Generally speaking, mass production and mass application are necessary. Despite a shortage of manpower, it is better, even in the application of the more scholarly sciences, to base our production level on the 8th grade graduate than on a Rube Goldberg or a Ph.D. with a mechanical complex. Obviously, research and development are properly accomplished by the highly talented few, but application must be entrusted to a lower order of intelligence or genius.

The third test to apply, and the most difficult, is whether the new procedures, methods or instruments possess sufficient advantage over those now used to justify their adoption. It is largely a question again of changing horses in the middle of the stream. We would be undeniably dumb if we though that our concepts of tactics and strategy at the end of this war would be identical with our initial concepts. We would be even more dumb if we thought that the weapons, whether they be mapping instruments or guns, need undergo no improvement during the course of the conflict. Some improvements appear as gradual changes, others demand the complete discard of former notions and the adoption of something entirely new. The former is preferable because it continues to produce results with increasing efficiency, but it will not always suffice. The man who decides, therefore, to completely abandon old methods or machines must carefully weigh the total effect of his decision.

Passing from procedures and speaking strictly of equipment, having applied the first three tests and reached a passing grade, we may now proceed with those more indeterminate things:

Does it require strategic materials?
Can we get a manufacturer?
Can we get it standardized before the war is over?
Are the Army and Navy too hide-bound to accept it?
Will WPB let us have it?
Or, shall we just forget the whole thing?

Let me mention a few things entirely unconnected with photogrammetry which illustrate my points. I shall avoid the impracticable applications of photogrammetry deliberately because I might seriously offend someone here, including myself.

Test No. 1. Does it promise to produce results without labor? As fundamental as this is, there are yet hundreds of cure-alls being brought to the attention of the responsible war leaders every day, which upon close scrutiny fail to pass this practical test. A gentleman recently declared that current methods of aerial navigation, based on the flat map, are obsolete and too complicated for practical use. He proposed an alternate method of plotting, based on the same basic data, but applied to a spherical surface. The modest claim for this method of plotting was that with a sphere of certain dimensions one's position could be plotted while in flight with a maximum error of 10 miles. Omitting entirely the errors in basic data, fundamental to any method of visual observation, it may be noted that the precision of plotting with a fine micrometer and a sharp pencil at the scale indicated is definitely in excess of the supposed maximum error.

In other words, we were offered a new labor saving device, but unfortunately as presented it does not meet requirements.

Test No. 2. Can our boys use it? Some ten years ago in conducting tests of aids to aerial photographic pilotage, Bruce Hill, one of our earlier explorers in the game, imported a German device called the Quo Vadis. This gadget proposed to actually plot on a map the ground track of the plane, thus enabling the pilot to fly a straight and direct course, turn 180° and fly the parallel course with exact spacing between flight lines. Amazingly enough the instrument worked, *sometimes*. After many trials, Bruce Hill concluded that it operated with reasonable efficiency only when attended by 3 expert Quo Vadis operators. Cockpit space being a *bit* cramped under these conditions, he further concluded that the machine worked best when left in the laboratory, and when the pilot flew by the seat of his pants. No doubt, since that date there have been many improvements in flying aids, including devices not entirely unlike the Quo Vadis, but there is no evidence that our boys can use them. The best photographic pilots still fly by the seats of their respective pants.

Test No. 3. Is it enough better than what we are using to justify its adoption? Some weeks ago a young man from Alabama exhibited the working drawings of a device said to be especially suitable for reconnaissance mapping of difficult jungle areas. The drawings were a bit complicated for *my* understanding, but it became clear after some study that here was a machine to be carried on the person, much in the manner of a cigarette girl carrying her tray, which would actually plot the course of the individual as he moved through the dense undergrowth. The question immediately arises, "What manner of man is it, who can proceed in an erect position through dense underbrush carrying a 100 lb. instrument in the shape of a cigarette tray?"

The examples I have given are deliberately exaggerated, yet it is of most importance that before we expend our precious energy upon the development of new processes, we carefully examine, first, what we need . . . what we have . . . and where we are lacking in performance. Only with such a critical analysis as a proper function can we proceed safely.

These remarks are not intended to discourage any new application of the principles of photogrammetry. On the contrary, we welcome any new device or method which will improve our chances of obtaining information about things, which by reason of a certain hostility on the part of our enemies, we are not privileged to inspect in person. In certain of its applications, photogrammetry has played a considerable part in the present war. Its usefulness in the minute examination of specific objectives has been pronounced. This business goes much further than photographic identification. It includes precise measurement of the dimensions of ships, docks, powerhouses, factories and other important weapons and utilities. Through its application, we are enabled to reconstruct objectives, to evaluate factory capacities and even to lay out and duplicate hostile terrain as a basis for planning and rehearsing our attacks. In none of these applications has the science reached the zenith of its possibilities. In map making, in particular, photogrammetry has not produced the anticipated results. Perhaps this is because in time of peace we have allowed ourselves to become too dependent upon the photograph, not fully appreciating the elements of time and space, nor the effect of hostile defenses which are encountered in a modern war. We have recognized the difference between peace and war practice in construction operations. We do not expect to erect permanent masonry buildings for the housing of millions of soldiers, nor do we expect to build memorial bridges over every stream we cross. By the same token, we

should not expect that every map we make of hostile terrain must employ the most modern technique in map making, nor that the result will be a permanent monument to the art of cartography.

This war has illustrated every phase of physical combat from the early system which Cain practiced on Abel, namely, the simple bashing in of a head to the excruciating refinement of scientific destruction at 35,000 feet. We have seen all types of combat from the jungle fighting of New Guinea and Guadalcanal, in which every man is a Daniel Boone, to the delicately balanced and precisely rehearsed attack on Eben Emael, which brought into play the carefully calculated operation of every type of modern weapon known to man. Physical conditions and the character of the enemy determine the method and forces to be used.

In the same way and for the same reason, the maps which we shall produce and the extent to which we shall apply the finer methods will be governed largely by the scene of operations and the end to be obtained. A map of high precision is a waste under some conditions, and a vital necessity under others. We make and use everything from the rude sketch scratched in the sand to a carefully constructed relief model, the produce of thousands of hours of exacting research and labor. As an actual contribution to the end to be gained, the sketch in the sand may prove more valuable than the model.

The statement that I am an exponent of precision mapping is misleading in that it infers a passion for accuracy of geographic position. It leaves the impression of exact computations, refined measurements and precision plotting. Precision, in connection with mapping, extends much farther. It means precision in planning and execution of the job as a whole, including:

Formulation of an accurate conception of the purpose of the job.
The analysis of the material available.
An accurate estimate of the additional information required.
Calculation of the instruments and forces necessary for the task.
Processing of these materials with the maximum precision justified by the character of the basic information, with due consideration of time available and the purpose of the job as a whole.

To be specific, let us examine a typical military operation from the standpoint of the terrain information required. The operation will include the planning of tactical dispositions and logistics, calculation of troops, equipment and supplies, and the actual combat including all of those elements involved in modern battle such as aerial bombardment, artillery concentrations, the infantry fire fight, demolitions, constructions and repairs of communications, etc. Planning must make provision for hostile air and ground interference from all directions; all alternate operations; pursuit; and all uncertainties and intangibles which may be introduced by the enemy's reaction to the attack.

The second step is to establish the minimum requirements for terrain information for each element of the operation from the planning stage to the successful conclusion.

The third step is to analyze the existing information; for example, general terrain information may be adequate for logistics planning, but inadequate for close combat or for aerial bombardment. These deficiencies must be made good.

The fourth step is to analyze our means of improving our terrain intelligence in terms of the time available; and to concentrate on those elements most essential to a successful outcome of the engagement.

The next step is the actual acquisition and processing of the information into form which may be transmitted to and assimilated by those responsible for each

detail of the operation. Maps form only a part of this terrain intelligence study.

The final step is the actual transmission of the information into the hands of those who require it. Too often our effort stops just short of this point. The task cannot be considered as properly accomplished unless each step has been performed with precision and completeness. When I speak of precision in mapping, therefore, I do not refer to accuracy of geographical position of objects as represented on a flat sheet of paper. I refer to the whole scope of map making with reference to its objective. Let us not, as photogrammetrists, conclude that in the application of photogrammetry, we are doing more than the mechanical elements of map making. Let us not attribute to photogrammetry in any of its ramifications, from the simple plotting from a single photograph to the application of machines of high precision, the fundamental basis of mapping which is precision of thought.

SEMI-ANNUAL MEETING

THE semi-annual meeting of the American Society of Photogrammetry was held at the Roger-Smith Hotel, Washington, D. C., July 23, 1943, at 7:30 P.M.

Guest speakers for the evening were Squadron Leader D. W. Steventon, RAF; Flight Lt. M. G. Brown, RCAF; and Flight Lt. G. H. E. Maloney, RCAF.

In addition to short talks by the above three, the following sound movies were shown:

1. Photo Interpretation in Bombardment Areas.
2. Activities of the 17th Reconnaissance Squadron at Guadalcanal.
3. Desert Victory.

The total number of members and guests present was 133.

EDITOR'S NOTE

The Secretary of the Society has available pins, charms and buttons at the following prices:

	Pins	Charms	Buttons
Gold	$6.25		
Silver	1.00	$0.75	$0.75
Bronze	—	.50	.75

Due to priorities the limited supply of bronze charms and buttons that are now on hand is all that will be available for the duration.

The price quoted above for the various pins is the current one and is subject to change with manufacturing conditions.

The Secretary of the Society has on hand a number of complete volumes of PHOTOGRAMMETRIC ENGINEERING beginning with the year 1937. These are available for members at the price of $3.00 per year.