

DISCUSSION OF MR. LAMBERT'S PAPER

O. S. Reading

It seems to me that Mr. Lambert deserves bouquets rather than brickbats if one accepts his qualifying statements at full value. Certainly it is poor engineering to strive for accuracy beyond the capabilities of instruments, methods, and personnel or for that refinement obtainable only by multiplying costs several times without appreciable practical benefit. If one has need for higher accuracy than is readily attainable in a given set-up he should revise his methods, get better instruments and/or instruct or replace his personnel.

It is one of the major purposes of the American Society of Photogrammetry to acquaint its membership with the most efficient and accurate methods of mapping known in the world, and to furnish cost data for the different methods so that the most efficient method can be applied to a given situation.

Nor do I think that many will quarrel with the necessity at times of emergency hand-to-mouth short cuts to obtain needed information as quickly as possible without much consideration of accuracy beyond that needed for the special purpose of the particular project.

However, national mapping should be done in accordance with the most efficient total usefulness rather than to meet an emergency need. It is generally accepted that a high percentage of sharply defined detail of an enduring nature should not be noticeably in error in position (say 90% within $\frac{1}{2}$ millimeter on the scale of the published map). Such accuracy is usually best obtained by reducing the plotted survey from 25 to 100 percent or more in the reproduction process rather than by attempting to plot at an accuracy beyond the capabilities of the method in use. Such accuracy is now obtainable with modern instruments at from approximately \$25.00 to \$75.00 per square mile on a 1/24,000 scale for complete topographic surveys exclusive of control. Methods which approach this cost for sizeable projects without attaining such accuracy or completeness should be replaced as rapidly as practicable.

There are many uses for such accuracy which I gather is somewhat higher than contemplated by Mr. Lambert. If the survey is to be used for charting, errors in position will often be multiplied in the "fixes" taken by navigators. "Fixes" on different objects will not check with each other and much confusion (or danger in close waters) will result. If the survey should be used for artillery fire in national defense, wrong positions will cause waste of ammunition far exceeding the cost of good maps, if not more serious results. If the survey is used for determination or verification of acreages, much complaint, unjust taxing, or compensation will result from lower accuracy. If there is a question of changing river banks, shorelines, marsh areas, or extending erosion, data from surveys of low accuracy are misleading and may result in unwise expenditures many times the cost of accurate maps. When it comes time for revision, instead of merely adding the additional works of man and a few natural changes from supplemental photographs, it is necessary to junk the old survey and make a complete new one. No map intended to be generally useful is complete without accurate contours. If Mr. Lambert's Jonathan Marshmeadow finds as the reservoir is staked out that the map which led him to believe that only the marshy part of his land was to be flooded was wrong and his best meadow land is also to be under water, there will be an expensive lawsuit at the least.

The requirement of some definite measure of the relief of the terrain on a complete map in turn means the double or stereoscopic instead of the mono-projector plotting machines. The cost of going into the field to get control, to

verify names, to check boundaries, to supplement the occasionally obscure places on the photographs, and to carefully edit and publish the maps, form a relatively large part of the cost of mapping. There have been several papers in this publication pointing out the fact that the cost of accurate stereoscopic mapping by the Multiplex and other machines is so low that it is uneconomical not to do a complete job with such machines when the contour interval is ten feet or more.

The uses of accurate complete maps on suitably large scales are legion. Hundreds of different special purpose maps can be compiled from them—special studies can be made that were never thought of—entirely unpredictable—at the time of survey. In mapping, as in other types of engineering, a strong margin of reliability—a “safety factor” over ordinary needs—is valuable and necessary to avoid expensive corrections or repairs.

All of these considerations point to the desirability and economy of making complete, accurate (90 percent within $\frac{1}{2}$ millimeter at scale of publication) maps except when emergency conditions of time and funds demand hand-to-mouth limited purpose surveys. The development of our country will require the accurate maps eventually. That development will be expedited and will be accomplished with much less confusion of thought and waste if the accurate maps are made available as soon as practicable. Otherwise we are likely to have the same ground surveyed over and over many times with various hand-to-mouth surveys until their discrepancies become so annoying that we are forced to supplant them with a standard accuracy job. Mr. Lambert is right when he speaks of the high cost of standard accuracy throughout the map if he is talking about ground surveys or air photographic surveys without modern stereoscopic equipment. But with such equipment and trained personnel, standard accuracy throughout can be had at less cost than the old ground surveys with their few critical details of high accuracy and the rest sketched or “fudged in,” and for only a fraction of the cost of ground surveys so carefully done as to be accurate throughout. Photogrammetric engineers who have carefully studied the test projects and the reports of larger areas mapped with modern stereoscopic equipment understand this. It is up to us to carry the news to the engineering profession and the public generally. Then money for the standard mapping will be forthcoming and the waste of hand-to-mouth surveys can be stopped.

The idea of giving the co-ordinates of control stations and boundary monuments in figures alongside them would appear to be excellent for very large scale maps or construction plans. For medium or small scale there is not sufficient room without sacrificing clarity or valuable information. But such points might be indicated by small symbols with the co-ordinates printed on the side or back of the map or in a special leaflet for engineering or artillery use. Control monuments, landmarks, aiming points, and property boundary monuments determined by control surveys might well be listed by degree quadrangles or other suitable units.

Mr. Lambert has apparently overstated his case and used provocative words in many instances to encourage discussion. For instance, if he means to “fudge” his sheet junctions by 1/100 of an inch or less, few will gainsay him, but if more, many would consider it “topping off the package” to the disgust of all honest men. There are many such statements in his paper which require clarification but this discussion grows too long. Surely the editor will be glad to hear from many others. At any rate, Mr. Lambert’s invective against over-refinement of poor methods and praise of photographs for quick hand-to-mouth results is worth careful consideration.