THE ACCURACY OF POIVILLIER PLOTTERS

EDITORIAL NOTE: Under the above title a translation of Mr. E. Torquebiau's letter of November 8, 1951 is given of pages 173 and 174 of the March 1952 Issue (Vol. XVIII, No. 1). In a letter of May 19, 1952, Mr. Torquebiau called attention to an error in translating the Nov. 8 letter and also discussed the "Note by Publications Committee" on page 174. A translation of the May 19 letter has been reviewed by Mr. Altenhofen of the Publications Committee. His comments follow.

MR. E. TORQUEBIAU of Société d'Optique et de Mécanique de haute Précision, Paris has called attention to a misstatement in the translation of his letter published in the March issue of PHOTOGRAMMETRIC ENGINEERING. In this communication concerning the *C* factor determined for the Poivillier-SOM stereotopographs, the paragraph following the tabulation on page 173 should read as follows:

"These values of the *C* factor cannot be compared strictly to those published in the American literature concerning the Multiplex and Kelsh plotters and stated as being in the neighborhood of 1,000. Such a comparison is invalid because the American *C* factor is influenced by the metric qualities of the survey camera and the characteristics of the film base, which data are extraneous to the stereoplotting apparatus. The values in the tabulation correspond to the *C* factor as defined in the paper of Mr. Sharp."

Perhaps this incorrect rendering of the French can be attributed to the translator's cognizance of the high performance standards of the Poivillier plotters operated by technicians of the National Geographic Institute. If the ambiguity of language permits either an "aye" or a "nay," then the "aye" is selected if it tends to prove the superiority of a particular plotter. But alas, Mr. Torquebiau states that the "nay" was intended in his statement concerning the comparison of stereoplotters on the basis of *C* factor. This comparison of accuracy he believes valid only if all the conditions influencing the *C* factor are identical.

This ideal definition of conditions can only be approached when grids are oriented in the stereoplotter and the resulting model is analyzed with due allowance for the method of distortion compensation. But even this method of determining instrumental accuracy has not been accepted unanimously by photogrammetrists throughout the world. If this ideal approach meets with resistance there is certain to be opposition to *C* factor comparisons under practical conditions.

Under practical conditions the photogrammetrist is given the record of the survey camera either on glass or on film. From this initial source of data he proceeds through a series of operations to the final product, a map. Suppose the use of a glass plate survey camera and the strict application of the porro-Koppe principle are characteristics of a particular stereoplotter. These characteristics would weigh heavily in its favor if a *C* factor comparison proved its accuracy to be superior to that of plotters utilizing film negatives and compensating for distortion by other optical or mechanical means. It was this practical viewpoint which caused the editor of the original letter to misinterpret the statement which has been corrected.

Mr. Torquebiau expresses a different opinion than that of the Publications Committee note accompanying his original letter when he states in his recent communication that the French National Geographic Institute and the Belgian Military Geographic Institute "have shown that the precision of contours is hardly inferior to that of isolated spots apart from certain systematic defects

attributable to the operators." American experience does not confirm this statement since errors of stereoscopically measured spot heights usually are less than the errors of points whose elevations are determined by interpolation between contours. Even in the clear areas of the model non-uniformity of ground slope between contours weakens the interpolated values. Also, the contours vary greatly in strength throughout the model because of the variations in the appearance of the terrain which may range from light to dark in tone and from clear to heavily wooded in vegetation characteristics. Recognition of these conditions has led to the statement that an appreciable disparity exists between the *C* factor indicated by the mean square error of spot heights read in the stereoplotter as opposed to that indicated by the error of interpolated elevations based on stereoscopically drawn contours.

If a *C* factor comparison is to be made between stereoplotting instruments it should be based on the mean square error of spot height readings. Such a procedure will establish practical conditions which most nearly approach the ideal conditions of the grid model.

ROBERT E. ALTENHOFEN

METHODS OF FIELD CAMERA CALIBRATION*

E. L. Merritt, Head, Research and Evaluation Division,
U. S. Naval Photographic Interpretation Center†

IV. THE STAR EXPOSURE METHOD OF CAMERA CALIBRATION

A. GENERAL

The purpose of this section is to present a method of calibrating cameras from zenithal exposures of stars. The method consists of making exposures of the zenith and calculating the camera constant (f, Δx, Δy) and residual lens distortion, with the plate and celestial coordinates of the stars imaged as given data. The concept of a negative exposure of the zenith for calibrating purposes is illustrated in Figure 16. Reasonably accurate camera calibration data can be calculated because of the multiplicity of star images, and the relatively high accuracy of the star's celestial coordinates.

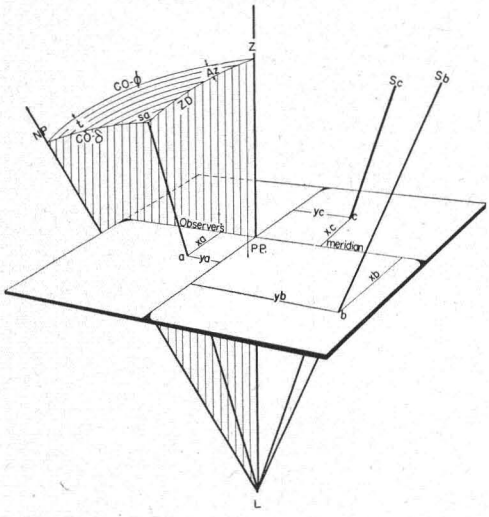

FIG. 16. Idealized camera orientation.

In the star exposure method, there are certain operations, such as identification of the stars imaged, reduction of the stars from the mean epoch of 1950 to their apparent places at the instant of exposure, and com-

* This is the completion of Mr. Merritt's paper. Parts I to III are in the September 1951 issue (Volume XVII, No. 4, pp. 610–635). The author is now a member of the staff of Photogrammetry, Inc., Silver Spring, Md.—*Publications Committee.*

† This was the author's title and occupation when this paper was prepared.