An Application of Models and Stereo Images to Teaching Photographic Geometry

RAYMOND M. NELSON, *Head, Metrics Division, Training Department, U.S.N. Photographic Interpretation Center*

ABSTRACT: *The design, creation, and application of models and stereo images, in color and black and white, are described relative to teaching photographic geometry. Presentations to large classes correlate descriptions of photo geometry definitions with projected 3D images and perspective diagrams. The specific association of definitions with colored planes in the 3D image is required for clarity. The method has proved to be effective and other government organizations have adapted the idea to various programs.*

IN THE various training programs conducted by the USN Photographic Interpretation Center, the student is trained in both qualitative and quantitative interpretation. An integral part of his metrical knowledge is the understanding of the photograph in its relationship to object space. This information is presented as an important segment of his early training, and part of this phase of the curriculum is the presentation of basic photo geometry, an elementary form of interior and exterior orientation.

Early attempts at teaching the basic concepts, by means of the usual perspective diagrams, were disappointing because of student difficulty in visualizing three-dimensional space. The extreme diversification of educational backgrounds among the students contributed to this difficulty, and many had no suitable training to prepare them for this kind of subject matter.

After considering various means of overcoming this deficiency, it was decided to use a 3D approach with models. While contemplating model design, however, concern was expressed over the difficulties others have had with permanently erected models. Although the models proved to be functional, they created a problem in storage and transportation. They were bulky and occupied a large quantity of space, and many had been broken while being moved. It was then decided an attempt should be made to obviate these problems as well.

Therefore, a series of models was designed by the author in which each consisted of slotted, interlocking, transparent plastic planes erected on an opaque platform, the plastic planes being in various colors. Each model was designed to be assembled and disassembled easily for safe storage and transportation. Fifteen models, ranging from 6 inches to 18 inches in height and from 1 foot to $1\frac{1}{2}$ feet to a side, were constructed to illustrate various concepts in geometry related to vertical, oblique, and horizontal photography. The model shop at the Center constructed the models.

These models were then photographed, stereoscopically, in color and black and white. The color exposures were made into slides for stereo projection, and the b. and w. photographs were enlarged and printed as stereograms for stereo viewing with a two power lens stereoscope.

The stereogram illustrations, Figs. 1–10, in this article are a selected group. Stereograms of some of the more complex models have not been included because of difficulty in reproducing desirable details.

A week before the subject is presented to a class, the students are issued a "handout" consisting of a list of photo-geometry

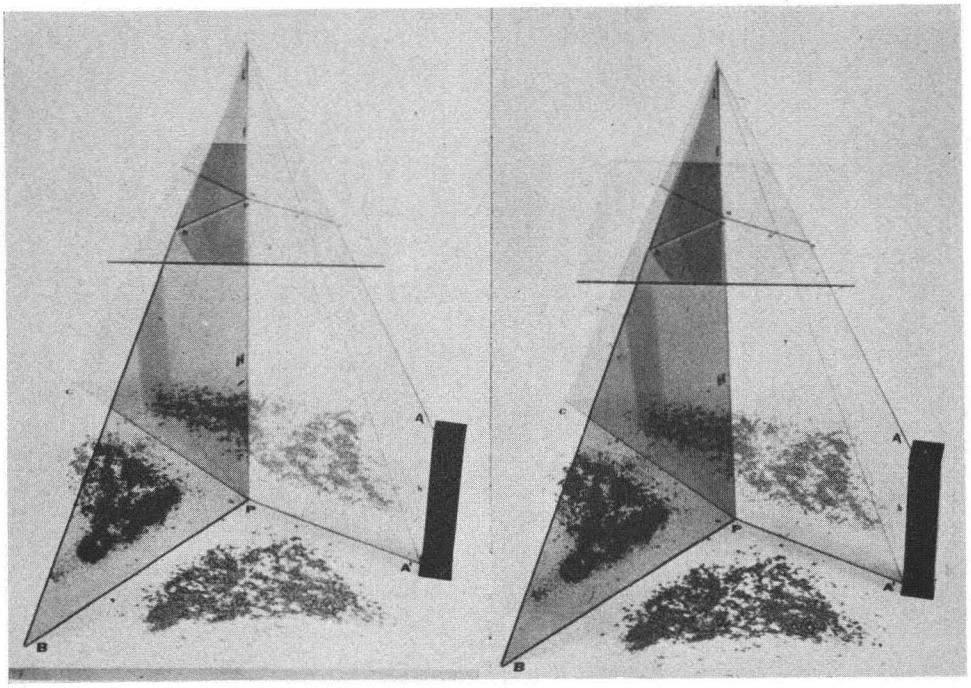

FIG. 1. Space pyramid of vertical photograph. (Use 2 power lens stereoscope.)

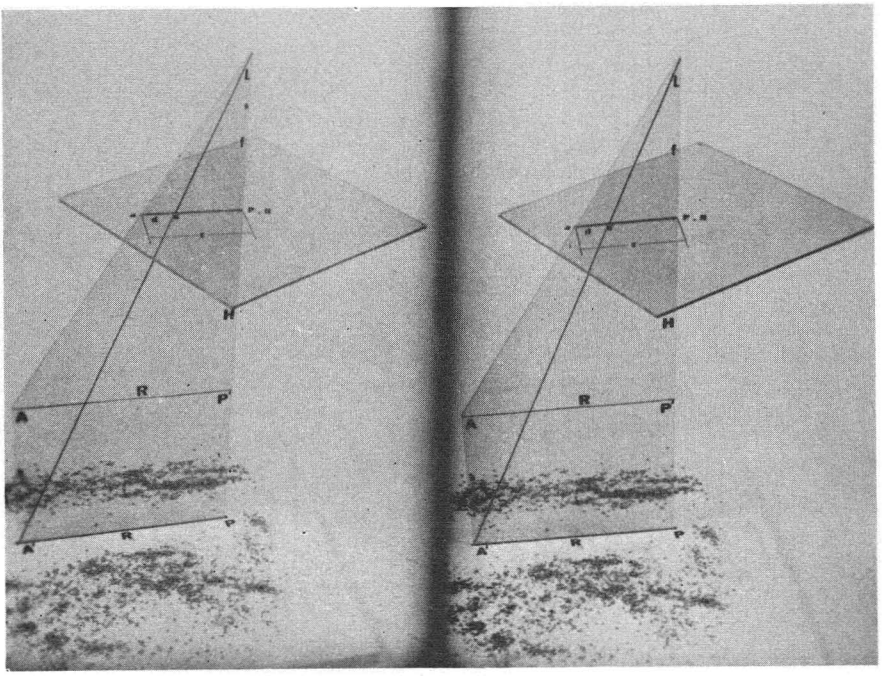

FIG. 2. A vertical object plane and vertical photograph illustrating relief displacement.

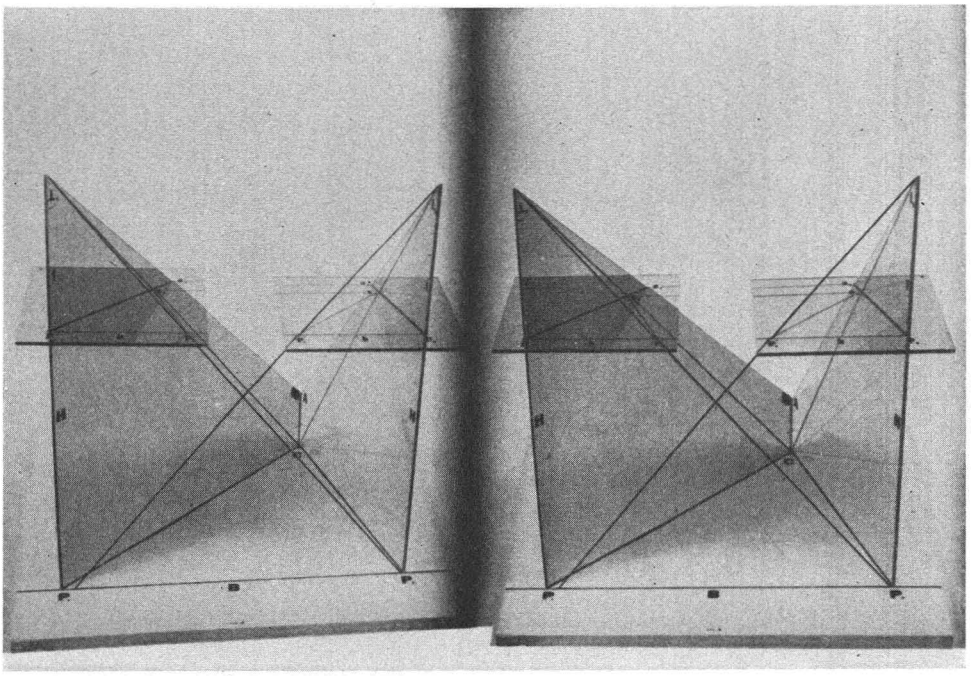

FIG. 3. Orientation of stereo vertical photography.

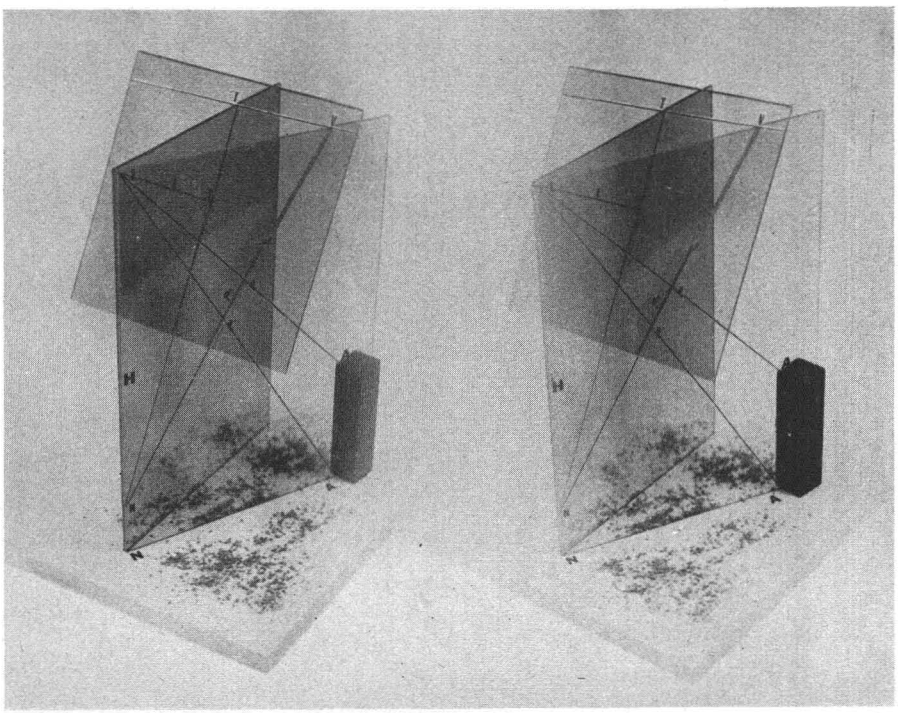

FIG. 4. Orientation of oblique photograph with a vertical object.

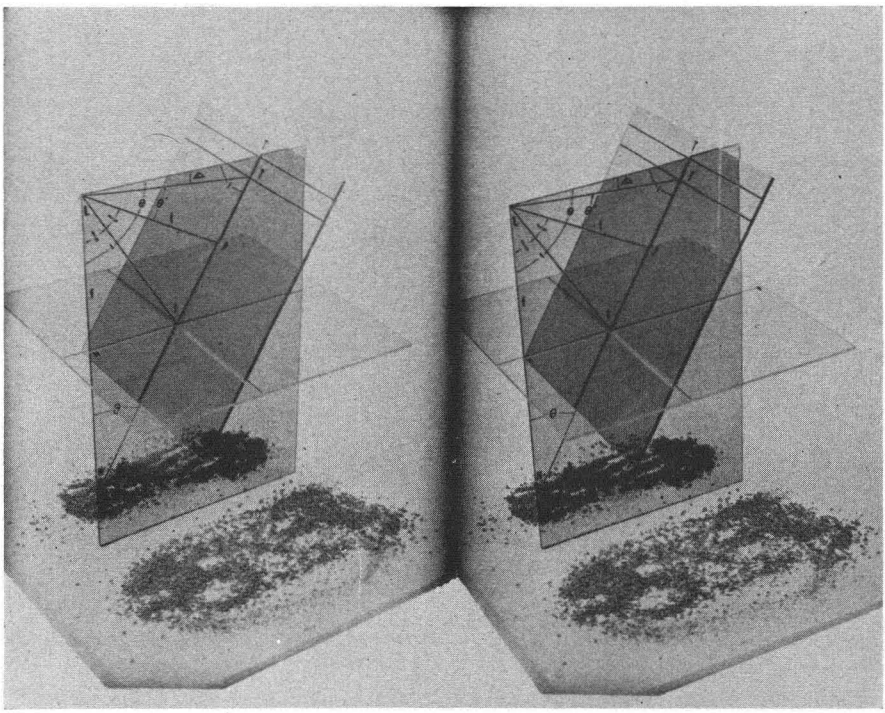

FIG. 5. Angle notation in principal plane.

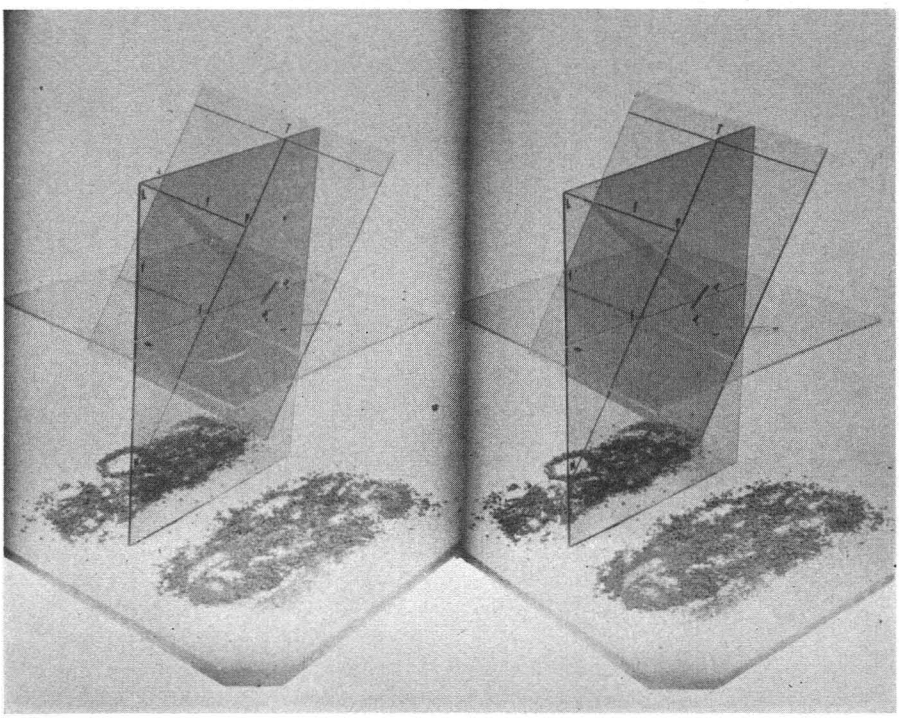

Fig. 6. Correlation of vertical object images on vertical and oblique photo planes.

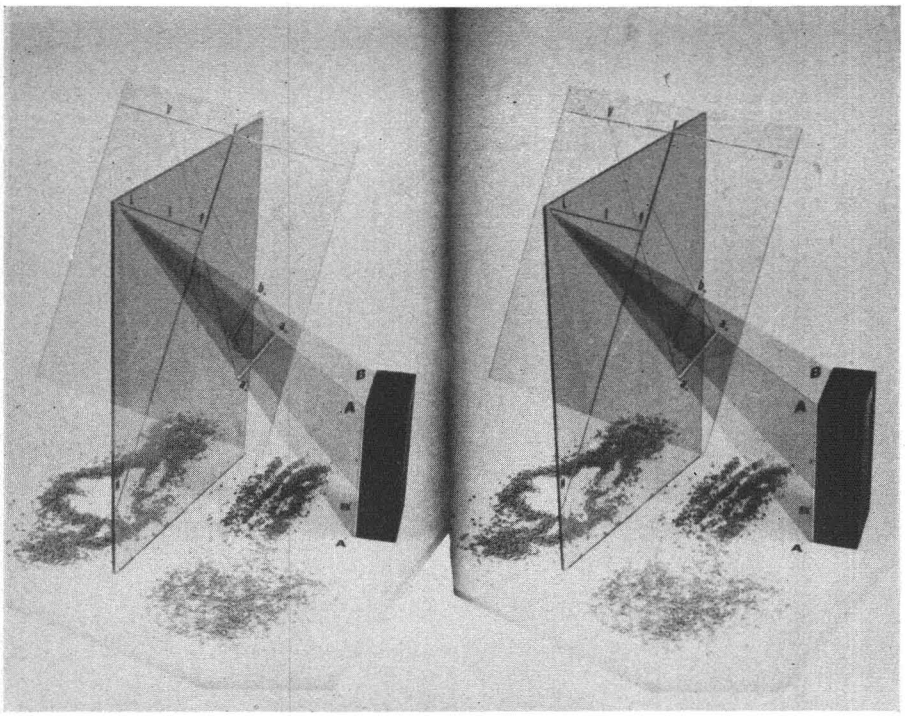

FIG. 7. Correlation of perspective images from vertical lines and horizontal, parallel lines.

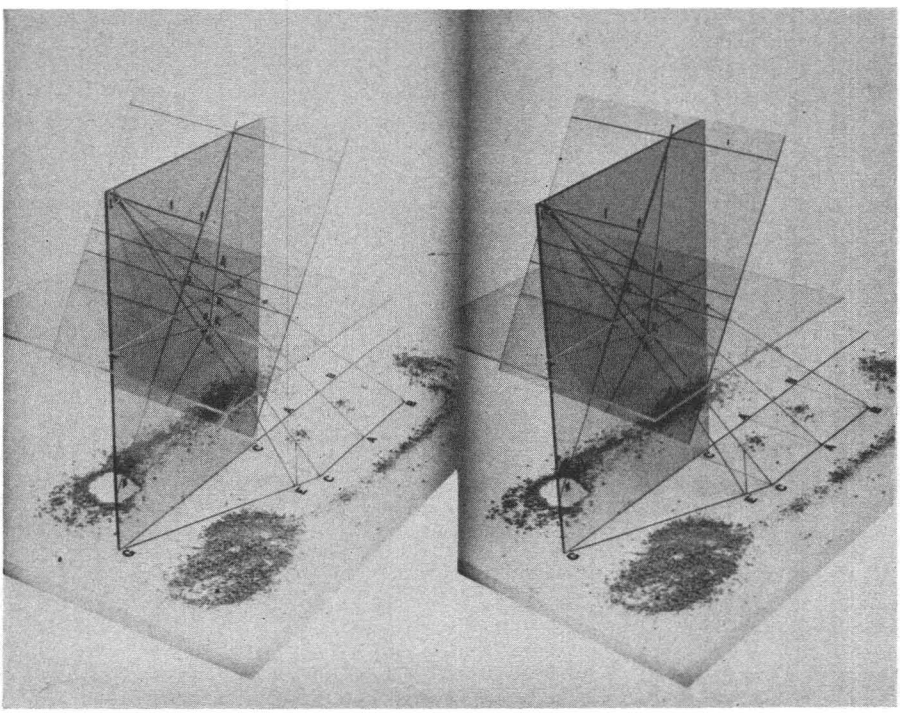

FIG. 8. Correlation of scale on vertical and oblique photo planes.

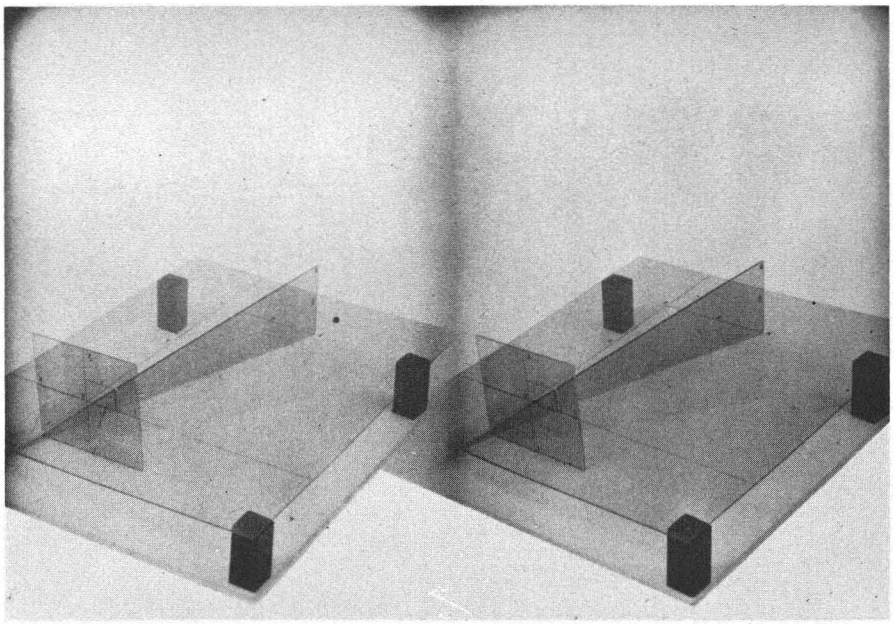

FIG. 9. Orientation of horizontal photograph.

definitions, the complete collection of b. and w. stereograms, and a group of perspective diagrams correlated with the 3D illustrations. This handout is for home study. Before class, the models are assembled for display on tables in the classroom and remain there during the entire metrics program.

During the classroom presentation, the student has his handout and stereoscope on a table in front of him, dons his polarized spectacles, and views the projected images in 3D and in color. Perspective diagrams corresponding to the three dimensional views are projected on a separate screen alongside the 3D images. Basic definitions are presented by stating the concept and then describing it by

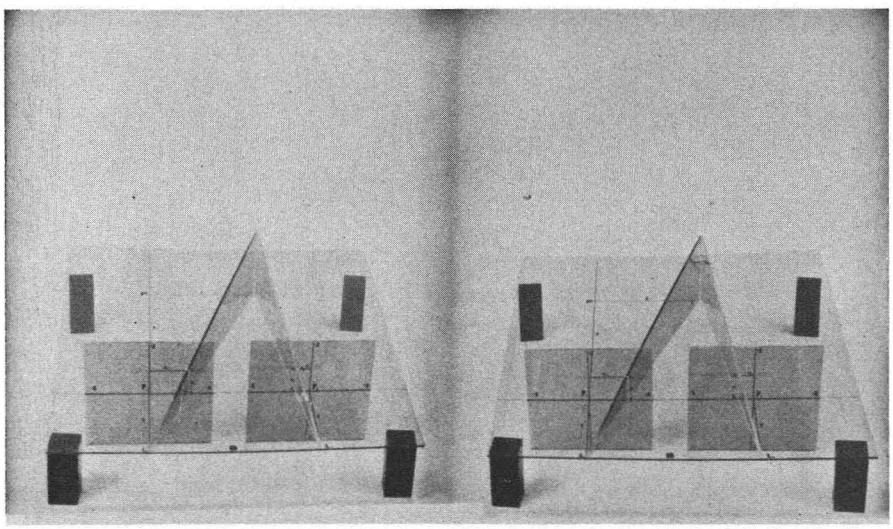

FIG. 10. Orientation of stereo horizontal photography, photo planes coplaner.

correlating a perspective diagram with a three-dimensional image. Some ideas are presented only with perspective illustrations. During class break periods, the models may be examined in detail.

Personnel with backgrounds in perspective, analytics, or solid geometry usually absorb this material from the handout during home study. But those with no suitable background have difficulty in learning this subject by themselves, since they usually see the 3D image as a confusing series of intersecting planes. Therefore, during the classroom presentation, it is necessary to point out the item specifically by referring to its color in the 3D projected image. For example, if the plane of the photograph is defined, then the red plane would be pointed to; the principal plane would be the green plane; a vertical object plane would be the yellow plane; etc. The 3D image illustrates the spatial relationship, but the color identifies the particular item, and of course the perspective diagram is appropriately labeled.

On a stereo projected view, annotated points are usually too small to discern easily. When such points are described, the student removes his 3D glasses and examines his b. and w. stereogram with his stereoscope.

Correlating perspective diagrams with 3D images teaches the association of 3D space with a 2 dimensional drawing. When a student then reads texts about photogrammetry, he is capable of visualizing the three-dimensional space embodied in the perspective diagrams.

For small student groups, the instructor can usually work with the models directly, but for large classes this method becomes impractical. The stereo slides are then useful in presenting the ideas.

The models and technique described have been in use at the Center since July 1956, and to date the method has proved to be highly effective.

The Naval Training Device Center (USN) has made adaptations of the principle to meet its requirements, and the Army has reproduced a selected group of these models for us in a kindred program.

NOTE BY AUTHOR: In this paper reference is made to models constructed of slotted, interlocking planes. This idea is an invention for which my employer, the U. S. Navy, is making a patent application. The application is titled, "Photo Geometry Models," Navy Case No. 25143; the patent application number is not available at this time.

It is regretted that the illustrations are not clearer or more sharply defined. This is due to the original photos and the method of obtaining them.—*Editor*

ANNOUNCEMENT

By letter of June 9, Sherman M. Fairchild, President of Sherman Fairchild & Associates, Inc. sent the unwelcome information that Karl J. Fairbanks died on Sunday, June 8, after an illness of several weeks. The services were held on June 11 at Havey's Funeral Home, in Yonkers. Karl was Vice President of Sherman Fairchild & Associates, Inc. and of Fairchild Data Devices Corporation. The information sent by President Fairchild reached me just as the page proof dummy for the June issue was completed—EDITOR