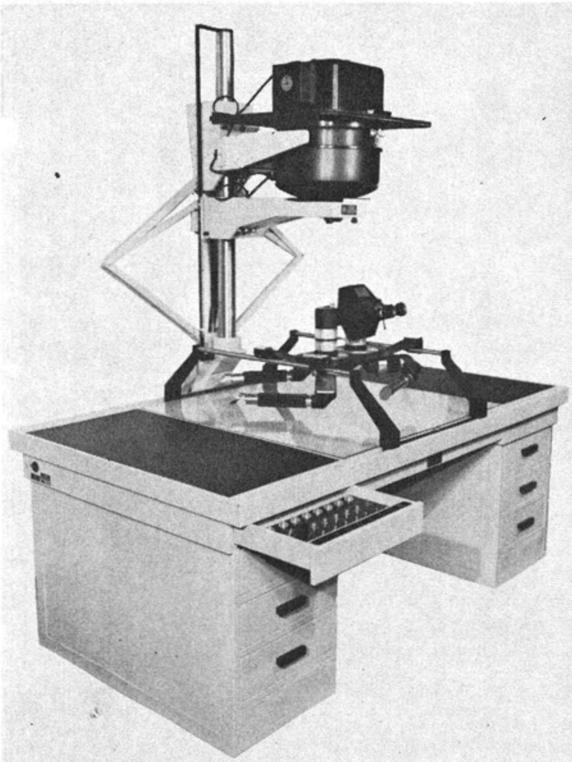

FIG. 1. Overall view of the Versatile Planimetric Compiler showing the projector, stereoscope, and light table.

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The Versatile Planimetric Compiler

Multi-purpose tool serves as stereoscope, projector, light table, etc.

(*Abstract on next page*)

IN THIS DAY and age when we have created a multitude of complex equipment to solve the problems of Photogrammetry, I would like to describe to you an instrument which, due to its unique design, encompasses many of the basic needs of our profession in a rather straightforward and simple manner. This instrument was initially named "The Planimetric Compiler" but, because of its unique ability to utilize so many input media, we have seen fit to name it "The Versatile Planimetric Compiler."

This paper is presented in two parts: a general description of the instrument, and some of the technical aspects of the design. The Planimetric Compiler is designed for the efficient manual compilation of planimetric map manuscripts by abstraction of data from orthophotographs. It provides for the addition of supplemental data from aerial photographs and existing map coverage. It is also suitable for use in compiling overlays containing planimetric data to be added and/or intensified on orthophotomaps by overprinting. The Planimetric Compiler is a modular design consisting of: an illuminated drafting

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surface, a stereoscopic viewing system, and a projection unit.

THE DRAFTING surface (Figure 1) is 37×72 inches with the illuminated 36×36-inch area centered in the 72-inch dimension. The two 18×37-inch areas, one to the right and left of the illuminated area, may be used for the placement of auxiliary equipment.

The illuminated area can be varied in brightness from 40 to 4,000 foot-lamberts and is supported on two pedestals. The top drawer in the left hand pedestal contains the control panel. The top drawer in the right hand pedestal has been designed to accommodate a typewriter or small desk computer. The two drawers under each of the top drawers can be used to store drafting material and related sundries. The rear section of each of these pedestals, with access through doors in the back, contains the electrical components.

The system permits stereoscopic viewing of overlapping photographs at all magnifications from 2× to 32×. Individual magnification control of each optical path is provided to permit stereoscopic viewing with scale differences between photographs up to 16×. It is also possible by means of a third optical leg and a rotating front surface mirror to view map information monocularly and compare it with a stereoscopic pair. This is accomplished by two of the three optical legs being able to rotate around the right hand vertical optical axis, and the first surface mirror being used to bend the light path, at this point, having the capability to be rotated from one optical leg to the other.

The resolution and field coverage of the system is a function of the magnification and varies as follows: resolution, on the optical axis, from 14 lines per millimeter at 2× to 192 lines per millimeter at 32×. Field of view from a diameter of 2.25 inches at 2× to 0.22 inches at 32×. The system permits an image rotation of 360° on each optical leg of the system. A focusing adjustment is provided in order to accommodate variations in operators eyes and/or variations in thickness of the material being observed.

The horizontal optical leg (Figure 2) of each path may be rotated 360° around the vertical optical axis and contains an elbow that also may be rotated 360°. The horizontal optical viewing distance may be varied from $1\frac{1}{2}$ to 42 inches without moving the stereoscope on the X-Y rails.

A unique feature of this optical system is the varied modes in which the light path may be directed to the eyes. By the use of fully reflecting and semi-reflecting mirror surfaces in conjunction with an occluder, the following combinations can be effected:

- Stereoscopic perception—right eye viewing right image and left eye viewing left image.
- Pseudoscopic perception—right eye viewing left image and left eye viewing right image.
- Both eyes viewing image on right.
- Both eyes viewing image on left.
- Right eye viewing only image on right. (Occluder blocks left optical path.)
- Right eye viewing only image on left. (Occluder blocks right optical path.)
- Left eye viewing only image on left. (Occluder blocks right optical path.)
- Left eye viewing only image on right. (Occluder blocks left optical path.)

The two optical legs that rotate about the right-hand vertical optical axis have the appropriate mode for directing the light to the eye depending on which leg is in the system.

THE PROJECTION UNIT provides for the projection of maps or auxiliary photography onto the drafting surface. It has a 9×9 inch projection area but can accommodate film or paper prints up to 24×30 inches in size. The auxiliary copy holder is designed to prevent excessive bending of any portion of the auxiliary copy. Any portion of the auxiliary copy can be projected and can be rotated 360° with

ABSTRACT: *The Planimetric Compiler permits efficient manual compilation of planimetric map manuscripts by abstracting data from orthophotographs, with provision for adding supplemental data from aerial photographs and existing map coverage. It is also suitable for compiling overlays containing planimetric data to be added and/or intensified on orthophotomaps by overprinting, or to be added to basic planimetric manuscripts produced by conventional plotting instruments. The Planimetric Compiler is a modular instrument consisting of an illuminated drafting surface, a stereoscopic viewing system, and an image projection unit*

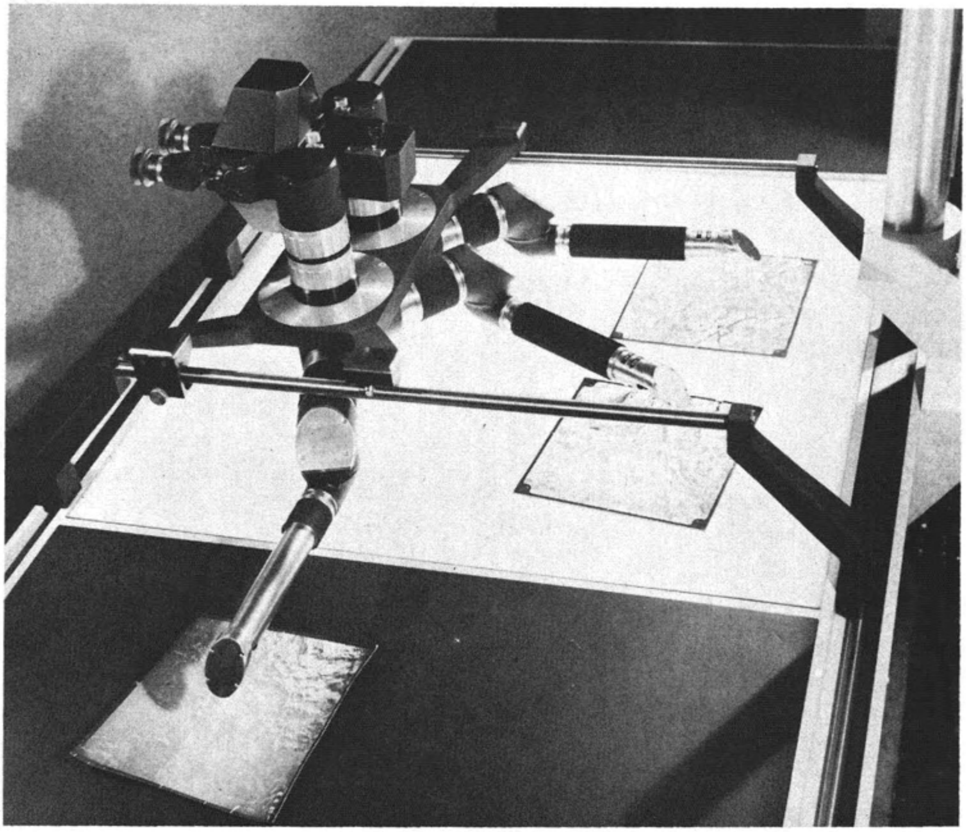

FIG. 2. Close-up view of the Versatile Planimetric Compiler showing the details of the Stereoscope.

respect to the drafting surface. In addition, the projected image may be rotated 360 degrees by using an auxiliary prism rotating unit attached below the lens.

Magnification of the projected image is continuously variable by means of a Peaucellier* inversor from 0.6× to 3×. The projected image can be tilted ±5° in both tip and tilt by means of electrical motors. The projector tilts are defined with respect to the drafting surface. To accommodate for the depth of field at the maximum tilts of the projector, the lens may be tipped or tilted ±3°. The resolution of the projected image is 10 lines /mm. or better.

A challenging phase in the design of the Planimetric Compiler was the development of the stereoscope. In the limited time period scheduled for the completion of this instrument it was not possible to approach the optical design problem in the orthodox manner. It was necessary to arrive at a design solution within rather narrow parameters and then choose commercially available optical elements that conceivably would fall within these parameters.

The available optics were set up on the optical bench and evaluated individually and then in combination with the other associated optical elements. In this manner, by testing many optical elements in conjunction with many other optical elements, an empirical solution was finally found that would meet the design criteria. In order to be assured that the best possible solution had been achieved, other optical elements bearing the same characteristics were substituted and evaluated and other geometrical arrangements were evolved until there was no doubt that we had achieved the best possible solution.

It was then necessary to determine if the optical elements could be mechanically packaged with the kinematics needed, such as 360° image rotation, scale variation, focusing, etc. In order to arrive at a mechanical solution

* *Manual of Photogrammetry:* second edition 1952, pages 478 and 486; third edition 1966, pages 830 and 832.

that would meet the human engineering aspects of operation minor variations in the optical design were made. A full size mock-up of the instrument was made in order to integrate the units in such a manner that the human engineering aspects could be appreciated and solved. The mock-up also helped appreciably in the solution of many of the optical and mechanical problems encountered.

As HAS BEEN MENTIONED, a unique feature of this optical system is the varied modes in which the light path can be directed to the eyes. This has been accomplished by being able to interpose into the light path at will one of three mirrors: a fully reflecting mirror, a semi-reflecting mirror or a full transmitting mirror. It is also required that an occluder be used in order to interrupt the light path in conjunction with the reflecting surface being used.

This feature necessitated an unsymmetrical arrangement of optical elements and, therefore, major consideration had to be given in order to obtain equal light paths. A reversion prism is used to obtain 360° image rotation. It was chosen because it required only 180° of rotation of the prism to obtain the 360° of image rotation, and also an optical element was required that had an odd number of reflecting surfaces in order to obtain an erect image at the eyepiece.

A zoom system is used in association with a lens which occupies one of two conjugate positions thus giving a two step magnification range with continuously variable magnification by means of the zoom lens in each step. Focusing means are provided, as stated previously, to accommodate variations in operators eyes and/or variations of the object plane. The first optical element, a front surface mirror of the system is located approximately 3½ inches above the object plane in order to allow enough clearance for the operator to annotate the photographs (or a map).

THE PRIMARY PROBLEM in the design of the projection unit was to encompass both a reflecting and a refracting projector into one unit utilizing a common objective plane and lens. This was also desirable as the motions (tip, tilt, and azimuth) would be common. Optically, in order to combine the two units in one, it was necessary to be able to interpose into the light path of the reflecting projection system an optical element with an odd number of reflecting surfaces. Here again the reversion prism seemed to be an ideal solution which also gave us the privilege of image rotation.

In order to keep the total height of the instrument within the ability of the operator to load and unload, an 8¼-inch focal length lens was used. In view of its mechanical simplicity and compact design, the Peaucellier, or scissors, inversor was used to solve the lens equation.

IN SUMMARY, an instrument has been created that integrates many of the basic elements necessary to compile and up-date map information. The original design of the basic elements have been modified and redesigned in order to present a unit which encompasses the desired parameters for a rather broad scope of planimetric compilation.

Tokyo Symposium—*Continued from page 182*

- *K. Linkwitz* (Germany), "Application of Photogrammetry to Model Architecture."
- *H. Nakamura* (Japan), "A Photogrammetric Technique Applied to Making Highway Perspective Drawings."
- *C. O. Ternryd* (Sweden), "Photogrammetry, Electronic Computation, and Automatic Drawing in Highway Planning and Design Today and Tomorrow" (read by *W. Blaschke*).
- *S. Ibukiuana* (Japan), "Live Loads on Long-Span Bridges—An Example of the Applications of Aero-Photogrammetry."
- *T. Kaji, R. Kamiya,* and *M. Nasu* (Japan), "Application of Analytical Aerial Triangulation to Staking Out of Highways, and Simulation of Aerial Triangulation."
- *L. Skladal* (C.S.S.R.), "The Applications of Photogrammetry in Civil Engineering and Industry in Czechoslovakia."
- *T. Maruyasu, H. Nakamura, H. Taura,* and *H. Matsunaga* (Japan), "Analysis of Snow Depth in the Kurobe River Basin with Aerial Photographs."
- *K. Linkwitz* (Germany), "Geological Joint Survey by Means of Terrestrial Photogrammetry."
- *T. Nakano* and *H. Kadomura* (Japan), "Aerial Photo-Analysis of Soft Ground and the Possibility of Its Application to the Plannings of Regional Development and Regional Disaster Prevention."
- *K. Kasamatsu, K. Nakamura, M. Yamakami,* and *H. Tanabe* (Japan), "Determination of Both Wind Velocity and Directions through Synchronous Stereo-Photographs taken of Smoke Trail."
- *H. M. Karara* (U.S.A.), "Stereometric Systems of High Precision."

(*Concluded on page 220*)