

THE MULTIPLEX AERO PROJECTOR

by

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Ladies and Gentlemen: It is a great privilege to present to you this morning a picture of the most recent type of stereoscopic plotting instrument for use with vertical aerial photographs in the compilation of topographic maps therefrom. The attention of mappers has been turned on this problem for some years. Until the development of the Multiplex projector, types have been cumbersome and moreover required that the operator undertake a long period of training before he might be considered apt.

The Multiplex is, I believe, at the present, the simplest and most readily usable type of plotting instrument developed. It utilizes the principles of direct optical projection of two overlapping aerial photographs. The anaglyphic principle is made use of in achieving image separation. This means that the two projections are made in light of complementary colors and the resultant double image is viewed through filter spectacles of like colors so that each eye then sees only that image of like color to the filter worn before it.

The resulting projection as viewed is then an image of the earth's surface in three dimensions, and is like that which would be formed in the mind should it be possible to separate the eyes so that they would be at the points from which the two exposures were taken. The detail of the original aerial negative is magnified approximately two times in the projection.

The machine itself consists of two or more small projection cameras of like characteristics to the aerial camera which made the original exposures. These projectors are suspended from a bar and may be moved within limits in three directions, and rotated as well around three axes.

In order to make use of direct optical projection of the images and still have sharply defined images projected on the screen, the size of the lens has been reduced from that of the taking camera.

The cameras have a source of light for projecting the image printed on the transparent reduced positive glass plate made from the original aerial negative. A proper condensing system is also provided in order that the illumination of the image may be even. An auxiliary reducing projection printer is required to prepare the small-sized dispositive plates which are projected in the cameras. The projection is made on a screen which can be moved in space in any direction. A measuring mark is provided on the screen with which it is possible to actually fix the position in space of any feature of the earth's surface visible in the photograph.

Beneath the measuring mark a pencil is provided so that this position in space may be recorded on the map sheet beneath. Thus it becomes possible to trace directly from the dual projection the shapes and meanders of features of the earth's surface.

The stereoscopic model in space is formed by a method of trial and error; the operator sets his plates in the instrument and proceeds by inspection of various portions of the overlap to set one projector with respect to the other until there results perfect stereoscopic vision over the entire portion of the overlap. This spatial model still does not coincide with the earth's shape, and adjustment of the model to so conform is achieved by referring the spatial model to points on the earth's surface whose positions are known and then rotating the model and shifting and lengthening or shortening it until points in the model do coincide with their true positions on the map.

When this process is completed, the operator is ready to draw the map.

Now you would possibly like to know what has been accomplished with this apparatus in our hands. The first machine was received a little more than eighteen months ago and has been in use constantly since that time and uniformly excellent results have been obtained in every case. The first map produced on the instrument

was of an area in the State of Washington around Mount Olympus. In this area, relief varied over some 5,000 feet; most of the region was covered either by dense timber of trees 200 feet high; or by glaciers pouring down from the heights. This map will be produced at one inch to the mile with a vertical interval of 100 feet between contour lines.

The next job was maps of a series of reservoir sites in eastern Ohio and western Pennsylvania. These maps will be reproduced at a scale of one inch equals 1,000 feet, and a contour interval of 10 and 20 feet.

The third project was an inch-to-the-mile map of a quadrangle in the State of Washington, much the same as the Mount Olympus area, without such great relief.

We have had experience, then, with medium and large plotting scales and we feel sure that the accuracy of the equipment is such as will permit drawing of map detail at scales roughly the reciprocals of the flight altitude of the photographs. Vertical accuracy will lie between one five hundredth and one one thousandth of the flight altitude. In other words, we can scale the elevation of distinct points within from 5 to 20 feet, and an average of 10 feet at flight altitudes of 10,000 feet.

The apparatus has, of course, omitted certain of those refinements seen on other more elaborate instruments of this order. The fixed interior orientation of the cameras limits the scales at which detail may be compiled since there is a restricted band of usable definition in the projections. However, the Mount Olympus area will rarely be exceeded in ruggedness and the range was sufficient for that area.

The recovery of the camera stations cannot be entirely recorded as can be done in the more complex types.

The quality of the transparent plates used in the projections more than any other single item of the process influences the quality of the work. Great care is necessary that these plates are suitable. A little extra care in their preparation is more than repaid in the expedition and accuracy of subsequent operations.

Of course, the error introduced by film distortions and rough handling in processing are most troublesome. Dealing as we are with minutiae since differences of displacements of one hundredth of an inch are not uncommon, and changes of shapes materially influence the results.

The Multiplex projector is here to stay and will be an ever-growing influence in the art of mapping from aerial photographs. Its limitations will be increased by the desires of its users to increase its field of activity. With an increased desire for better lenses and better aerial cameras, the art of mapping from aerial photographs will come into its own and even the most sanguine supporters will be amazed at the expedition and economy of the process.

The Multiplex has even now won for itself a secure place in any mapping program.

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NEWS NOTE

Annual Meeting of the American Association for the Advancement of Science

The American Association for the Advancement of Science will hold its annual meeting at Atlantic City December 28, 1936 to January 1, 1937. The Annual Sciences Exhibit will be held in the Atlantic City Auditorium and will be one of the leading features of the meeting. In connection with the exhibits, the American Association for the Advancement of Science has suggested that the American Society of Photogrammetry participate in presenting an exhibit or that individual members of the Society send exhibits that might be interesting to the American Association for the Advancement of Science. While it has not yet been determined as to whether the American Society of Photogrammetry will be able to participate as an organization, it is suggested that any members who might be interested in sending exhibits get in touch with Mr. F. C. Brown, Director of Exhibits, American Association for the Advancement of Science, Smithsonian Building, Washington, D. C.