EXPERIMENT IN LARGE SCALE MAPPING USING MULTIPLEX METHOD

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IT IS always the ambition of most engineers in the course of exploring any new technique, to strike at the ultimate limitations of a process. The multiplex method of topographic mapping is no exception to this general rule. With multiplex technique, the principle holds that accuracy in elevations is indirectly proportional to flight altitude. The following is an account of an attempt to carry this principle to its ultimate, and to map with photography flown at an elevation of 1,500 feet.

In the summer of 1947, a survey problem was presented to K. B. Wood Engineers which normally would have been accomplished by means of a plane table and transit, involving the production of spot elevations on the ground with 2-foot contour intervals for an 0.8 mile stretch along the banks of the lower Tillamook River in Oregon. In addition to topographic work, a small-scale planimetric map was required showing the vicinity of the area. It was necessary to show the exact meanderings of the deep water channel, the exact elevations on the tide flats above low water and a detail of the banks above the tide flats. The survey work was for the purpose of determining the location of a pocket for turning around ocean-going log barges. Elevations had to be sufficiently accurate to permit computation of yardage of any dirt to be removed for purposes of opening up this pocket. For log raft storage, it was also necessary to locate the exact position of all piling and dolphins along a four-mile stretch of the river.

To do this project with plane tables would have been exceedingly difficult due to the fact that the tide lands consisted of deep mud deposits, making operation of any instrument almost impossible. It was therefore decided to use aerial photography with multiplex for accomplishing the job.

Specifications were set up for ground control, photography and multiplex work. It was felt necessary to be able to spot elevations on the ground to the nearest 0.5 of a foot which in turn required a multiplex mapping scale of 100 feet to the inch. Using this large scale, 0.1 of a millimeter would equal 0.4 feet, and with sufficient control it was felt 0.5 foot accuracy could be accomplished whereever the ground was sufficiently open to see. The photographic specifications called for two flight lines parallel to the center of the river; one flight of photographs at 1:12,000 scale and one flight of photographs at 1:3,000 scale.

The general plan called for setting up a base line across the project 2,000 feet in length for purposes of establishing horizontal control up and down the river on as many points as possible, such as trees, houses, barns, dolphins, etc. This control was set up and points established on the 1:12,000 photography for purposes of over-all horizontal control.

Inasmuch as topography and elevations were required only along the banks of the river, it was decided to control the map work vertically by using the level of the river at low tide. The exact instant of photography was determined and computations were carried out to determine the exact level of the water in reference to mean, lower low water at this instant. Actually, photographs were successfully obtained when the water was 0.2 of a foot above mean, lower low water so that practically all of the tide lands were showing.

The photography of this project was contracted to Delano Aerial Surveys of

Portland, Oregon, and the work was done with a K-17 six-inch focal length camera at a shutter speed of 1/300, an aperture of F-8, with a plane speed of 135 mph. The original fears of distortion due to inability of stopping motion at this scale were unfounded and very clear photography with an extremely minute detail of ground shapes was obtained. It was found after setting up models on this job that stereoscopic perception on the river bottom to a depth of about 15 feet was possible and that soundings could have been made by correcting for the light refraction of the water.

Some difficulty was found in establishing ground elevations by multiplex along the dikes above the tide flats due to the prevalence of heavy grasses. To reduce this source of error to a minimum, notes were kept in the course of ground control work regarding the exact height of grasses in various portions of the area. As a result, the precision of the work was well within the limits as indicated for the job.

Obviously the procedure used is applicable only where the ground is not overly obstructed by heavy vegetation or timber and where the topography of the surrounding country permits safe flying at elevations of 1,500 feet above the terrain. The cost involved for this type of work approximates $\frac{1}{3}$ of the costs of doing the work with differential levels and plane table, and also permits mapping of areas such as mud flats and tide lands where it is impossible to carry out ground instrumental work. The technique should have wide usage wherever good leveling is required in open or cleared land where differences in elevation are not excessive.

A FUNCTIONAL COMPARISON OF STEREOSCOPIC PLOTTING INSTRUMENTS

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ON SEVERAL occasions, various organizations and individuals have contacted representatives of the Bausch & Lomb Optical Co. to discuss the possibilities of our developing for manufacture, various photogrammetric and particularly stereoscopic plotting instruments for aerial surveying. It has seemed strange to some that we did not immediately embark upon development for manufacture of each new photogrammetric instrument, its optics or other components when presented for development. The reason may be simply found in the fact that the number of problems and personnel required to develop an instrument, even from an operating prototype to a manufactured instrument, are as multitudinous as those in developing the prototype. To develop such instruments for manufacture also requires that each instrument of a given type when manufactured must meet the same manufacturing specifications as to quality and function. Then only is the user of the equipment assured of consistent performance for each instrument he secures. Only then, also, can he safely base economic commitments for funds to secure equipment and personnel to operate a successful mapping organization. This latter continuity specification is a major cost—often overlooked—in the manufacture of such instruments by small instrument shops, besides the usual costs of material, of labor, of factory operations, of engineering, of administration, of distribution, and of operating capital. There has been, likewise, a need expressed by several members of the Photogrammetric Society for a readily available and compact summary of the functions of stereoscopic instruments, such information often being remote and