Similarly, numerical values for cos mx', cos my', and cos mz' may be calculated by substituting known values in the original equations. In this case

$$\cos mx' = +\ .99894390$$

$$\cos my' = -\ .04308369$$

$$\cos mz' = -\ .01540865$$

and with these values, the direction of the relative tilt on the oblique photograph may be determined from the relation

$$\tan s = \frac{\cos mz'}{\cos nz'} = -\ .01745430 = 179^\circ\ 00'\ 01''$$

The above calculation was based on data from a pair of fictitious photographs prepared for this purpose. It is interesting to note that the calculated values agree with the known values to within less than thirty seconds of arc in all cases.

	Correct Value	Calculated Value
t	62° 00′ 00″	61° 59′ 59″
s	179° 00′ 00″	179° 00′ 01″
α	2° 00′ 00″	2° 00′ 25″

*The Galileo Santoni Stereosimplex Model III**

GEORGE D. HARDY, *Photogrammetric Engineer, Abrams Aerial Survey Corporation, Lansing, Michigan*

Before starting my remarks on the Stereosimplex, I will describe the background and reasons for the design of this instrument.

Like all other instruments produced by the Galileo Corporation in Florence, Italy, the Model III was designed by Professor E. Santoni. He for a number of years has been one of the foremost advocates of the production and use of first-order plotting instruments.

Professor Santoni made the following comments on the general criteria which inspired the design of this new plotting instrument: "With the remarkable advance in lens design and mechanical arrangement, the aerophotogrammetric cameras have considerably improved in recent years. The taking of pictures has nowadays become an easy and reasonably cheap task. A few hours flight is today sufficient to get photographic record of very wide areas."

"Also, in the production of first-order plotting instruments a considerable progress has been made, so that the use of aerial views has become much more rigorous than it was some years ago; technical and high precision maps are produced out of pictures taken from higher altitudes than those used about ten years ago; while, when using first-order instruments for aerial bridging, which is the foundation of every aerial triangulation, a degree of precision is achieved, which was not possible a few years ago.

"Notwithstanding this, the application of photogrammetry for systematic works of a precise nature is not so wide as was to be expected. On the contrary, the remarkable bulk of work done using methods of lower order accuracy leads many unquali-

* Presented at the autumn meeting of Ohio Section, American Society of Photogrammetry, held at Ohio State University, October 28, 1955.

fied people to think that photogrammetry is a low quality topographic method. This situation is due to some deficiency still existing in the present means and methods.

"The lack of diffusion of the aerial triangulation methods, which are the only ones capable of resolving practically the problem of cartography in many countries where maps are required quickly and at low costs, is probably due to insufficient coordination of research. The initiative taken by a Belgium group within the OECE should succeed in selecting, perfecting and diffusing the aerotriangulation activities for which the tools are ready.

"The normal applications of photogrammetry for technical, town planning, cadestral maps and etc., do not require the study and choice of special working methods; notwithstanding this, there are many countries where little or nothing has been done. The application of photogrammetry will spread only when the plotting instrument has become a normal working instrument, and every user can dispose of a sufficient number of apparatuses easily operated and of low cost. This means that the plotting instrument suitable to carry out maps at the technical and precision scales must be as simple as possible, easily operated (so that it does not require too skilled operators), and of a low cost, as today all the instruments used for works of a lower precision order are.

"I have been designing photogrammetric instruments for over thirty years. I have been following, for over thirty years, the instruments made by Officine Galileo in the various activities and countries where my plotting equipments are used. I have therefore the opportunity of convincing myself that the design of the Stereosimplex Model II, with some convenient changes introduced into the Stereosimplex Model III, is suited to obtain the aims I am looking at, i.e.:

"(1) to obtain a sufficient precision for the maps at technical scales out of pictures taken at an economical flying altitude;

"(2) to obtain a low production cost with no loss of precision and few limitations in use.

"I am sure this will contribute to a large diffusion of the photogrammetric methods, an increase of the equipment in operation, a reduction in operating cost and a higher quality of the final product."

With the above use in mind, Professor Santoni proceeded with the design of the Stereosimplex Model III. I will describe the instrument.

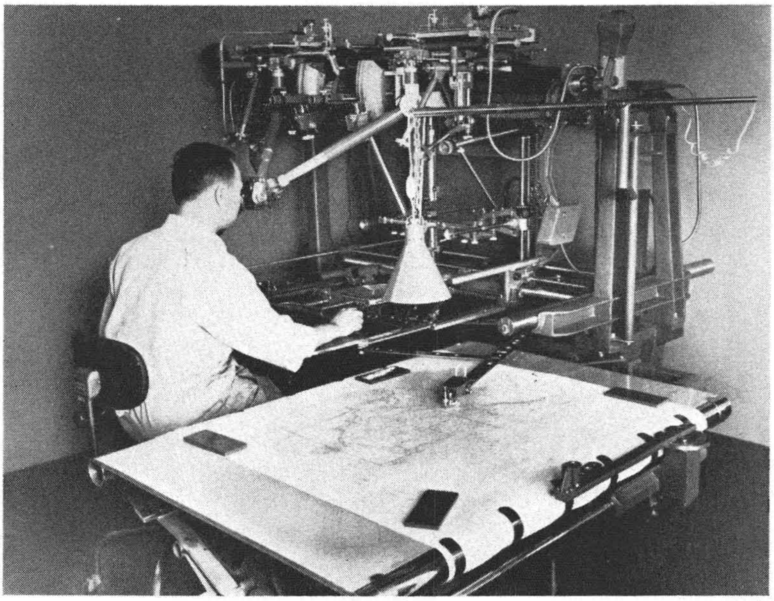
The Model III is a first-order photogrammetric compilation instrument, with mechanical representation of visual lines, moving photographs and fixed observation. The instrument employs contact diapositives, thus making it possible to obtain the precision required for large-scale maps from pictures taken at comparatively high altitudes. It also allows a remarkably large range of enlargement and reduction between the photo-scale and the final map scale.

The homologous lines from columnated point to the camera lens are accomplished with two tubular rods, which pivot around the projection centers. Each of these rods is prolonged beyond the projection center inside the camera by means of a sliding rod or pin. The end of the pin is connected with the plate holding the frame, by means of a ball joint. This joint is provided with the cam for correction of lens distortion. These correction cams are approximately $\frac{1}{4}$ of an inch in diameter and are ground to the exact distortion of the camera lens of the particular taking camera used. This one feature is of a considerable advantage in that a mean curve is not used to correct the distortion; instead a curve in accordance with the actual lens distortion is used. Because a pair of cams for the Stereosimplex Model III costs only $40, obtaining an exact distortion correction system is very economical.

The plate-holding frame moves in its own plane guided by a cross rail system.

The columnating optical system is located directly under the diapositive. The illumination of the viewing area, approximately 20 mm. in diameter, is obtained by a fixed electric bulb just above the diapositive.

The system contains optics which have two reflections before the floating mark and three after it. None of the optical parts preceding the mark undergo any change of position during the formation of the model or during the plotting. The other optical devices are completely motionless during plotting. This fixed optical system makes possible the high stability of the optics at all times, and contributes considerably to the lack of difficulty in maintaining precision calibration of the instrument.



The diapositive is centered in the plate holding frame by a supplemental centering device which is furnished with the instrument. The plate holding frame can be moved closer to or farther from the projection center, and can be set at any distance from this center, between 125 mm. and 215 mm. This and other adjustments to the plate holding frame permits using cameras of focal lengths from 98 to 220 mm. Diapositives of any size up to $9\frac{1}{2}\times 9\frac{1}{2}$ inches can be used.

The maximum angular field of the plotted photograph is 92 degrees.

In order to vary the plotting base, each camera can be displaced as follows:

Total *bx* component 400 mm. Total *by* component 80 mm. The *bz* component of the base is introduced in the coupling carriage. Differences of 40 mm. between the two cameras can be used. The movement of the *XY* plane of the carriage can be accomplished directly with an adjustable arm, for rapid scanning of the model during orientation, or through a pantograph with a reduction of 10 to 1 or 6 to 1, for final completion.

The carriage to which the tubular rods are fastened is used for the terminal of the movement of the pencil point. The movement of this carriage is limited to the following: *X* plus or minus 300 mm., *Y* plus or minus 400 mm.

The movement of the *X* and *Y* plane of the carriage can be read directly on glass scales or can be used for plotting by attaching the pencil point in a direct movement from the *X* and *Y* carriage. This movement can also be reproduced on the tracing table through the use of a pantograph which will make possible the following enlargements or reductions from the original photo to plotting scale: The model is established at 0.5 to 4.5 enlargement. These ratios combined with a pantograph ratio to the drawing table, which can vary from 1:33 to 3.3:1, permits a plotting scale of 1/7 to 17 times the original photo scale. The plotting, either by direct or pantograph method, is accomplished on a table which is 34×50 inches and is located to the right of the operator and is immediately adjacent to his position while accomplishing the plotting.

The position of the drawing table is extremely convenient to single operator procedure; however, it is possible to use two technicians if so desired.

The *X* and *Y* movements are obtained by using the right hand to move an arm in an *x* and *y* direction, thereby making it very similar to the plotting methods of the Multiplex or Kelsh.

The *Z* movement is obtained through a wheel which is operated by the left hand. This wheel moves a drum which is calibrated in both meters and feet and can be adjusted in accordance with the model scale by changing gears in the Z wheel movement. The maximum excursion of the Z carriage is 325 mm.

We have found that the instrument can be operated and meet standard map accuracies using C factors of from 1,500 to 2,000, depending upon the type of terrain and control available.

From the operators standpoint, the instrument seems to be very satisfactory. The resolution in the instrument is extremely satisfactory and all of our operators feel that they can obtain as near an absolute orientation as is possible using this instrument.

A fair Multiplex or Kelsh operator can start to produce after approximately 16 hours practice, and will produce with about 50% efficiency for the first 100 hours. After 200 hours he should be able to produce a product of normal requirements.

The instrument requires a floor space of approximately 10×12 feet and need not be operated in a completely dark room. However, subdued light is advantageous to the operator's eyes.

The Abrams Aerial Survey Corporation of Lansing, Michigan now has in operation two Galileo Santoni Stereocartographs Model IV, and one Stereosimplex Model III. Also on order from the factory in Florence is a Stereosimplex Model III that will be capable of taking 20 degree convergent photography. We expect delivery about the first of the year and have high hopes that it will be possible to plot topographic maps using "C" factors of 2,500 to 3,000.

*A Method of Shoreline Delineation**

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SYNOPSIS: *This is a presentation of an empirical method of determining the usual (or mean) high water line on both beach and rock shore line. Evidence is presented as proof of the accuracy of the method, and mention is made of the consistency of results when the method is applied. Because the criteria are based on a combination of photographic tone, texture, alignment patterns and small indistinguishable object images and their shadows, it is claimed to be applicable to most circumstances. All the criteria may not be present. Selection of the few illustrations is based upon proximity of beach and rock shore lines with additional evidence in the vicinity presented for verification of the conclusion. The area has been independently compiled from prints of the same exposures a sufficient number of times to afford a check on consistency of interpretation. The above conditions have limited the selection of illustrative material. The illustrations are believed to offer about average difficulties. The text contains the keys to letters and numbers which appear in the illustrations.*

PURPOSE

A NUMBER of state and federal agencies delineate shore line as part of their photogrammetric compilation responsibilities. Others use such compilation in pursuance of their duties. In addition there are a number of independent map contracting agencies which are faced with the problem of shore line delineation. Finally, a knowledge of a compilation method of this detail

* The opinions and assertions contained herein are the author's and are not to be construed as official or reflecting the views of the Navy Department or the Naval establishment. The Office of Public Information, Dept. of Defence has evidenced that there is no objection to publication on grounds of military security.