OBSERVATIONS ON CAPTURED GERMAN MAPPING EQUIPMENT

A. M. Wilson

IN ORDER to make a first-hand study of German mapping instruments, U. S. Army topographic troops in E.T.O. were notified of the importance of being on the alert for any possible leads as to where such equipment could be found. Leads were obtained in many ways but the most productive results were obtained by the interrogation of enemy personnel and the examination of captured shipping lists. In one case the opening of a safe by a bomb disposal squad disclosed a receipt for geodetic data that proved to be a valuable lead.

The actual finding and gathering of the material furnished many unusual experiences and lead the searchers down many a winding trail. Equipment was found in candy factories, doll factories, in private homes, and garages. Some instruments were located in salt mines, barns, caves, and in potato cellars. In one instance a pile of instruments, like the needle, was found in a haystack. One batch of control data was found neatly stacked on a pile of skeletons in a crypt beneath a monastery. Only one instrument, a stereoplanigraph, showed evidence of having been sabotaged and no instruments were found booby-trapped.

All instruments to be returned to this country were duly packed for overseas shipment, the simpler instruments being crated by our own troops or by such other means as were available. In packing and crating the more elaborate equipment the help and advice of German experts were secured. The fact that practically all the equipment arrived in good condition is a credit to the personnel who did this work just before and after V-E day under extremely trying circumstances and during a most confused period.

A majority of the mapping instruments received in the United States were shipped to the Engineer Board for purposes of inspection, cataloging, and evaluation. Each instrument has been or will be carefully inspected and tested to find any unusual design features or new ideas that may be incorporated in future Army equipment.

Observations in the field and analysis in the office indicate that very little photogrammetric progress was made in Germany during the war years. The only instruments found that had not been extensively used there before the war were the slotted templet equipment and the camera lucidas. Before the war in a comparatively small and well mapped country the need was for very accurate and large scale maps compiled with the more elaborate instruments. However, when trying to conquer a very poorly mapped world, the simpler though much faster methods had to be used.

Figures showing some of the most interesting pieces of this captured equipment, with descriptions, are reproduced on the following pages.

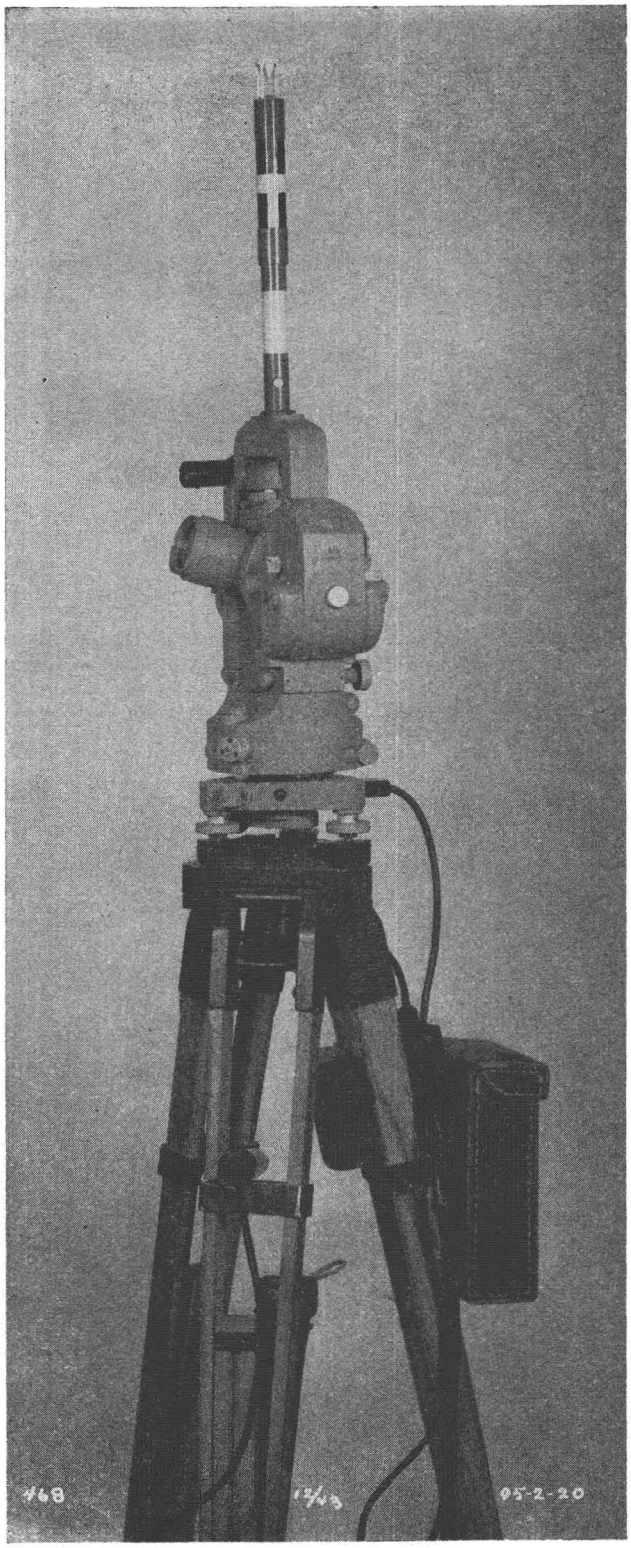

FIG. 1. This Zeiss, model 40 theodolite is the standard German Army instrument. It weighs but $10\frac{3}{4}$ pounds, which is less than an ordinary surveyor's transit. The $3\frac{1}{4}$ inch diameter circles are read to one second of arch on a built-in optical system that balances the values on opposite sides of the circle, thus eliminating any small errors due to eccentric mounting. The instrument is equipped with an electric lighting system for night work, and with a special target mounted above the telescope as a mark for other instruments. An optical plummet, or vertical collimator, is used for setting over the point.

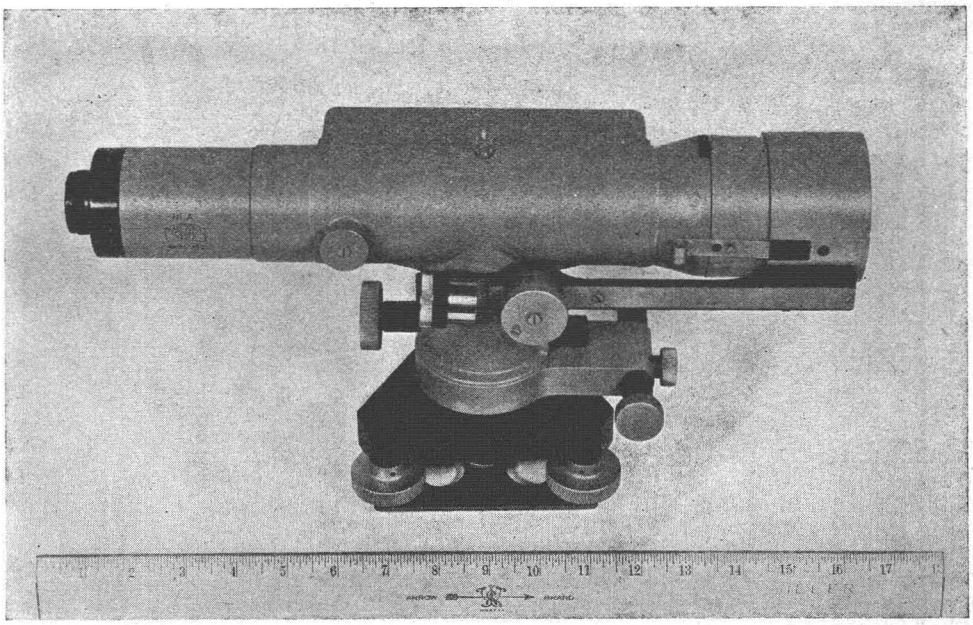

FIG. 2. The Carl Zeiss model B precision level. The weight is approximately 4½ pounds and the telescope has 32 power magnification. It is a tilting type instrument using a bulls-eye bubble for approximate leveling. For accurate leveling of the telescope, both ends of a tubular vial bubble are viewed through a special microscope and brought into coincidence by turning the telescope tilting knob.

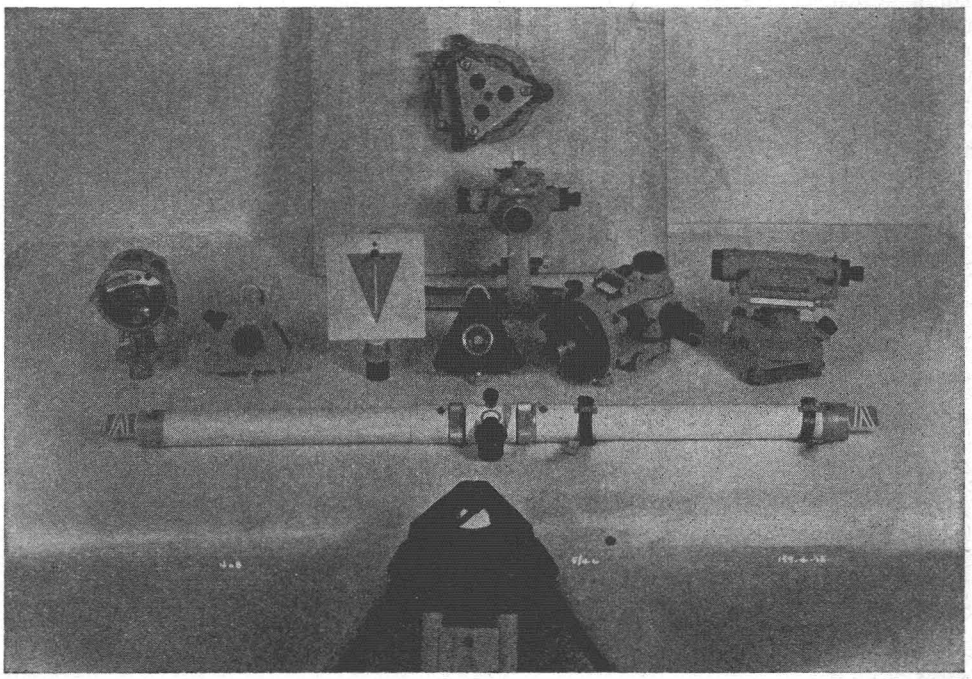

FIG. 3. In the foreground of this picture is the top of a standard Zeiss tripod. The other instruments are all usable with this tripod. Instruments shown are a one-second theodolite, a precision level, a plane table board and alidade, a subtense bar, target, and target signal lamp. This interchangeability between the theodolite and accessories is a big help where transportation is involved, as well as being a time-saver during survey operations.

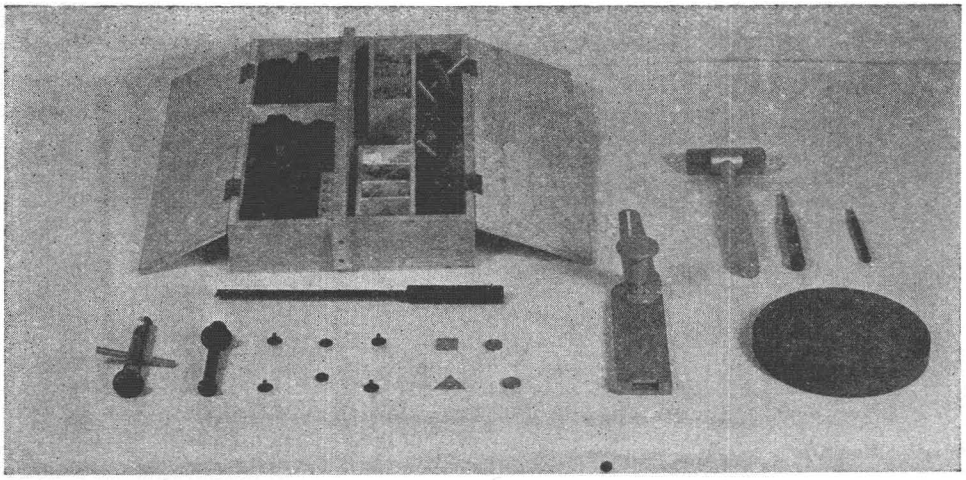

FIG. 4. The German slotted templet set. The studs are black painted aluminum about ½ inch high. Rubber washers are furnished to fit over the studs and by means of the washer applicator, shown just to the left of the studs, may be pushed down so as to hold the templets tightly together. The washer removing tool shown in the extreme left foreground has two tapered prangs that slip under the washer and a plunger that is pressed to pull the washer from the stud. A slot lengthener just to the right of the case is used to extend a slot either toward or away from the center while the templet is in place on the assembly board. The long spatula-like tool just in front of the case is used to hold a stud while it is slipped under a templet and into position. The disc is a linoleum covered block used as a support for the templet while the center hole is being punched. Two center punches are furnished. The small one at the upper right is driven through the templet with the plastic-headed hammer. The hand operated punch, shown just to the right of the hammer, is centered on the templet by means of a spring held needle and as the handle is pushed down a driving spring is cocked. Continued downward pressure releases the cocked spring and drives the punch through the paper templet.

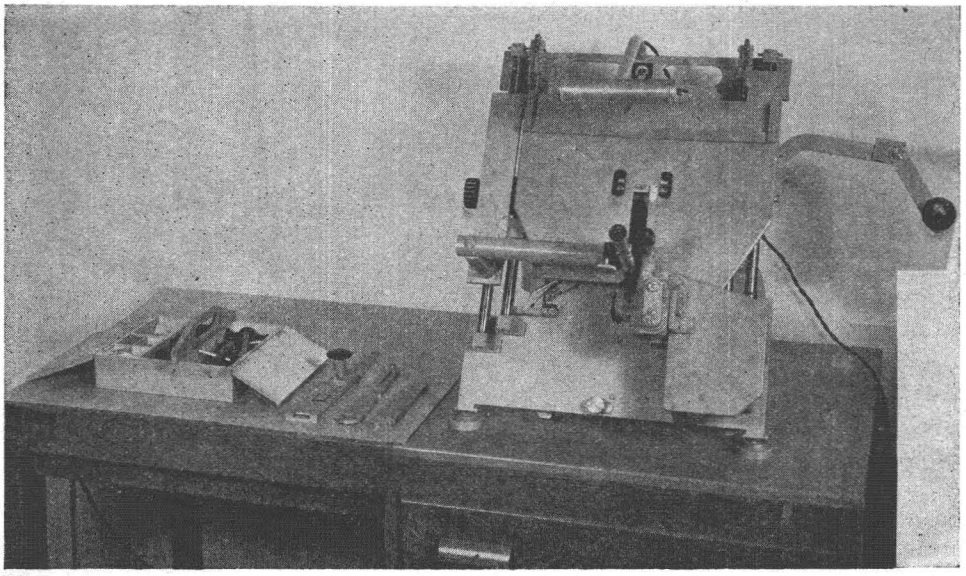

FIG. 5. A Zeiss scale-ratioing slot cutter, also for use with the standard slotted templet set. It is designed for making templets from 18×18 cm. or 30×30 cm. photographs or for work with aerial photographs obtained with the recently developed German Pleon lens. With conventional 18×18 cm. photographs, scale ratios of from 0.7 to 1.7 times the scale of the photos are possible. With 30×30 cm. photographs, the range is from 0.8 to 1.3. Scale ratioing in the instrument is accomplished by means of a mechanical linkage in the back of the instrument which automatically regulates the relative position of the slot cutter, microscope and center pin. For operation with the Pleon lens a linkage is used so that a slot will be cut at variably increasing proportional distances out from the center in conformance with the distortion characteristics of the lens.

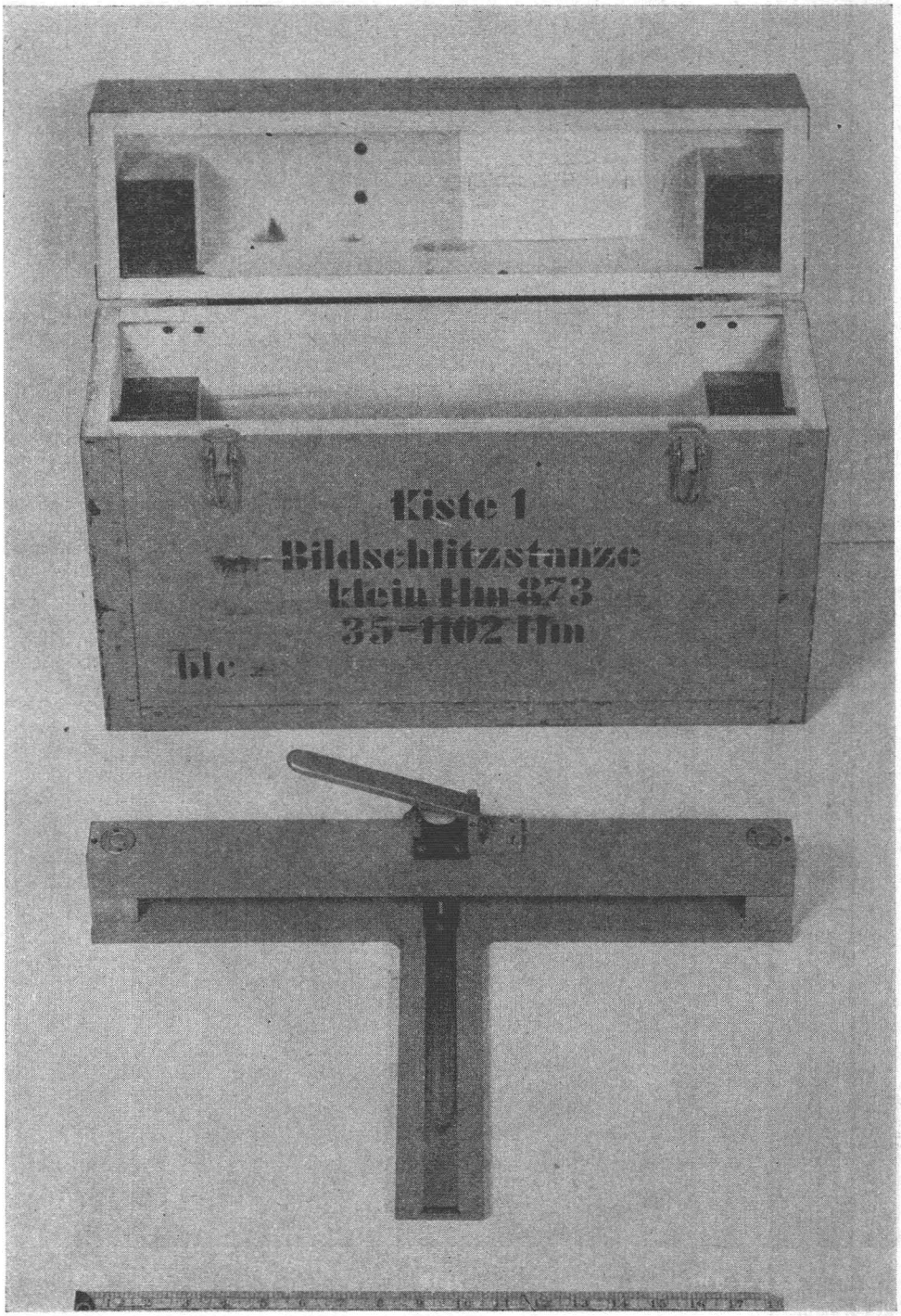

FIG. 6. This is a German slot cutter used with the template set illustrated in Figure 4. It is a handy compact cutter but cuts a slot only $1\frac{3}{8}$ inches long which seems hardly adequate.

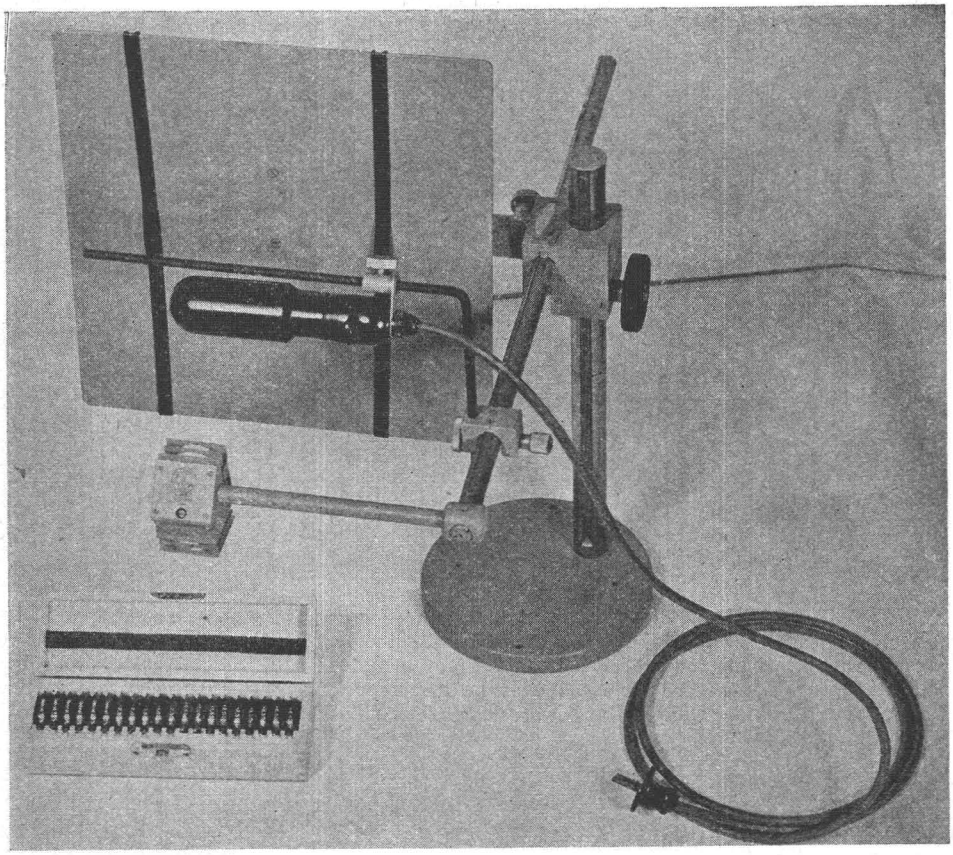

FIG. 7. A camera lucida, performs the same operation as our vertical sketchmaster. In operation an aerial photograph is placed on the photo holder and the entire instrument is placed over the area to be sketched or revised. The eye-piece of the instrument has a unique double prism which permits viewing the map and photo simultaneously thus superimposing the photo on the map. Scale change is accomplished by varying the eye to photo distance, and eye to map distance. The photo holder is mounted on a ball and socket joint to facilitate removal of small amounts of photo tilt. Lenses are furnished for inserting either between the eye and photo or between the eye and map so that both will be in focus though the distance is unequal. In addition, smoked filters are provided to balance the illumination of map and photo. When used with 9×9 inch vertical photos, the instrument has a range of from $\frac{1}{2}$ to $1\frac{1}{2}$ times the scale of the picture.

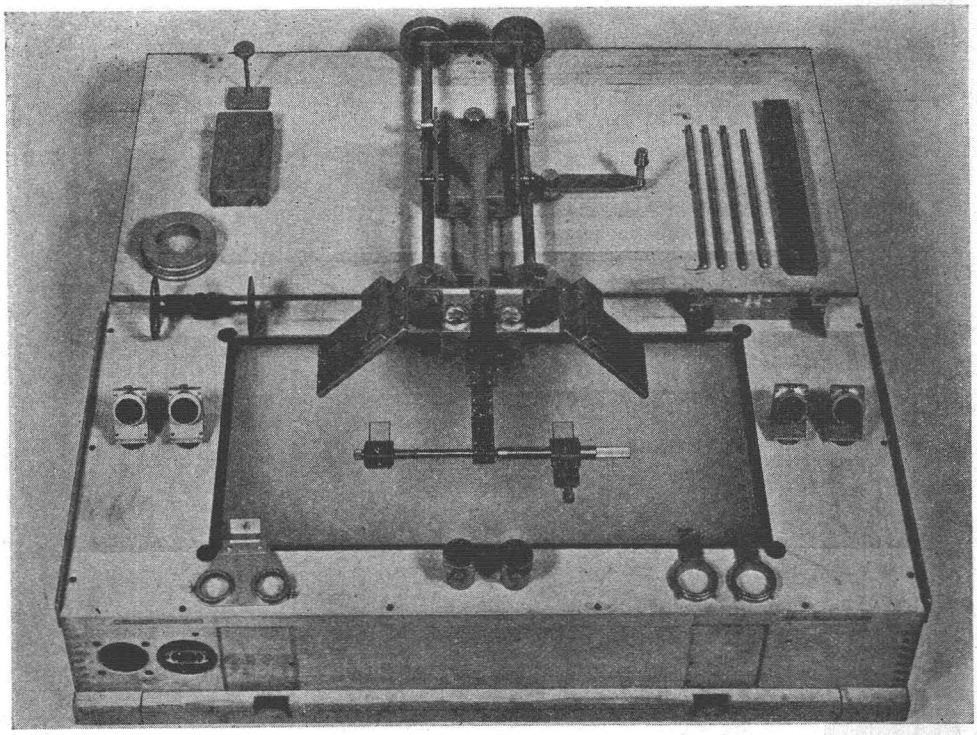

FIG. 8. The stereopantometer, performs the same function as the stereocomparagraph. Its most unique feature is the method of obtaining parallel motion. A roller guide consisting of two long axes with rollers mounted at each end affords movement in the longitudinal direction. A roller mounted carriage riding these two axes moves the stereoscope and floating dot normal to the line of flight. The stereoscope and parallax bar are detachable and usable as separate items.

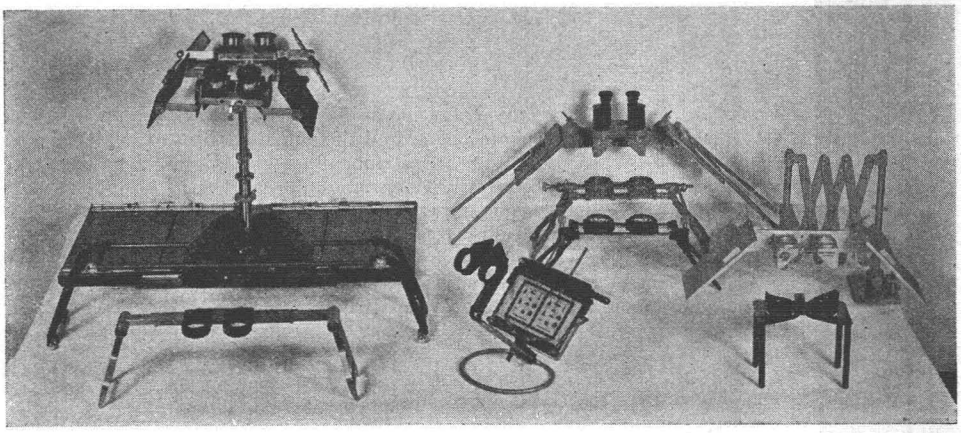

FIG. 9. A group of various types of stereoscopes. The tall double instrument at the left is of Italian manufacture and is apparently used where two people want to examine and discuss a stereoscopic pair together. The mirror stereoscope with adjustable bracket on the right makes a handy desk intrument that may also be used with legs or binoculars. When used in this manner it becomes the stereoscope shown in the right background.

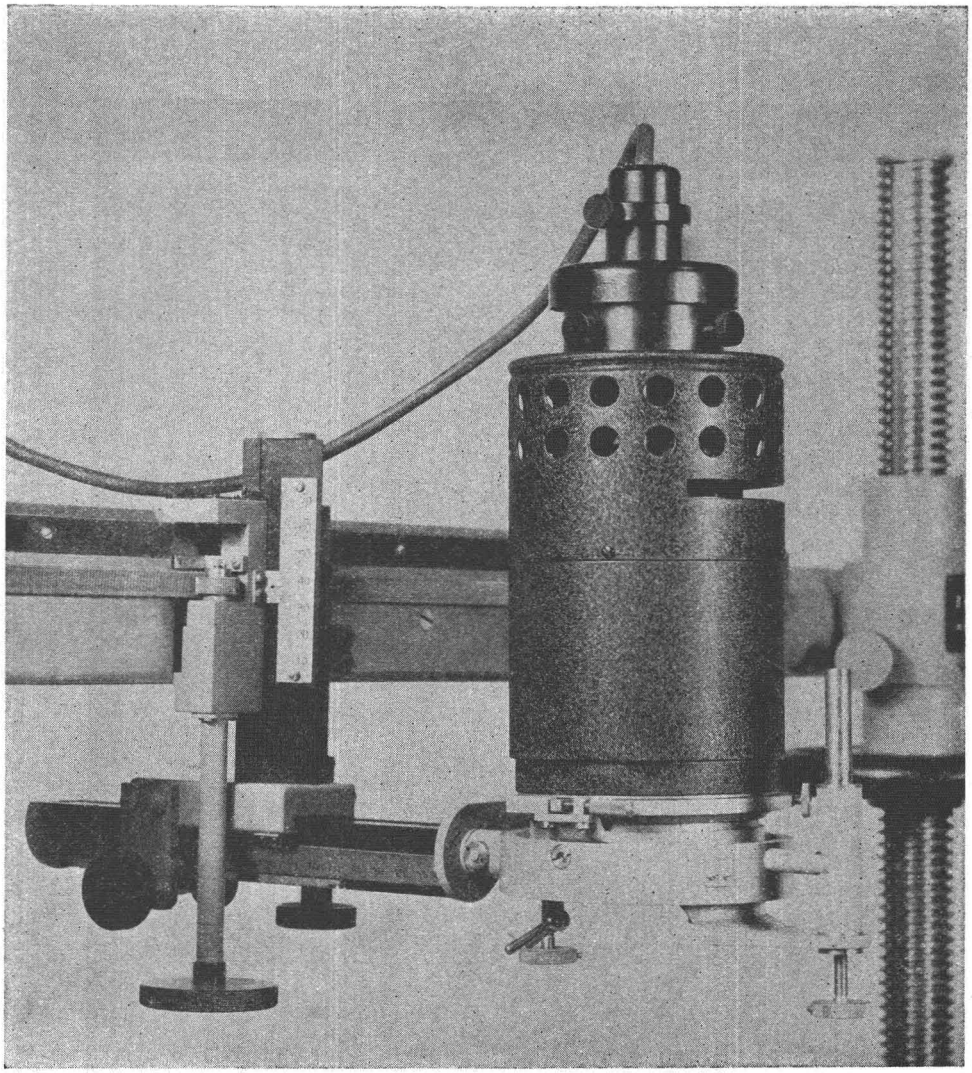

FIG. 10. The Zeiss wide angle multiplex projector. The mechanical design appears to be very similar to the equipment manufactured in about 1936 with the exception that they have lightened the weight of the slide system through the use of a light weight alloy, probably magnesium. Preliminary tests indicate that model flatness is inferior to equipment manufactured and used in this country.

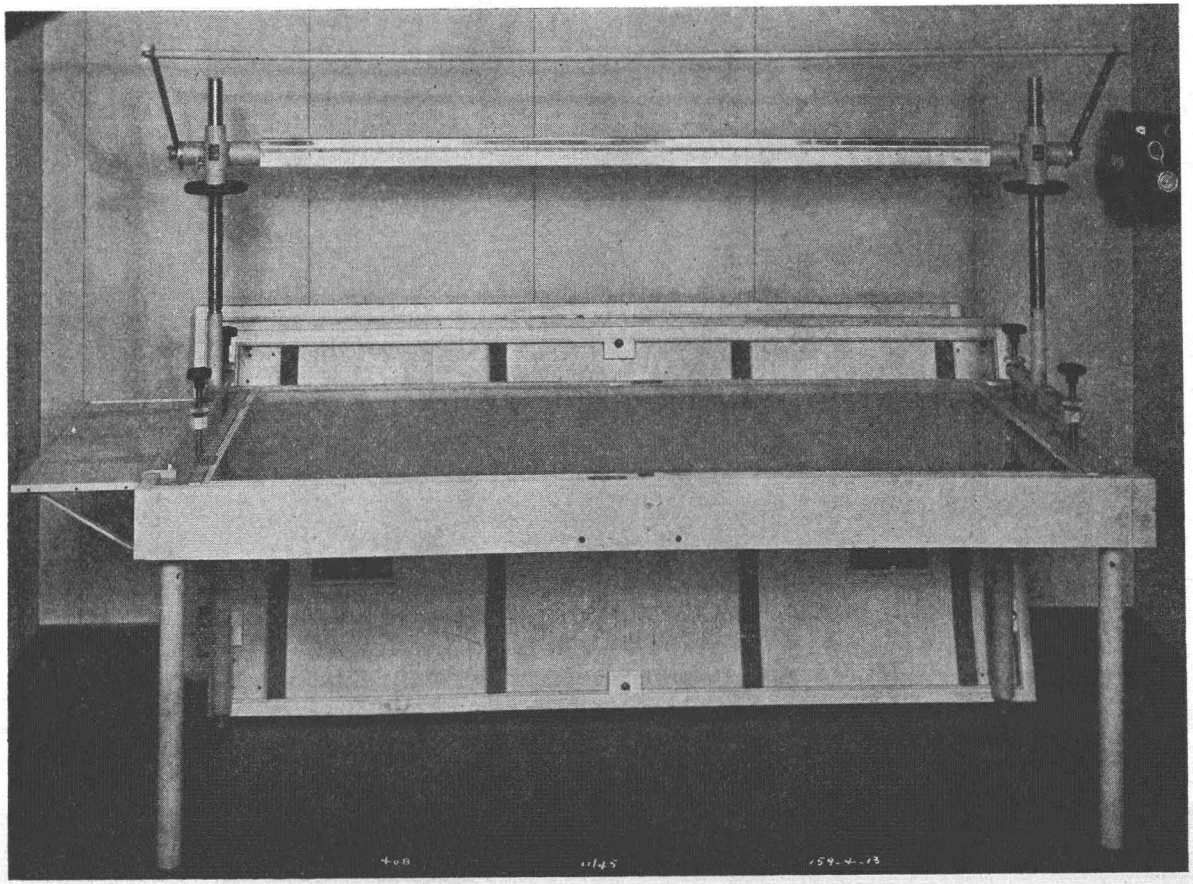

FIG. 11. German multiplex table and frame. The working surface is plate glass, ground on the bottom so that it can be used as a light table. The glass is supported on 8 pads which may be adjusted for leveling.

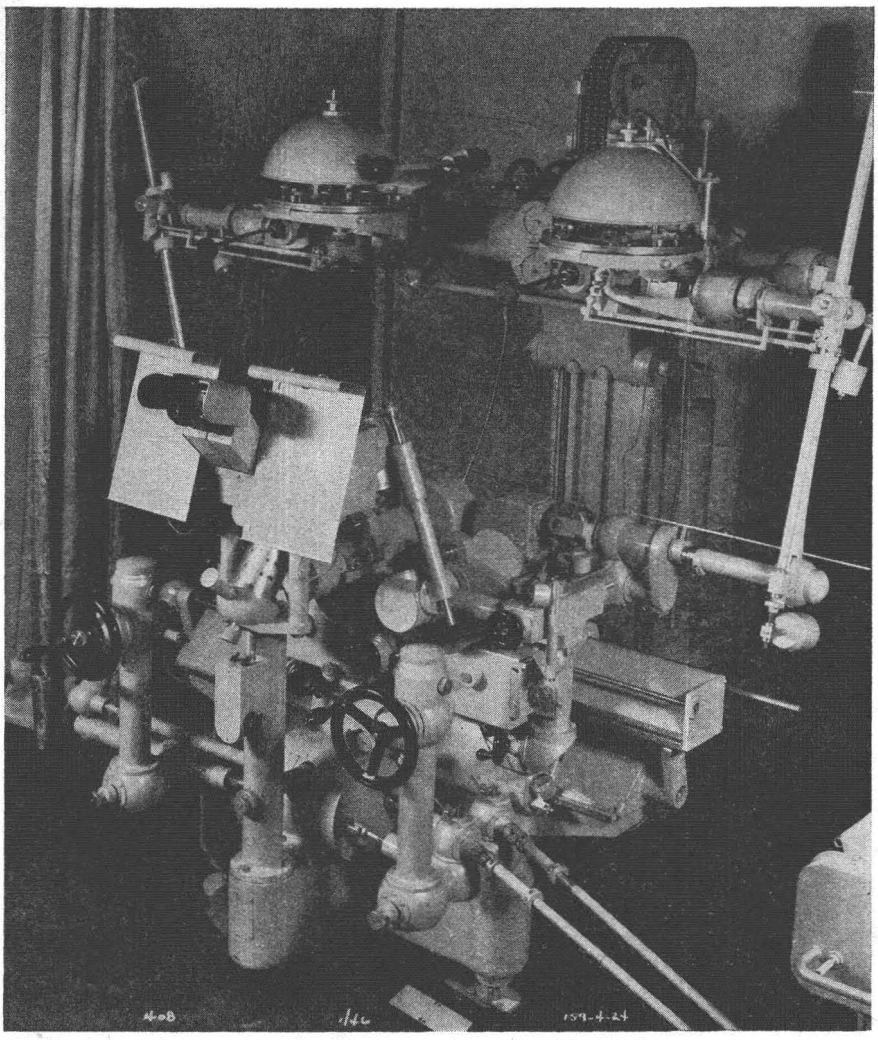

FIG. 12. The Zeiss Stereoplanigraph is one of the most elaborate and also one of the most universal instruments for the purpose ever constructed and used to any extent. The instrument as shown here is fitted with 100 mm. focal length Topogon lenses for use with photography from the wide angle Topogon cameras. Cameras for use with normal angle pictures are also furnished. Two handwheels and a foot treadle control the movement of the floating mark and at the same time operate the drawing attachment through the two rods shown at the bottom right of the picture. A gear arrangement permits drawing at scales anywhere from $\frac{1}{3}$ to 10 times the scale of the diapositives. Though it is especially interesting in connection with plotting from vertical aerial photographs, the instrument is equally useful with terrestrial pictures or with pictures having any amount of tilt. German photogrammetric engineers propose and practice the use of the stereoplanigraph for all aerial triangulation work in order to take advantage of its theoretical high accuracy. The multiplex is then used as an auxiliary for the detail compilation to control thus established.

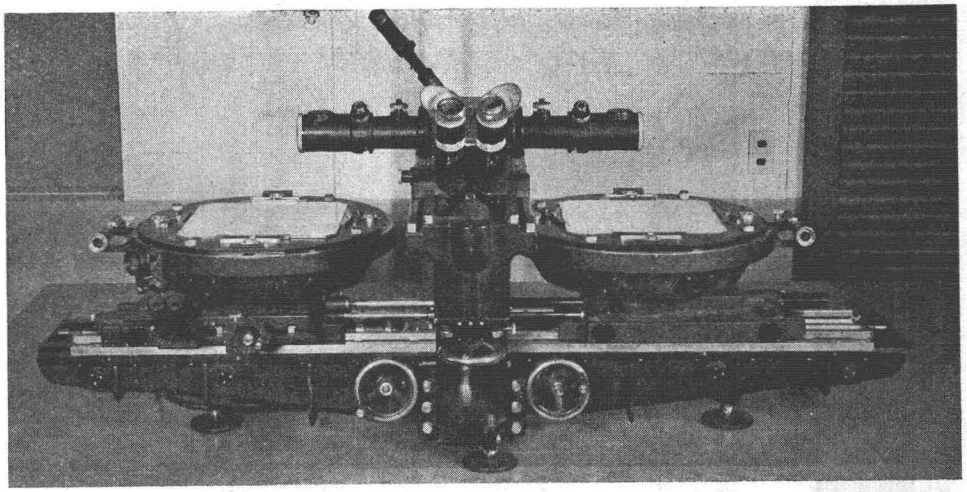

FIG. 13. A stereocomparator manufactured by the firm "Photogrammetrie" of Munich. The instrument measures rectangular coordinates and stereoscopic parallaxes on photographs up to 30 by 30 cm. Lamps provide illumination for all scales. A bank of 32 lamps beneath each stage furnish illumination for the photographs under examination.

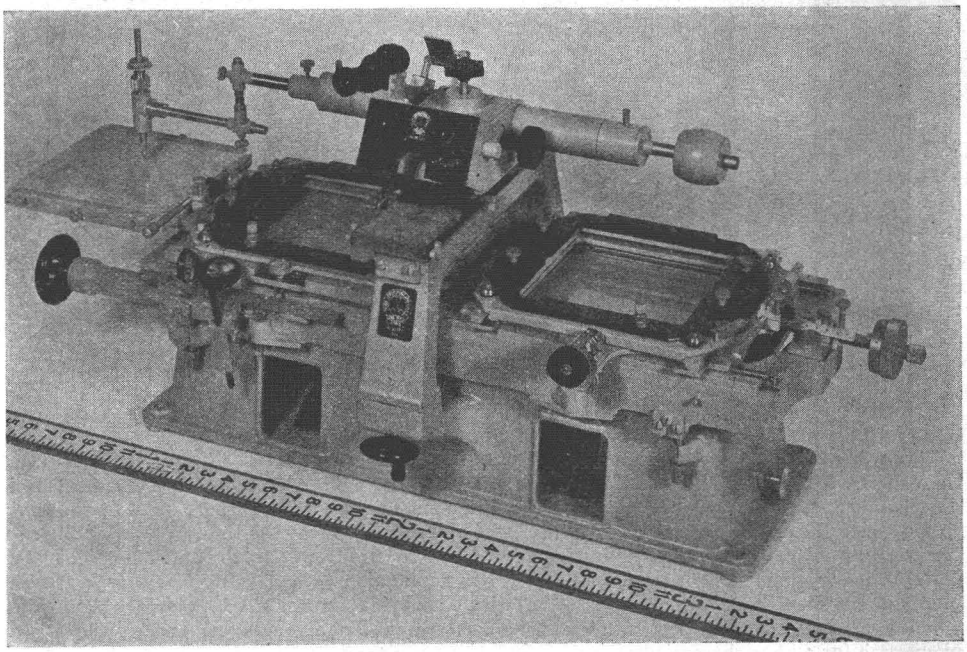

FIG. 14. A stereocomparator manufactured by Zeiss-Aerotopograph. All scales are readable through microscopes or mirrors so located that the operator has only to move his head slightly from an operating position. Coordinates and parallaxes on this instrument, as well as those measured on the instrument shown in Figure 13 are readable to .02 mm.

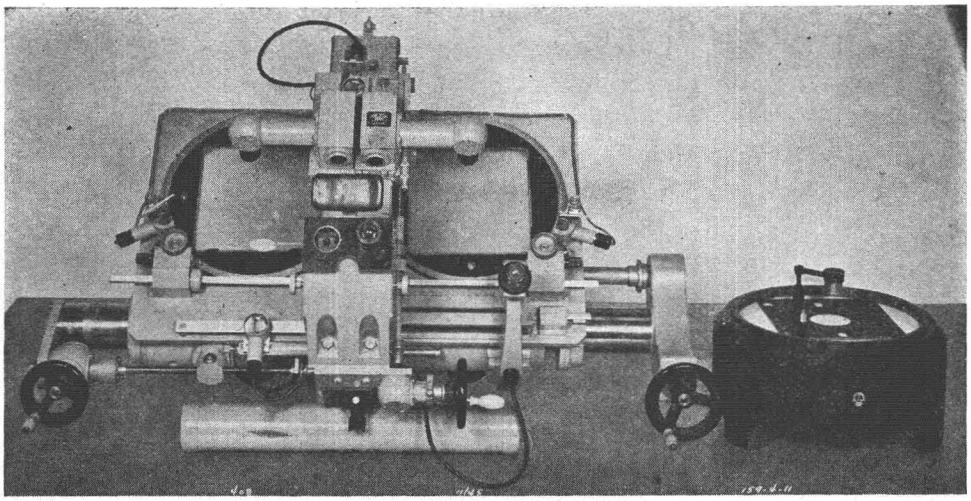

FIG. 15. A radial-triangulator used for measuring polar coordinates on aerial photographs for use in photogrammetric surveying by analytical methods. A linkage between the photo holders and prisms in the eyepiece maintain stereoscopic vision as the pictures are rotated. This triangulator is an improvement over older models in that it may also be used for measurement of rectangular coordinates and stereoscopic parallaxes.

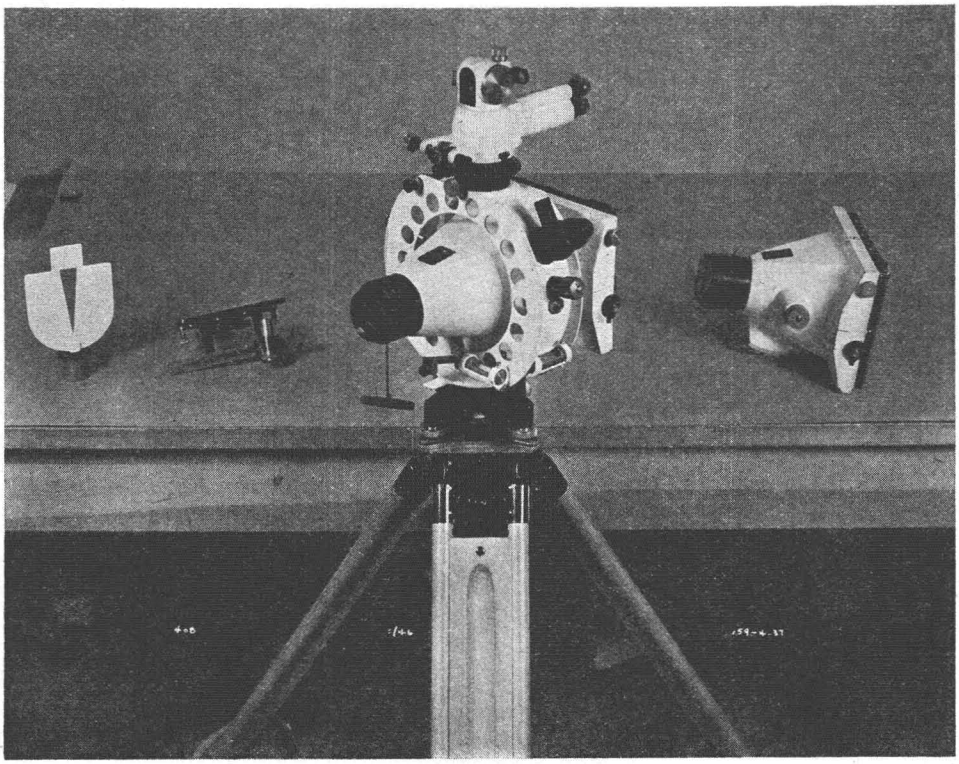

FIG. 16. A photo-theodolite manufactured by Zeiss-Aerotopograph, for use in terrestrial photogrammetrical surveys. Cameras of 25 cm. and 16½ cm. focal length are interchangeable and hold the same size glass plates in their focal planes. The target fits the same tripod as the camera. The accessory to the right of the target is a collimator used in aligning the optical axis of the camera with that of the telescope.

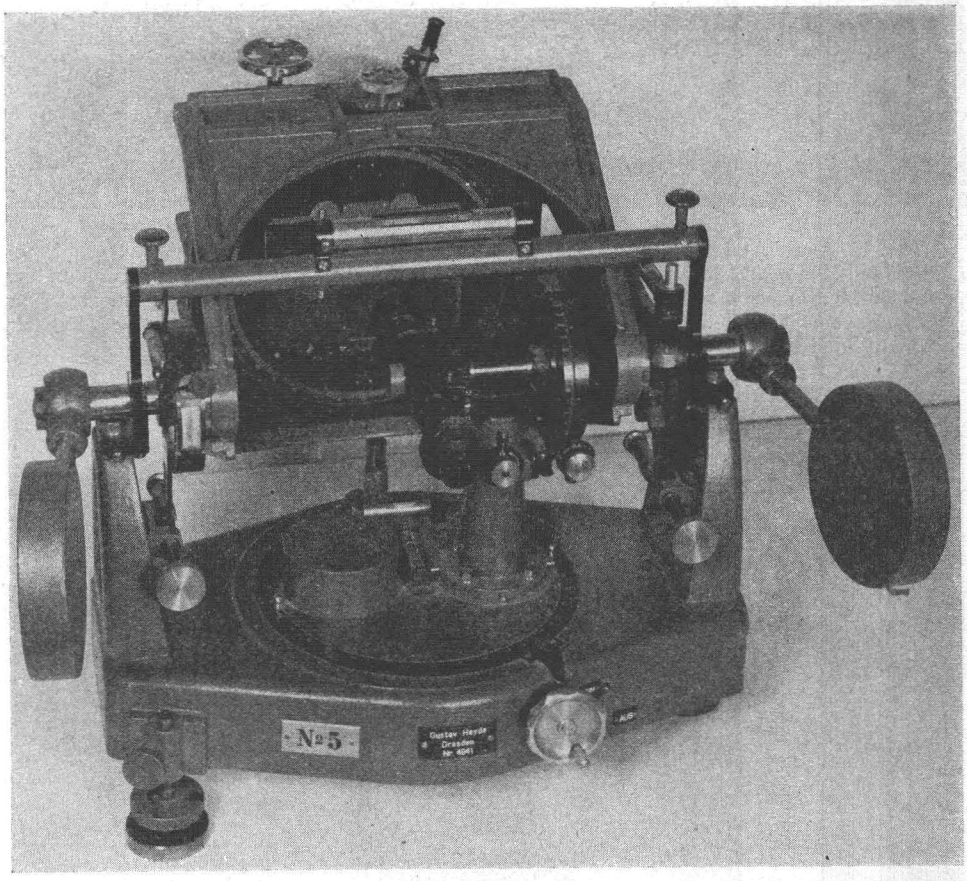

FIG. 17. This photogoniometer was manufactured by Gustav Heyde in Dresden and is used for measuring vertical and horizontal angles on terrestrial pictures. The sighting telescope may be plunged about a horizontal axis and is provided with a prismatic eyepiece which may be oriented for comfortable viewing in either the plunged or normal position.

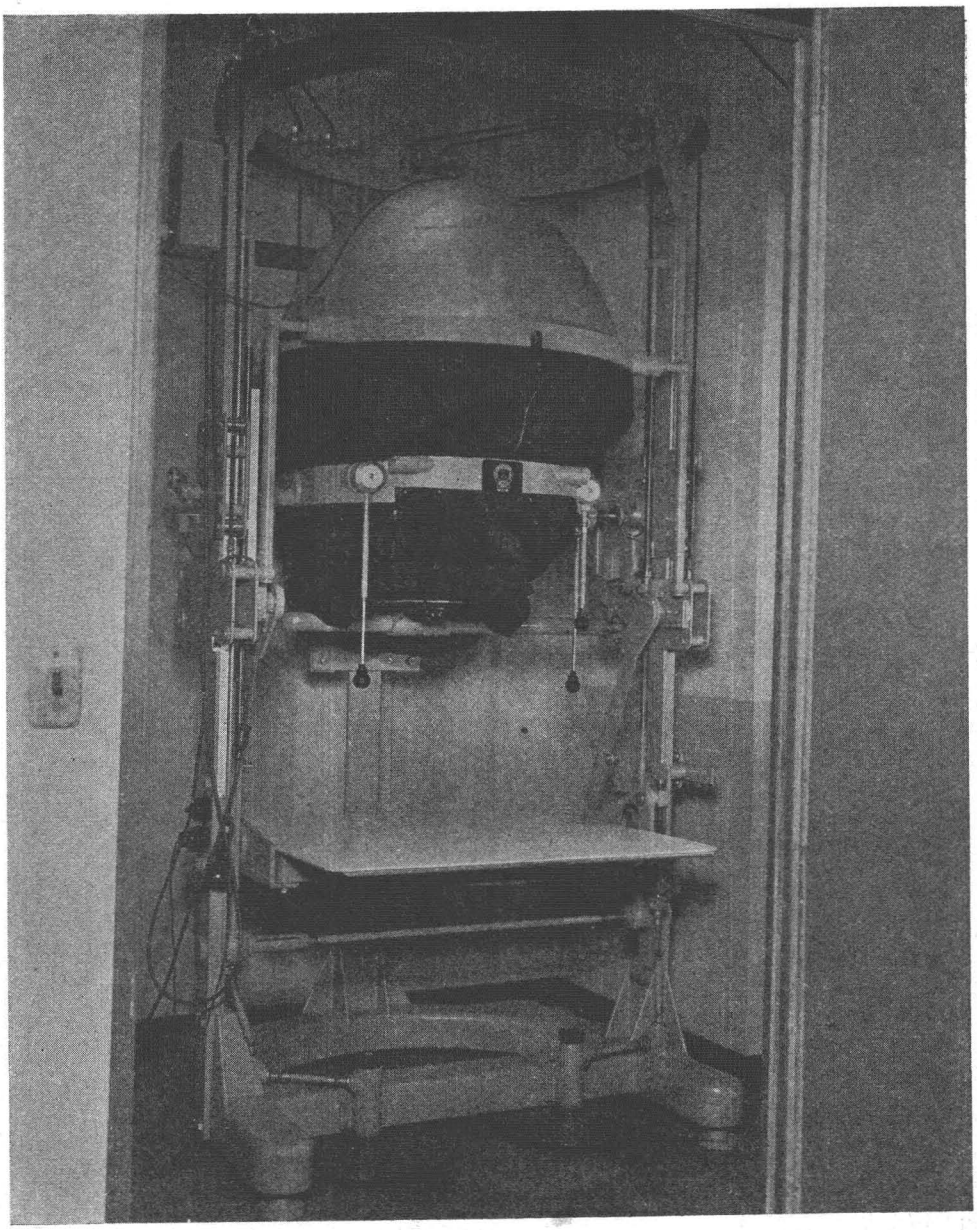

FIG. 18. Rectifier, model SEG I manufactured by Zeiss-Aerotopograph. It is used for the rectification of near vertical and low oblique aerial photographs in the preparation of controlled mosaics and photo-maps. It has provision for canting the aerial negative and easel about parallel horizontal axes, and for varying the spacing between the lens, negative, and easel planes. These motions are interrelated and controlled by invertors such that the projected image is in sharp focus at all possible settings. Graduations are provided on all motions so that settings can be made from precomputed data if desired.

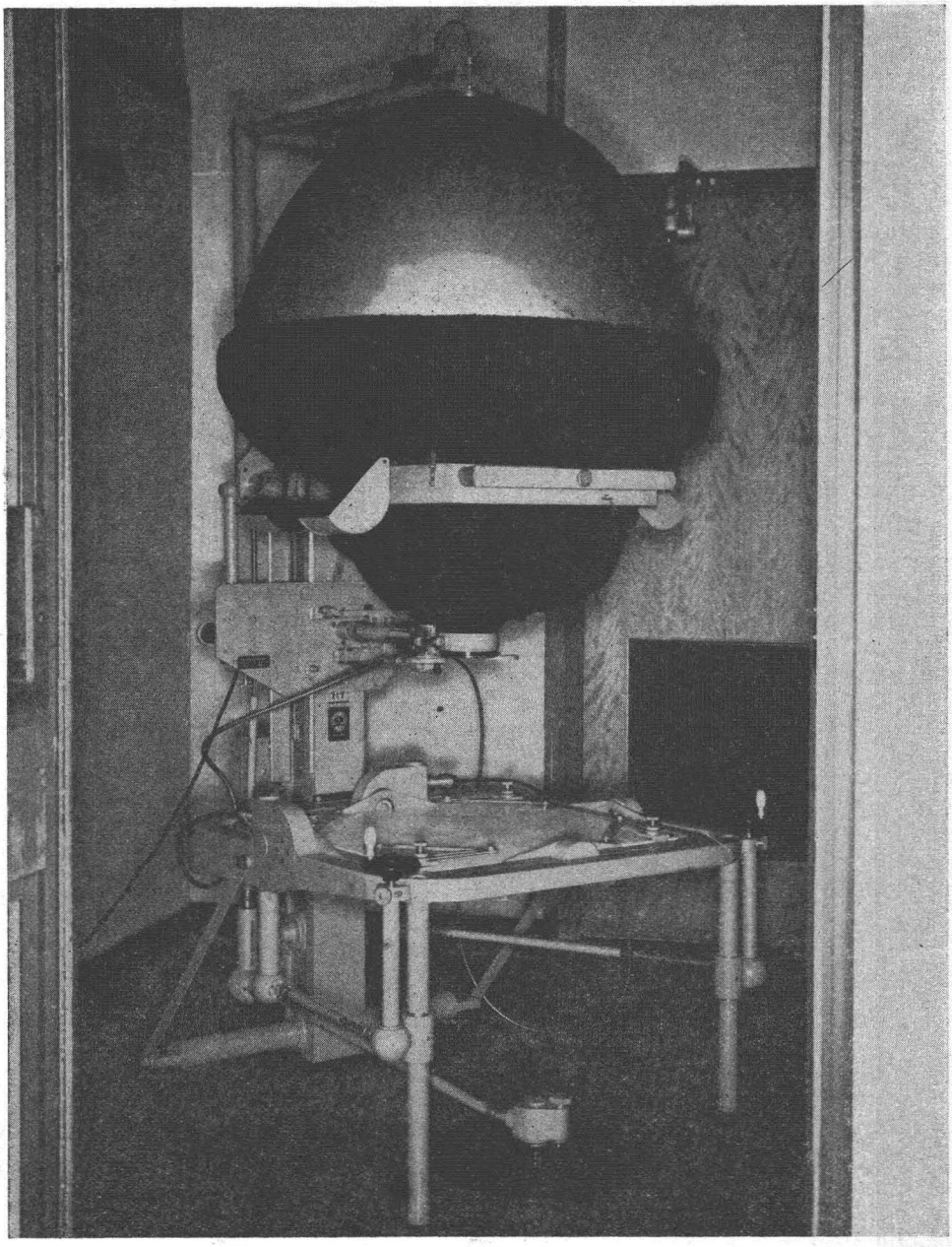

FIG. 19. Rectifier, model SEG IV, manufactured by Zeiss-Aerotopograph. It is also an automatic focus instrument but has no scales for setting to predetermined tilt data. Operation is accomplished by fitting the projected image of the photograph to a templet showing the desired, or true, position of at least four points per photo.