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		GERMAN ONE-SECOND THEODOLITES DOCUMENT IDENTIFICATION		

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Report 841

GERMAN ONE-SECOND THEODOLITES

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TECHNICAL STAFF
THE ENGINEER BOARD
Corps of Engineers, U. S. Army
Fort Belvoir, Virginia

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Report 841

GERMAN ONE-SECOND THEODOLITES

Project GNS 468

17 July 1944

Submitted to

THE ENGINEER BOARD

Fort Belvoir, Virginia

and/or

The Chief of Engineers

U. S. Army

Washington, D. C.

FOR OFFICIAL ACTION

by

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GERMAN ONE-SECOND THEODOLITES

I. DESCRIPTION OF THE ITEM

1. General. This report covers two captured German one-second theodolites. The two instruments are identical, except that one is equipped with a night lighting arrangement. The instruments were manufactured by Carl Zeiss, Jena, Germany, and are standard commercial instruments. The date or place of capture is not known. The German theodolites Model 40 and Model D, covered in previous reports, German Zeiss Theodolite, Model D, 15 December 1943; and German Military Theodolite 40, 15 January 1944, show appreciable improvement over the theodolite covered in this report. The improvement in the night illumination and the reading microscopes in these models is especially outstanding.

II. TECHNICAL FEATURES

2. Leveling Arrangement. The removable base is equipped with the conventional three foot-screw leveling arrangement. The foot screws are fitted to a trivet plate, which is clamped on the tripod head by a central hand screw.

3. Level Vials. The instrument base is provided with a circular level vial for approximate leveling. The plate level vial is mounted on the lower part of the telescope standards, and at right angles to the longitudinal axis of the telescope. The control level for final leveling of the telescope is a split bubble arrangement, mounted on the right telescope standard.

4. Circles. The circles are glass with etched graduations. Both circles are graduated to 20', giving a direct reading of 10' by the use of an index line. The horizontal circle is 2 3/4 in. in diam; the vertical circle, 1 7/8 in. The images from opposite sides of each circle are carried through the optical train to the microscope field, where the two reflected images of each circle are seen erect, one below the other.

5. Microscopic Scale. The microscopic scale is glass, with etched graduations. The scale has 600 divisions, giving a least direct reading of one second, with a possible interpolation to about 0.2 second. The scale is used in reading both circles and appears in the microscope field just below the reflected images of the circles.

6. Microscope. The microscope is estimated to be about 40X. It is mounted on the left telescope standard. The reflected images of both circles and the microscopic scale are visible at the same time in the microscope field.

7. Illumination. The illumination system for daylight use is the same in both instruments. The horizontal circle is illuminated by a prism arrangement on the bottom of the base plate. This arrangement extends about 3/4 inch beyond the edge of the base plate, and utilizes a mirror reflector to reflect the light into the prism. The light passes through the prism arrangement to a glass-covered opening in the center of the dust plate, covering the bottom part of the horizontal circle. The reflected light enters the regular optical train at this point and is carried to the circle and back through the optical train to the reflected image in the microscope field. A similar arrangement on the right telescope standard lights the vertical circle and is reflected through the telescope to the microscope field. A glass-covered light opening and reflector is provided on the objective end of the microscope to illuminate the microscopic scale. One of the instruments was adapted for night illumination by providing miniature electrical sockets and small lamp fixtures so arranged near the light reflectors that when they are plugged in the light is directed at the reflector. Both the vertical circle and the microscopic scale are illuminated by one of these fixtures. A small adjustable lens on the fixture, and an extra reflector, allow the light to be directed to the reflector for the microscopic scale and at the same time to illuminate directly the reflector on the vertical circle. The battery leads go directly to the light fixture on the horizontal circle. An electrical lead from this fixture connects to a small commutator plate mounted just below the clamp for the horizontal circle. A spring contact point and an outside lead complete the circuit to the fixture for lighting the vertical circle and microscopic scale. The night illumination fixtures were apparently added to the instrument after manufacturing, and could be easily added to other instruments of the same model.

8. Telescope. The telescope is an internal focusing, inverted type, estimated to be about 28X.

9. Center. The center is the straight cylindrical type. The material used is hardened steel. The weight of the upper instrument assembly is supported by a ball-bearing race on top of the center bearing.

III. USE OF THE ITEM OF EQUIPMENT

10. Length of Service. The two instruments covered in this report have been in service for a number of years. They have been well cared for and both are in excellent condition, with the exception of some slight smudges on the circles. It is believed that these instruments were manufactured about 1930.

11. Use. The instruments were probably used in obtaining geodetic control for topographic mapping.

IV. COMPARISON WITH AMERICAN EQUIPMENT

12. General. Since comparable American-made equipment is not yet in general use, the British Cooke-Troughton-Simms one-second theodolite will be used for comparison.

13. Accuracy. The British and German instruments have the same least reading on both circles, practically, ~~and~~ the same possible interpolation.

14. Compactness. The German instrument is slightly smaller than the British instrument. Comparative overall sizes of the two instruments and carrying cases are shown below:

	<u>British</u>	<u>German</u>
Instrument	5 x 7 x 11 in.	5 x 6 x 8 in.
Carrying Case	6.5 x 10 x 14.5 in.	7 x 7.25 x 8.25 in.

15. Weight. The German instrument is appreciably lighter than the British. Comparative weights are shown below:

	<u>British</u>	<u>German</u>
Instrument	12.5 lb	9.0 lb
Tripod	16.5 lb	13.75 lb
Carrying case and accessories	15.5 lb	7.25 lb
Total	44.5 lb	30.0 lb

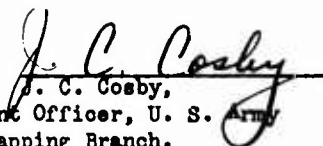
16. Design. In general, the British and German instruments are similar in design, and the production problems would be practically the same in both. The British instrument has a reading microscope and microscopic scale for each circle. The German instrument has only one reading microscope and both circles are read with the same microscopic scale. The centers of the two instruments differ somewhat, the British instrument having a tapered or conical shaped center, and the German instrument having a straight cylindrical center. The tapered center is generally considered superior to the cylindrical center; however, the Zeiss Company has an opposite opinion, but admits more difficulty in proper fitting.

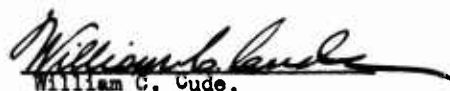
17. Operation. Since the two instruments are direction instruments and similar in design, the operation procedures are necessarily the same.

V. RECOMMENDATIONS


18. Recommendations. Since the Zeiss characteristics are well known and have been considered in designing comparable American equipment, and since later model Zeiss instruments examined by the Engineer Board have shown considerable improvement over the model discussed in this report, no action is recommended.

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APPENDIX A

DEDUCTIONS AS TO GERMAN ECONOMIC STATUS
AND NAMEPLATES AND MARKINGS

DEDUCTIONS AS TO GERMAN ECONOMIC STATUS

Since the two instruments are known to have been manufactured several years prior to the beginning of the war, no deductions as to present German economic status are possible from the examination.

NAMEPLATES AND MARKINGS

The following markings were stamped on the horizontal circle housing of the instrument not equipped with night illumination fixtures:

"D.R.P. Carl Zeiss, Jena, D.R.G.M. Nr. 16128"

The following markings were stamped on the horizontal circle housing of the instrument equipped with night illumination fixtures:

"D.R.P. Carl Zeiss, Jena, D.R.G.M. Nr. 16652"

APPENDIX B

PHOTOGRAPHS

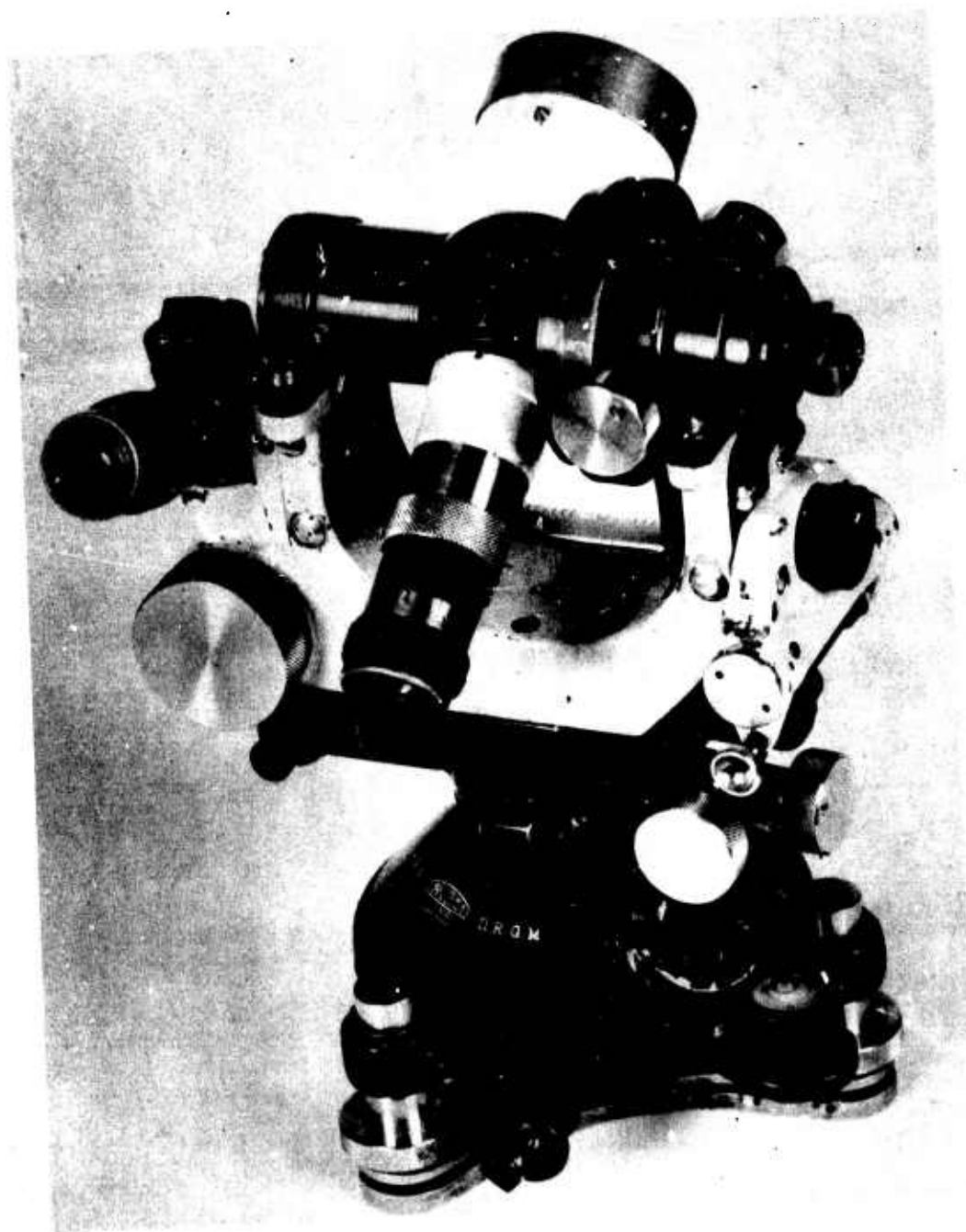


FIG. 1. GERMAN ONE-SECOND THEODOLITE. View shows eye piece end of telescope, microscope, split level vial assembly, light reflecting mirrors, universal circular level vial, and screw for setting horizontal circle. Instrument is not equipped with night illumination.

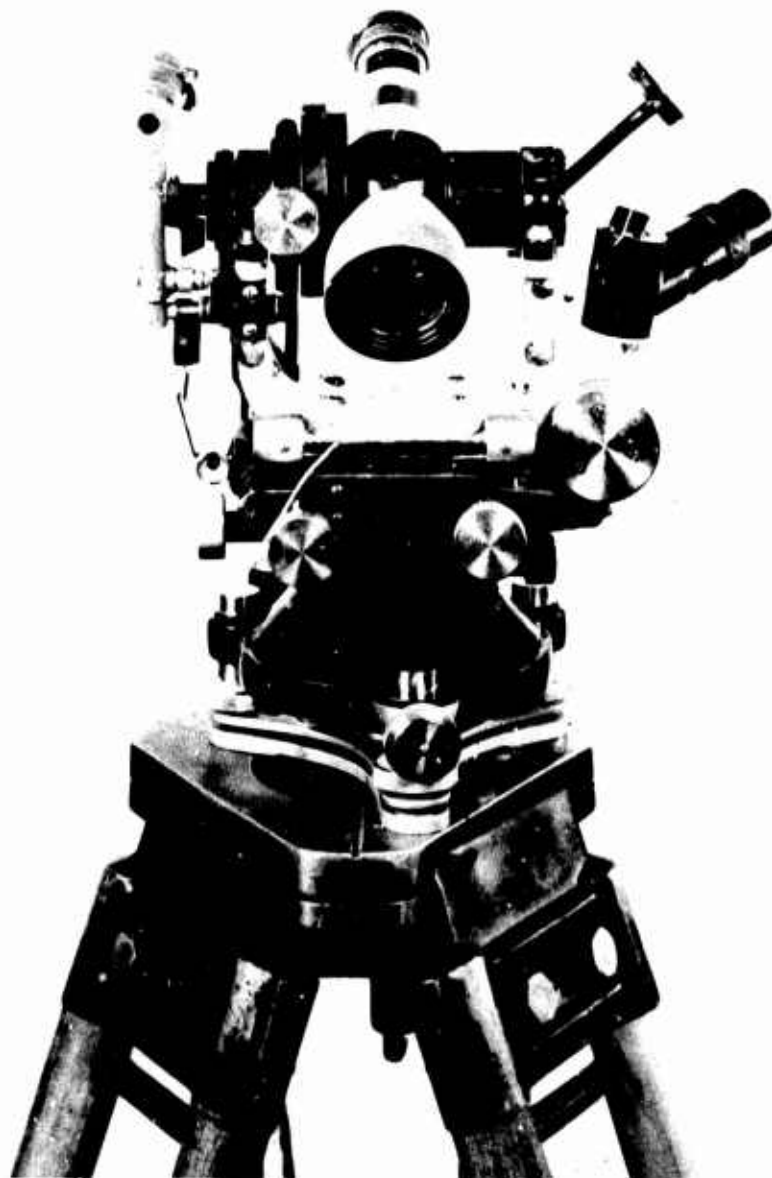


FIG. 2. GERMAN ONE-SECOND THEODOLITE. View shows night illumination fixtures for vertical circle and microscopic scale.

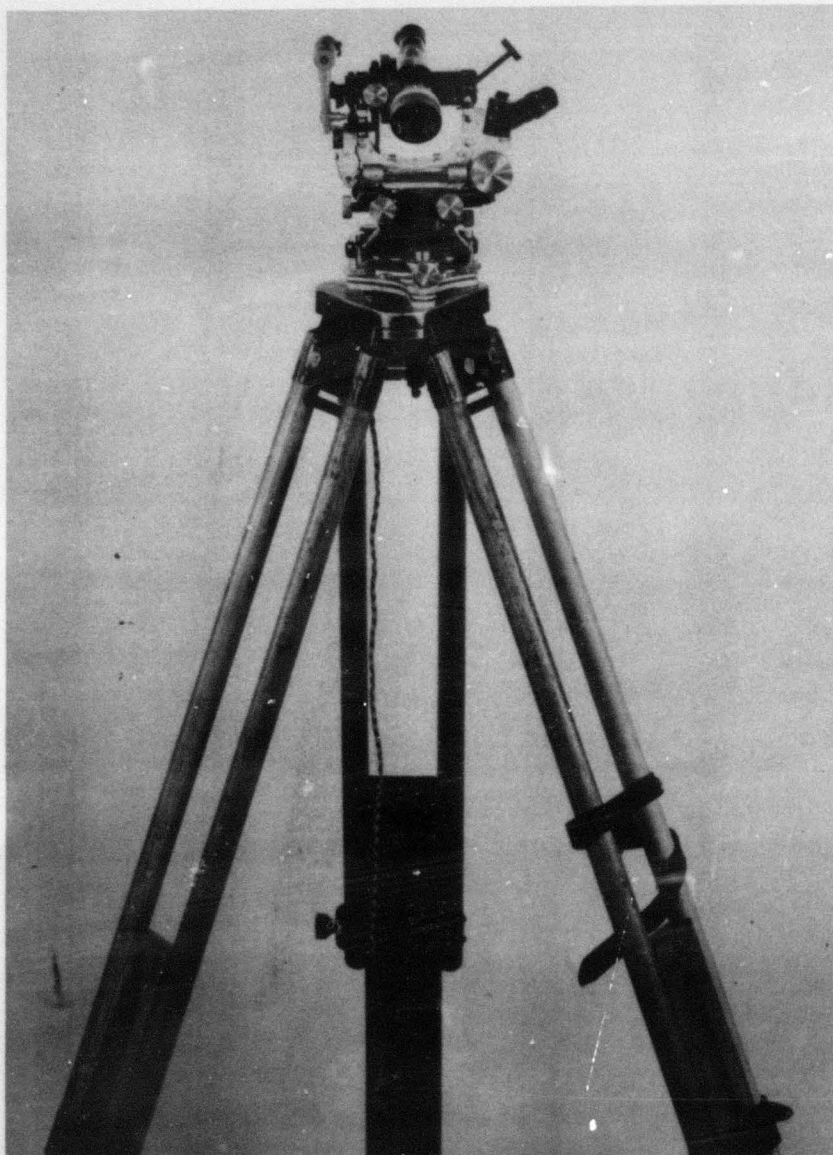


FIG. 3. GERMAN ONE-SECOND THEODOLITE. Theodolite mounted on tripod.

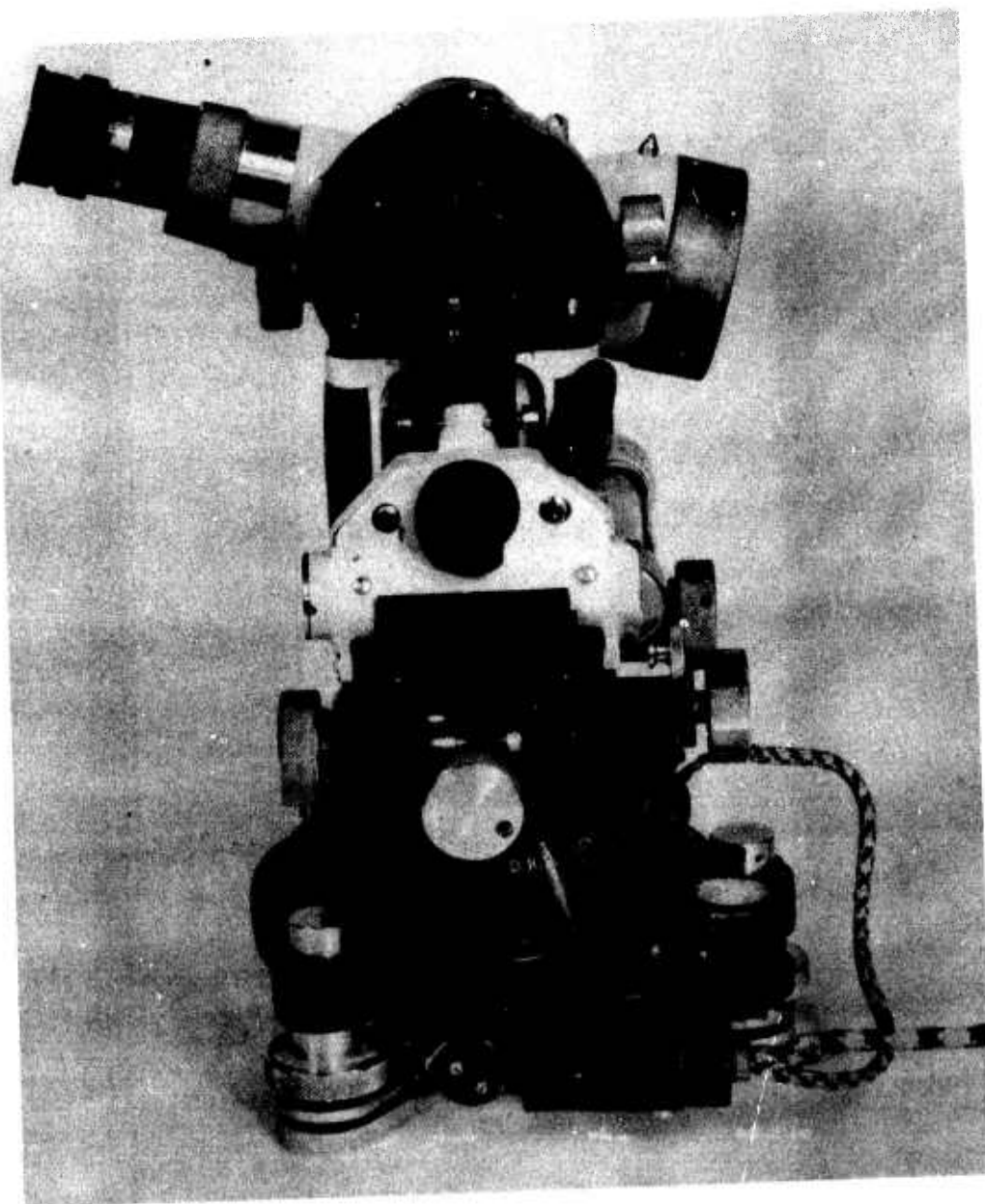


FIG. 4. GERMAN ONE-SECOND THEODOLITE. View shows fixture for illuminating the horizontal circle, electrical power lead from light fixture to the commutator plate, and the socket for the light fixture lighting vertical circle.

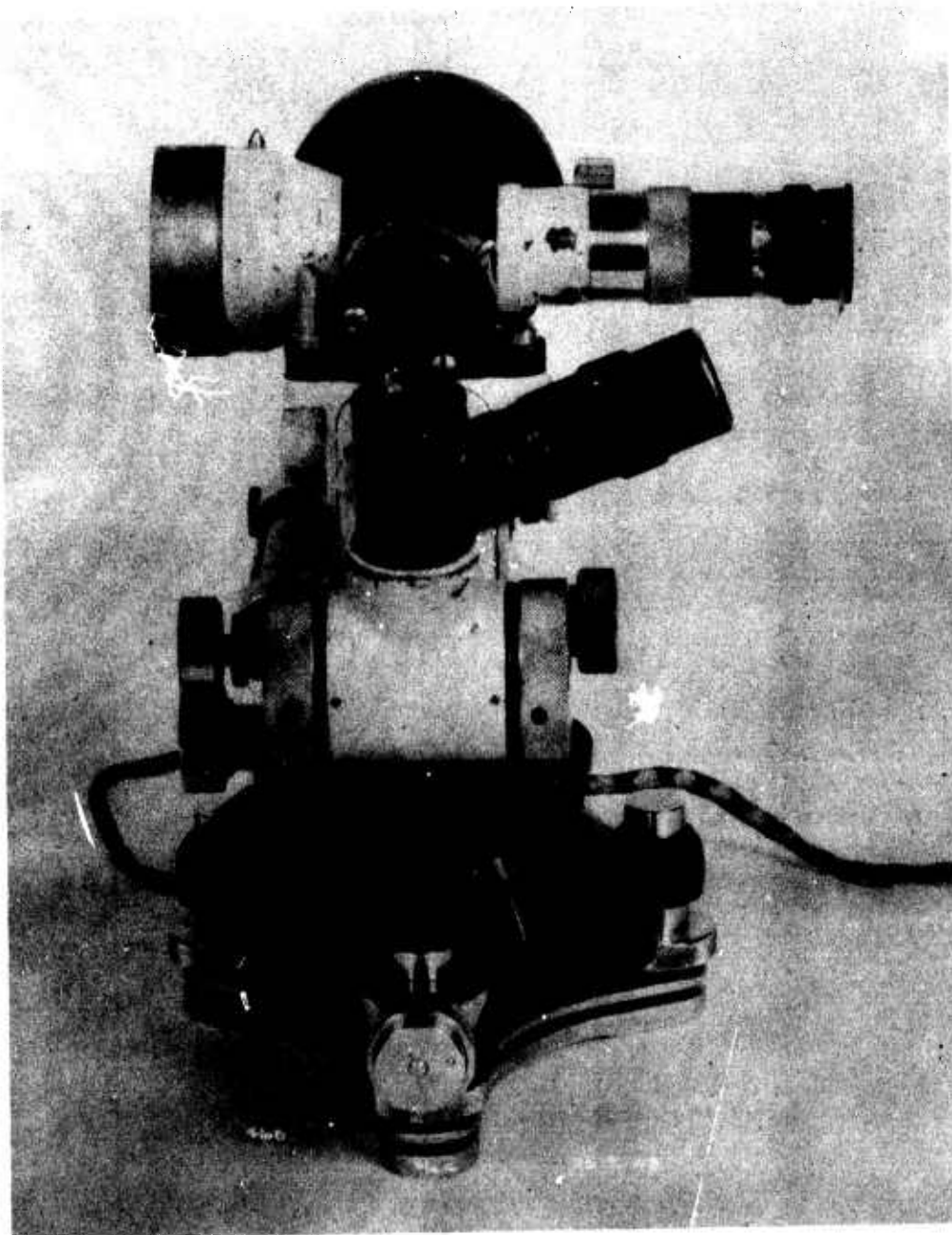


FIG. 5. GERMAN ONE-SECOND THEODOLITE. Left side of the instrument.

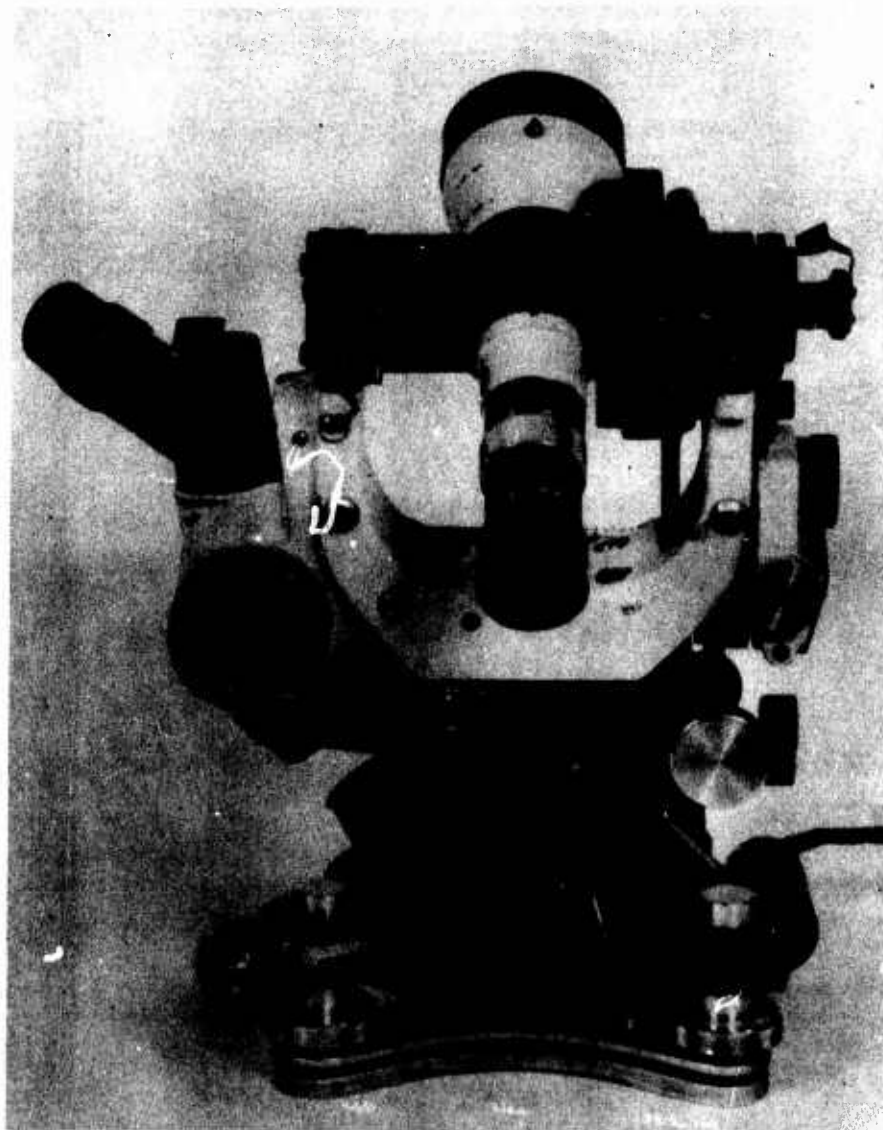


FIG. 6. GERMAN ONE-SECOND THEODOLITE. Rear of the instrument.

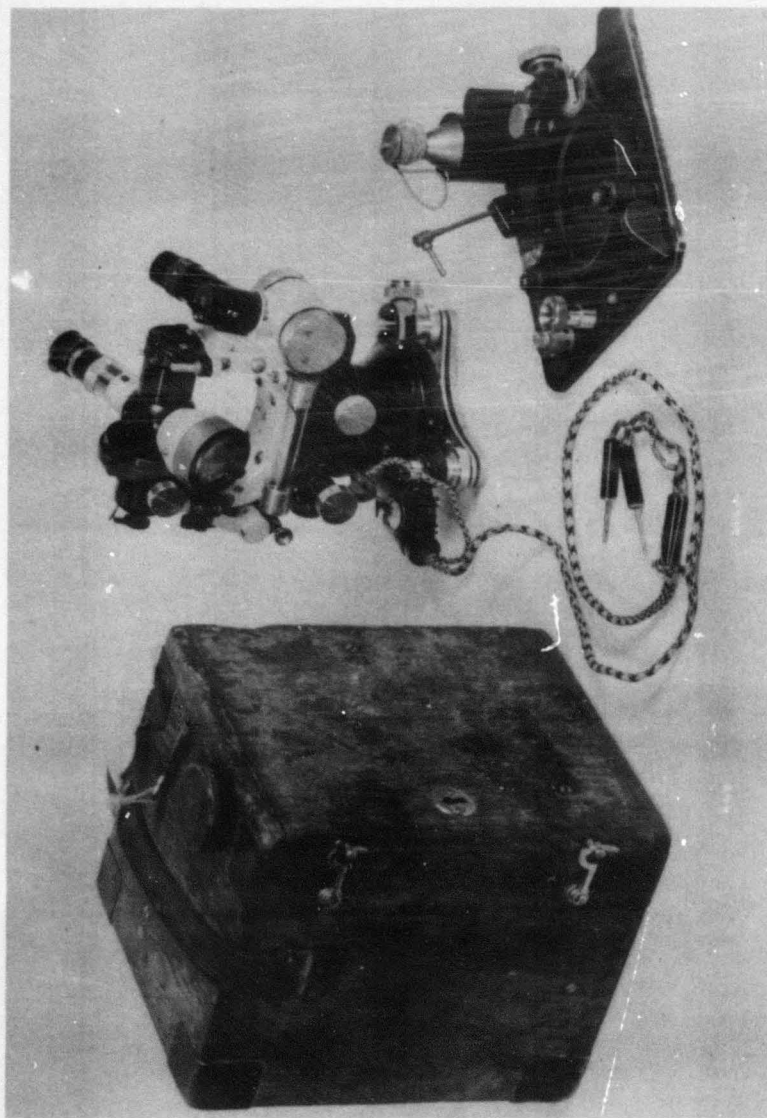


FIG. 7. GERMAN ONE-SECOND THEODOLITE. View shows theodolite, carrying base, and carrying case.

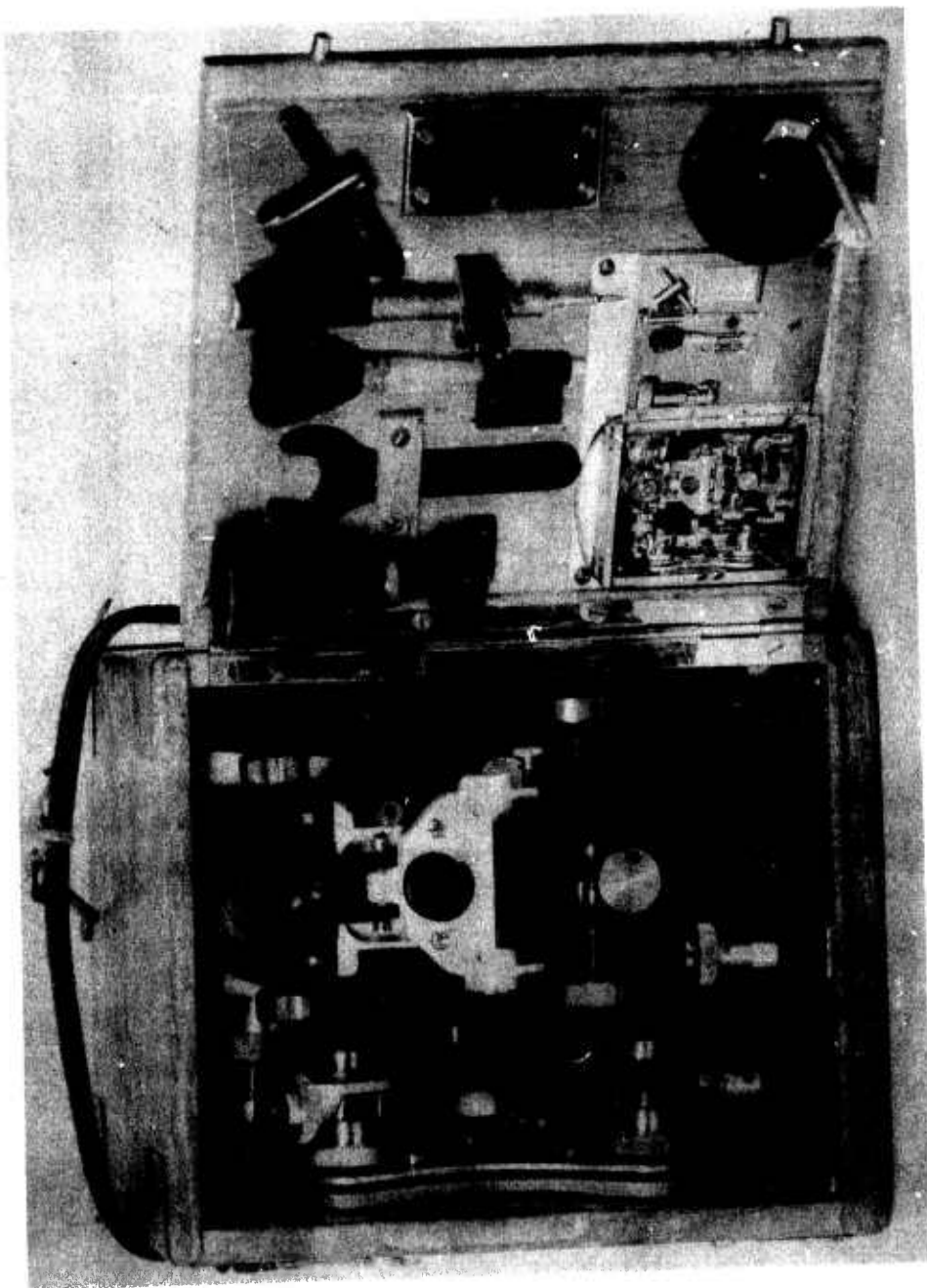


FIG. 8. GERMAN ONE-SECOND THEODOLITE. Instrument in carrying case.