# THE PLANE-TABLE AND ITS USE IN TOPOGRAPHICAL SURVEYING

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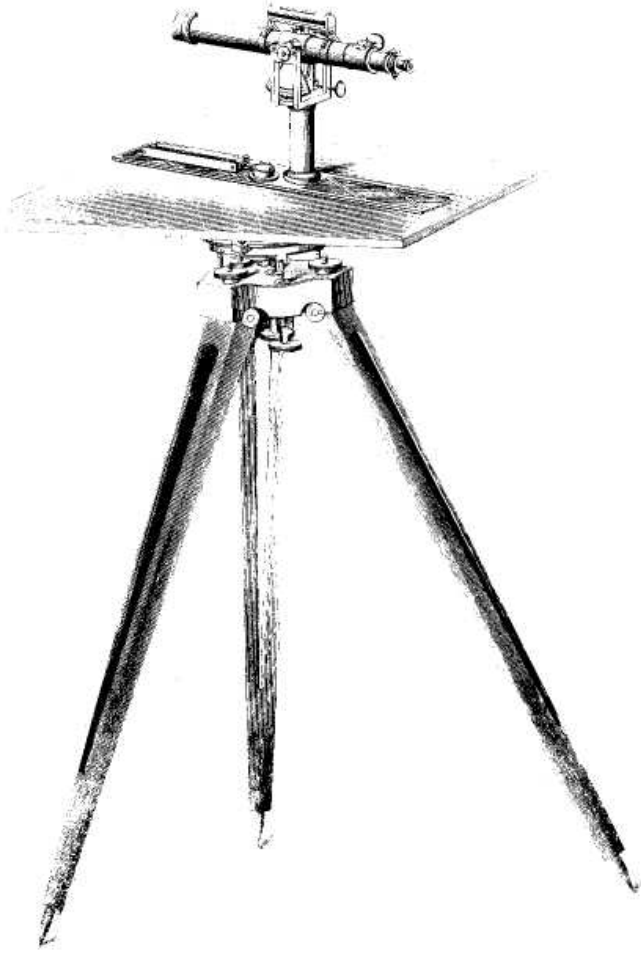

THE

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FROM THE PAPERS OF THE

UNITED STATES COAST SURVEY.

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# THE PLANE-TABLE

AND ITS USE IN

## TOPOGRAPHICAL SURVEYING.

THE following description of the plane-table, and notes upon its use, in the shape in which it is at present employed upon the Coast Survey, are given as the results of a long experience of its good qualities on that work. Being the instrument best adapted to topographical purposes, it is desired to supply information not to be found in the very inadequate notices given of it in most American and English works, and to furnish topographical surveyors with a practical manual of its use. This paper may seem, in some cases, somewhat amplified, but those more familiar with the instrument will overlook details intended for the benefit of beginners.

The invention of the plane-table is ascribed to Prætorius in 1537, but the first published description appears to be that of Leonhard Zubler, in 1625, who ascribes the "beginning" of the instrument to one Eberhart, a stonemason. From this time forward it has received successive improvements, chiefly from the Germans and French, until it has reached its present form, which seems to be in keeping with the existing state of science.

DESCRIPTION.—Topography is a more or less detailed representation, in the form of a map, of a certain area of ground, on a specified scale or proportion of nature, mechanically constructed by the measurement of angles, direct linear measurement, and tangential lines. In plane-table practice these are drawn in pencil upon the paper, which is spread upon the table, and the details are filled in according to established conventional signs. The work is so conducted that the required figure is obtained in the field at once by the simultaneous measurement and plotting of the angles; and while it is done with as much accuracy as it could be plotted with a protractor, errors of transfer are avoided and much time saved.

The plane-table at present in use by the Coast Survey (see Plate No. 1) is composed of a well-seasoned drawing board, with bevelled or rounded edges about thirty inches in length, twenty-four in width, and three-quarters of an inch thick. It is commonly made of several pieces of white pine, tongued and grooved together, with the grain running in different directions to prevent warping. It is supported upon three strong brass arms, to which it is fastened by screws passing through them and entering the under side of the board, the three holes for the reception of the screws being guarded by brass bushings let into the wood, and situated equidistant from each other and from the centre of the table. By means of these screws the board can be removed at will. The arms rest upon the sloping upper face of a conical plate of brass, to which they are permanently fixed. Upon its lower edge or periphery this cone is fashioned into a horizontally projecting rim, the inferior face of which is as nearly as possible a perfect plane, and this in its turn rests upon a corresponding rim of a somewhat greater diameter, projecting slightly

beyond it. This second rim forms the upper and outer flange of a circular metal disk in the form of a very shallow cylinder. The inferior face or plane of the upper flange or rim has, at its contact with the superior face of the lower, a horizontal rotatory movement about a common centre, which is the centre also of the instrument, and the two are held together by means of a solid conical axis of brass extending upwards from the centre of the inner face of the lower disk. A socket of similar shape fits exactly over this axis, projecting downward from the inner side of the apex of the conical or upper disk. The two plates are held together by means of a mill-headed screw capping the cone from the outside, and which can be loosened or removed at pleasure.

A clamp fastened to the edge of the upper rim permits, when loose, the revolution of the table about its centre, and, when clamped to the lower limb, holds the table firm, while a tangent screw gives a more delicate movement.

Three equidistant vertical projections of brass grooved on the under side, and cast in one piece with the under face of the lower disk, extending from the periphery towards the centre, rest upon the points of three large screws which come through a heavy wooden block below. This block, which is the top of the stand and is approximate in form to an equilateral triangle, is made of three pieces or horizontal layers, and is two and-a-quarter inches thick and very strong.

The three screws last mentioned have large milled heads, are quite stout, and play through the block from below by means of brass female screws let into it. They are the levelling screws of the instrument, and are equidistant from its centre.

Upon the under side and centre of the lower metal disk is a socket containing a ball with a brass arm, which projects through the centre of the block from beneath. The lower end of the arm is threaded, and upon it plays a female screw with a large milled head, which can be relaxed or tightened at pleasure. This screw clamps the whole upper part of the instrument to the stand; it is loosened only before levelling, and kept securely clamped at all other times.

The block is supported upon three legs, and with them forms the tripod or stand of the instrument, the legs being of such a length as to bring the table to a convenient height for working, and so arranged as to be taken off at will, or closed so that their iron-shod and pointed ends can be brought together or moved outward, as may be required. For lightness the legs are generally made open through the middle of their length, though sometimes they are solid, and each one is fashioned at the top into a cylindrical form with an outer flange, the cylinder fitting into a groove on the under side and near the edge of a truncated vertex of the block. The flange, by coming in contact with the lower edge of the block, prevents a too great spread of the legs. A brass screw, connected at right angles with the middle of a movable bolt which runs through the axis of the cylindrical head of the leg, and projecting through a hole in the block, is fastened above by a female screw with a large milled head.

A pair of compass sights or a watch telescope has sometimes been attached to the under side of the board of the plane-table. When the table has been put "in position," the watch telescope is directed to some well-defined object, and by after reference to it any movement which may have taken place, out of position, in the table during its use, can

be detected and adjusted. This, however, is but a complication of the instrument, and the same purpose can be more readily served by the alidade itself. The watch telescope has not been used in Coast Survey work.

Rollers have been attached to the under side of the table, taking the place of clamps for holding the map in its place; but these are very liable to get out of order, and are not regarded with favor by the best topographers.

The alidade consists of a brass rule about twenty-two inches long, having a circular level on its upper face. Near the middle of the rule is a perpendicular cylindrical column of brass, called the "standard," surmounted by two square brass plates joined by screws, and supporting horizontally a conical journal, through which extends a closely fitting cone of brass, coming from and attached to the side of the telescope. This cone forms the axis of the vertical movement of the telescope, and is secured at the extremity by a screw which holds it in its place. The telescope itself has the usual cross-hairs and means of focal adjustment.

A transverse level is fastened to the edge of the upper of the two plates at the top of the standard by means of adjusting screws.

The telescope is so placed that its line of collimation is above and in the same vertical plane with the fiducial edge of the rule, though this is not absolutely necessary. Its position with regard to the edge, and its relation to it, should, however, be constant.

A vertical arc with a tangent screw and clamp is attached to the telescopic side of the lower brass plate, and, with a vernier which moves in arc as the telescope is raised or depressed, is used in the measurement of vertical angles for heights.