

PROTRACTING TRIGONOMETER.

The annexed engravings represent an improved instrument for protracting maps and for other uses of draughtsmen, recently invented and patented in the United States and in Great Britain by Josiah Lyman, who may be addressed in relation to it at Lenox, Mass.

Fig. 1 shows the scale plate in its true size and proportions, except in length. Accompanying the trigonometrometer is a draughting board with a metallic border, easily rendered, by its adjustments, exactly rectangular.

Fig. 2 gives a vertical view of the entire instrument, the parts being shown in their true proportions, except

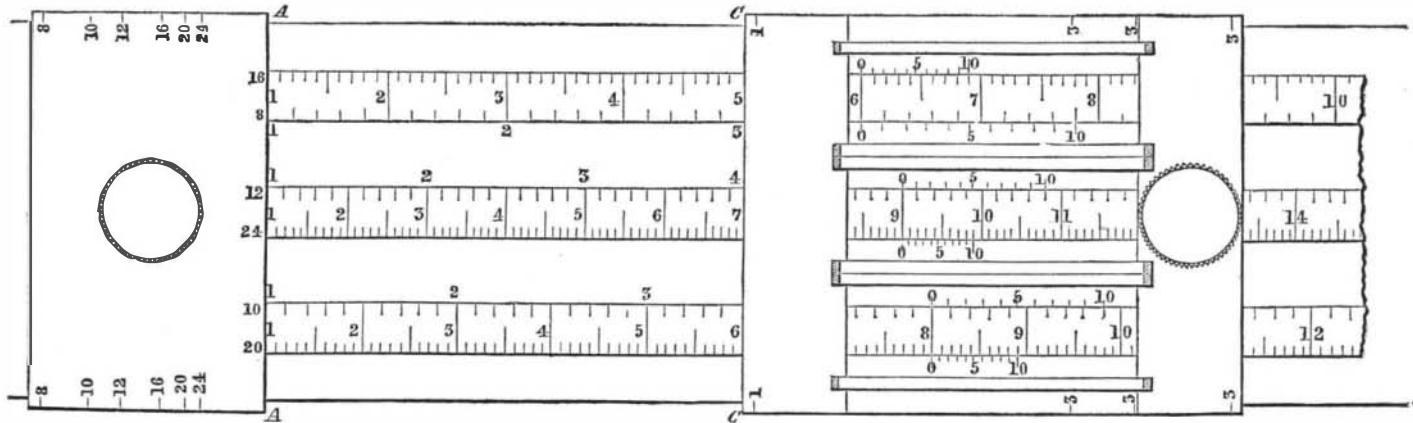
each of them can be taken in two positions of its vernier: hence, an azimuth motion of 90° gives 180°; the bearing and reverse bearing of a line always having the same line of direction. Hence, also, by reversing the instrument, every angle may be tested. The scale plate is used on either side of the ruler, or separately, as occasion may require. In the common instruments, it has graduated upon it six decimal scales—the units being 10-8ths, 10-10ths, 10-12ths, 10-16ths, 10-20ths and 10-24ths of an inch.

On the scale plate of the best class of instruments there are graduated nine scales instead of six. This is

places the use of logarithms, and, in all cases, the traverse tables. It thus saves half the time and labor in the mensuration of all forms of triangles and trapeziums, areas of irregular fields, and of heights and distances. For all purposes of draughting the trigonometrometer is wholly unrivalled, and needs only to be known to render its use a necessity to every surveyor, architect, draughting machinist, map maker and teacher of these branches—in a word, to every draughtsman. And its cost is such as to place it within the reach of every practical man.

These facts are fully substantiated by the mathema-

Fig. 1



LYMAN'S IMPROVED PROTRACTING TRIGONOMETER.

that the scale plate and rule are both represented as broken. The engraving is a little more than one-third the true size.

The metallic plate, E (Fig. 2), has a lip projecting downward from its straight edge, to be placed against the edge of the draughting board in the usual manner of this class of protractors, when the angle is measured by the position of the index upon the graduated arc.

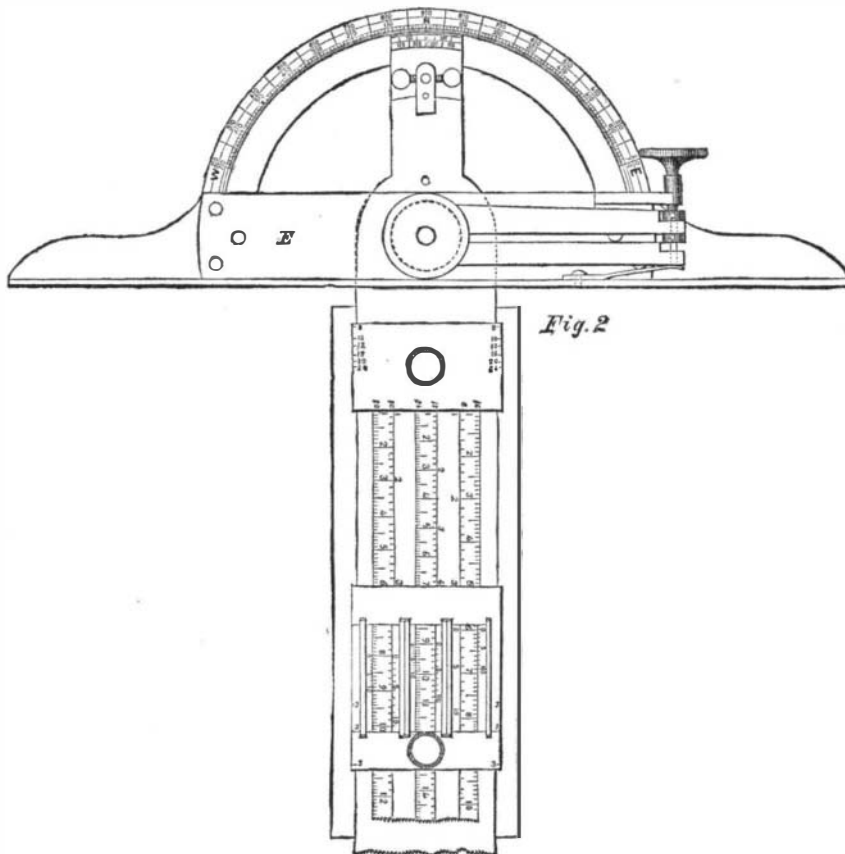
The principal feature, however, in this invention is the arrangement for measuring the lengths of the lines. For this purpose, a graduated brass plate is fitted to slide upon the long arm or rule of the protractor, and upon this plate is a shorter one furnished with adjustable verniers, called a "guide." Fig. 1 represents a section of the rule with a slide upon it. The slide is placed with the proper one of its zero points (marked 8, 10, 12, 16, 20 or 24) at one end of the line, and the guide, C, is slipped with its edge to the other end of the line, when the length is indicated by the proper scale and vernier to the thousandths of an inch.

This beautiful instrument is a twofold achievement. While it is strictly a scientific combination—uniting in one instrument the protractor, draughting rule and sliding vernier scale—the accuracy and skill apparent in the arrangement and construction of its mechanism are a triumph in art. For such are the peculiarities of its construction, though simple, that it enables the operator completely to eliminate the unavoidable errors of manufacture, and hence actually to lay down upon paper the data furnished by his field notes, and measure the varied parts of his work with mathematical precision.

The protractor and rule are connected by a common pivot, the divisions on the limb of the former being made to half degrees. To the attached end of the latter is fastened an adjustable, double, direct vernier, reading to minutes. The given angle and its complement are obtained at one setting of the instrument, and

done by merely bisecting the subdivisions of the three finer scales, changing the figuring and appending an additional vernier to each of the three corresponding vernier pieces. The units of the additional scales are 10-32ds, 10-40ths and 10-48ths of an inch. The 10-40th inch scale furnishes an even ratio between the

ticians, surveyors, teachers, &c., in various parts of the country who have had an opportunity to examine the instrument, among whom are the following:—Edmund Blunt, Esq., manufacturer of philosophical and astronomical instruments, and First Assistant in the United States Coast Survey; Professors Tatlock, Hopkins, Hubbard, Helsey, Snell and Curtis, of Massachusetts; Messrs. O. C. Wright, Z. Richards, C. H. Norton and A. C. Richards, of Washington, D. C.; Professor J. S. Benedict, Civil Engineer New York Free Academy; Professors H. A. Newton, W. H. Norton, C. S. Lyman and Alex'r C. Twining, of Connecticut; J. H. French, Esq., Superintendent of the New York State Map; George P. Bond, Esq., Observer at the Cambridge Observatory; Professor O. M. Mitchell, Director of the Cincinnati Observatory; mathematical instrument makers, delineators in the United States Coast Survey and Land Offices, as well as other practical surveyors, architects and distinguished teachers in various sections of the country.



inch and mile; the inch in this case representing 4, 40, 400, 4,000, 40,000, &c., chains. The French scale, with 5, 10 and 20 millimetres for the units, will be substituted for either of the systems above described whenever the demand shall require it. The same assurance is given in regard to any other scale which shall be largely demanded.

The trigonometrometer thus constructed is not only four times more reliable than the chain and compass, but furnishes the best means yet discovered for detecting their errors. It lays down or measures, at the same time, both the angle and distance, rendering unnecessary in all trigonometrical calculations to five decimal

ter of which there has long been a fierce dispute, they being claimed by the botanists as plants and by the zoologists as animals. Many of the plants in certain stages of their growth, swim about in the water and look and act so nearly like animals that they would probably have always been classed as such had they not been observed to branch out and grow up into perfect plants. There is no single character by which the animal or vegetable nature of an organism can be tested; but the safest guide in the doubtful cases is furnished by the mode in which the nourishment is taken. Animals are nourished by organic matter, which they take in some way into the interior of their bodies; while vegetables have the power of absorbing their food from inorganic elements on the exterior.