V.—*On an easily constructed form of Reflecting Goniometer.*

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ABOUT two years ago, while working at the crystalline form of a number of chemical substances of which I could obtain only small quantities, and in consequence minute crystals, I found that a great deal of time and trouble were lost in consequence of having the use of only one goniometer. When a crystal was fixed in its place by canada balsam and carefully centred,—a tedious operation when carried on under the microscope, as I had generally to do,—its angles measured and description noted, I found I often wanted to keep it for comparison, but before another could be examined, the first had to be taken off and half an hour spent before the second could be got into a satisfactory position, the first being very often spoilt in being removed, or even if still entire, much time must be lost before it can again be referred to. Now the possession of half a dozen instruments would obviate all this, but few chemists can afford the luxury of such a number of goniometers, and unfortunately so few possess one at all that it is seldom that such a thing can be borrowed. Finding myself in this predicament, I determined to construct an instrument which might serve the purpose of a more expensive apparatus, but which would be easily and cheaply made, and after several trials I succeeded in finding a form of gomiometer which has admirably served my purpose, and I think that since it has proved so serviceable to myself, I might help some of my brother mineralogists by bringing it before them.

It consists of a tripod stand A figs. 1 and 2, plate IV, made of four pieces of glass rod fused together at A, one for the stalk, and three for the foot, two of which are longer than the third and bent horizontally at B to admit of the instrument being held steadily by a weight or book being laid on the two feet, or it may be fixed by them to a wooden stand. To the top of the stand is fixed a tube C, which is narrowed at one end E till it is rather smaller than the rod D, which is bent into a handle at one end and narrowed slightly at the other so as to pass through the point E, into which it is ground with emery till it turns smoothly; a piece of cork F supporting the other end of the

rod in the centre of the tube. A piece of rod G bent twice at right angles, to one end of which is fused the tube H, is melted on at K, and above this but a little nearer E the pointer L is fixed, while the little bent rod I is carefully centred in the tube H by means of two pieces of bored cork. A large disk either of mica or card board is then fixed with glass cement on the tube at E, and a vernier at the point of L. Should this scale be of mica it must be put on before melting on G or L, but if of card board it may be cut radially to the centre and slipped into its place afterwards, the cut being subsequently carefully gummed together.

Two pieces of cork, one fixed with cement to K, and the other stuck loosely on the point of I, finish the instrument. The reason for having the cork on I loose, is that when minute crystals are to be examined, this cork may be removed and the point of I covered with canada balsam, the crystal being then stuck thereon and centred, and when larger crystals are being examined, the cork is replaced and the crystal wedged between the cork of I and that of K. Of course the corks with which I is fixed in the tube H should be rather tight, so that there may be sufficient friction to hold an ordinary crystal firmly. The reason for having the point of the rod D ground into E, is that not only does it keep the rod in its right place, but that on pushing the rod into the tube a little firmly, the apparatus may be wedged at any angle and left for a long time without any fear of its getting loose. The ground part should be slightly greased. I would remark that the scale of the instrument can, with ordinary care, be divided correctly to half minutes of arc, and this with a vernier gives an instrument which reads to seconds, and anything further is not required in ordinary crystallographic comparisons. Fig. 1 is from a photograph of one of the instruments, which may of course be made much more ornamental, but as it stands, so easily is it constructed that many of my students have made instruments for themselves, and have, consequently, that not very common attainment for a chemist a knowledge of practical crystallography. The disc of the instrument illustrated in fig. 1 has a diameter of nine inches, the other parts being in proportion.