Mr. John Bailey Denton, Assoc. Inst. C.E., presented and explained the use of the "A" Level which he designed for the use of workmen in the drainage of land, the formation of water-meadows, the making of roads, and all works requiring a regular inclination.

The wood-cut (Fig. 1) shows the instrument in use. The bar B turning upon a hinge and falling into grooves cut in the legs A, these may be closed, like a pair of compasses; and the whole may be used as a rod for measurement. The legs A are sufficiently narrow to stand in a trench; while the false feet F afford the means of stationing the instrument on the surface.

Fig. 1.

The object of the instrument is to assist foremen and workmen in testing and preserving an uniform fall, in all works requiring such regularity. A spirit-level, even if understood by workmen, is easily put out of order, and is liable to be broken; its use, therefore, is dreaded by workmen, as involving too much time, care and precision.

In draining and sewerage, the first object of the operator is to direct his drains according to the best fall of the ground; the next point of importance is that the floor of the trench, and the course of the tiles, soles, or bricks, should be even and regular throughout the length of the drain. Any depression in the drain intercepts the sedimentary matter which the flow of the drain-water would otherwise carry out with it; the sectional area of the water-way is thereby lessened, and the sediment, gradually accumulating, after a time causes a stoppage, the drain bursts, and the work has to be re-done.

The Level placed in the trench, as it is dug, preparatory to laying in the tiles, indicates by the plumb-line any irregularity arising from bad workmanship. It is easy to prove, that the principle upon which the A Level is based is so sound, that if accurately constructed

the instrument cannot work otherwise than with perfect efficiency, in determining the average fall of surface between any two spots within sight of each other.

It should be observed, that the legs of the instrument being equal in length, form, with the base upon which they are placed, an isosceles triangle, and that, when that base is perfectly level, the plumb-bob pendent from the apex, must necessarily divide the triangle directly in half. This admitted, it is equally clear, that by means of a bar connecting the two legs at any given distance, and exhibiting on its face the centre, or half of the angle at the apex, any person is competent, guided by the plumb-line, to raise or depress one leg until it stands on a level with the other; the plumb-line will then hit the centre.

Now, as the plummet will always hang vertically, any elevation or depression of either leg is immediately indicated on the connecting bar, by the equivalent deviation of the plumb-line from the centre.

The angle $A B C$ (Fig. 2) is equal to the angle $D E F$, *i. e.*, the angle made by the hypotenuse, or surface, with the horizontal line, is equal to the angle of the line dividing the triangle in half, with the vertical line.

Thus, the difference of height between D and E may be calculated by multiplying the natural sine of the angle $D E F$ (read off on the bar as $A B C$, if the index represents degrees), by the length of the ground spanned between $E D$. In the **A Level** this is already done; and instead of degrees and minutes, inches and quarters are divided on the bar, so that the operator may at once read from it the difference of height between the two spots upon which the instrument stands, and *vice versâ*. If it is required to sink one leg an inch below the other, the ground is lowered until the plumb-line strikes the 1-inch division of the index on the bar.

It will be seen, that at a certain distance from the apex, on each leg, a line of sight is shown. On the one leg there is a sliding sight-hole

answering to a fixed index, agreeing with that on the bar B; on the other leg there are cross hairs fixed, the centres of which are exactly the same distance from the apex, as the nonius of the index on the opposite leg. The line of sight, therefore, from these two points is ever parallel with the base of the instrument.

To arrive at the average fall of surface from the top to the bottom of a field, the instrument must be placed on a level by means of the plumb-line. The operator must then send forward his assistant-workman to the spot D, (Fig. 3) at which he intends to end his drain, with a stick marked by a paper fixed in it at a height c above the ground, agreeing with the height of the cross hairs B, above the base of the instrument. He then slides the sight-hole up or down, until he fixes the cross hairs upon the paper in the stick.

Fig. 3.

This line of sight, $c B c$, is parallel with the general line of surface $E D$ (regardless of its sinuosities), and therefore forms, with the horizontal line of sight $A B A$, an angle $c B A$, equal to the angle $D E F$, formed by the horizontal datum and the surface.

Now, as the opposite angles of lines crossing each other are equal, the angle $A B C$ is equal to the angle $c B A$; and it has been shown, that the angle $c B A$ is equal to the angle $D E F$; therefore $A B C$ is equal to $D E F$, and consequently the operator is enabled to read from the index at c , the angle converted into inches and quarters, which is common to the whole distance from E to D . The height thus read off, is transferred to the bar B, and retained by the shifting limb G (Fig. 1), to the edge of which the plummet is afterwards worked. This limb is used only to save memory, and assist the man who cannot read.

When folded the level forms a portable five-feet staff.

Sir JOHN RENNIE, *President*, addressed the meeting, congratulating the members on the success of the session, the character of the communications received, and the numerous attendance of members and visitors at the evening meetings, and announced, that the papers which had been received and had, from press of other business, remained unread, would be laid before the meetings at the commencement of the next session.