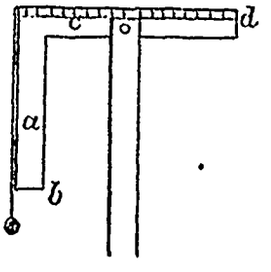
salt, and the latter in its various modifications now enters largely into the formation of chemical manures. Salt and lime mixed together and turned over for three months form the most active substance known for reducing vegetable matters and farm-yard manures into the substance usually known as "rotten dung." These matters, when mixed with lime and salt so prepared, decay in one fourth of the time they would otherwise take to fall into the most profitable shape as manure; and the action of these chemicals does not cause a loss of ammonia, or other fertilizing salts, to any serious extent.

Science has also pointed out to the farmer the benefits of liquid over solid manure; the necessity of keeping our heaps and reservoirs of manure from the leaching action of the rains; the reasons for the necessity of rotation of crops; and, indeed, it may be fairly claimed for science, that, through its aid, the average production of grain per acre throughout Great Britain has doubled itself within the last twenty years. VECTIS.

Practical Drainage

BY ALAN MACDOUGALL, C.E.

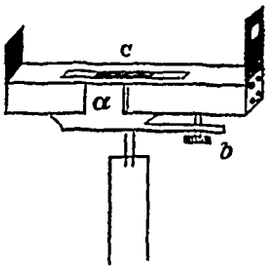
The next step towards a scientific instrument for obtaining levels is somewhat similar to the one mentioned before. Instead of having the head fastened on like a T, it has a square fastened on, with a plumb-bob attached to the perpendicular



arm. The square may either be fastened on firmly, or have a thumb-screw to allow of its being loosened or tightened, as may be required. The plumb-bob is made to hang down the side of the arm *a* in the same way as it hangs on the centre line of the T, and when it just touches the arm *a*, the other arm *c* is level. Some persons use this square with the arm graduated to inches, then by throwing it slightly off the level, a grade is obtained. For example, if the arm *c* were thrown a quarter of an inch off the level, and its length were 24 inches, then a quarter of an inch on 24 gives one inch in 96, or a grade of 1 in 96. This needs very careful handling and calculation, and for this purpose the arms must be of the same length, so that whatever distance is required to be laid off can be accurately measured. If not, and the arm *a* were 12 inches long, while the arm *c* were 24, let the point *b* be shifted a quarter of an inch, the point *d* will move through *twice* that distance, so that instead of obtaining a grade of 1 in 96, the grade obtained will be 1 in 48.

If it be desired to use this square and bob for laying out grades, the upright must be firmly set in the ground, and after the grade has been laid out, the arms must not be touched, in case any derangement to the grade takes place. It will answer pretty well on a perfectly calm day, but if there be any wind to swing the plummet about, then this method of laying out a grade is not very practicable.

Considerable accuracy in levelling can be obtained in the use of the undermentioned instrument. It is often used in levelling long distances for drains. It works with sufficient accuracy to be recommended as the nearest approach to an engineer's level that it is necessary for



a drainer to have. It consists of an ordinary spirit level, having an eye-sight raised above each end. At one end the sight is higher than the other, and is furnished with a piece of stained glass, or some other material of the same height as the other sight. The level is made to fit into a brass frame *a*, which acts as a spring to adjust it to the level position *c*, by means of a large-headed screw *b*. A stud, projecting from this frame, is to be firmly pushed into a gimlet hole on the top of a short staff, which is firmly driven into the ground. When not in use, the level can be carried in the pocket, as it is of no weight, and the staff used as a walking stick. It is preferable to have the frame with the spring attached to the level, for the convenience of carrying it. Even a better method than having the spring *a* and adjusting screw *b* is to have the stud fastened on the bottom of the level and made to fit on a core working on a ball and socket joint, like the working of a surveyor's compass on the "Jacob staff." It is rather more costly perhaps, but makes a more permanent level, and it can be very accurately levelled by the hand.

In every case, the sighting is to be done in the same way, which is similar to that formerly explained in the use of borning rods, the target on the graduated rod is to be moved up or down until it cuts the line of vision, and the difference in heights of the readings on the staff and the height of the level above the ground to be taken, which difference will be the difference of level between any two points.

Tile Drainage.

To the Editor.

SIR,—A circumstance has come under my notice respecting a tile drain, to which I should like to draw your attention, and that of your numerous readers.

The drain leading from the cellar of Mr. F. Coleman, in this neighbourhood, became completely blocked up. On examination, it was found that the fibrous roots of an apple tree, growing some thirty feet from the drain, had entered the crack between the tiles, and had become a mass so solid that the water could not pass. I enclose a portion for your inspection.

The drain was laid three years ago, by a professional hand from England. The tiles were two inch bore, laid four feet deep.

There is an orchard of ten acres in this vicinity, with tile underdrains. It has two main outlets, and in the spring does not run two barrels a day from either outlet.

I have a young orchard to underdrain. With these facts before me, it would be useless to attempt it, unless I can hear where tiles are manufactured with collars, or to connect in some way to prevent one falling below the other, as I find the mice or moles have undermined mine.

I think, in laying a drain around a cellar, elbow tiles would be an advantage, as they require to be close to the wall.

What do you consider the best drain for a cellar? W. T. CROUCH.

Virgil, Jan. 31, 1870.

REPLY.—The roots look very much like grass roots; probably when the tiles were laid they were covered with turf—a very common practice, and the turf being put on with *roots downward* has caused the mischief. It is highly improbable that a tree in three years could shoot roots down into four feet of depth, when it was thirty feet away from the drain, however wet and soft the subsoil might be. The subsoil must evidently be soft sand (will Mr. Crouch inform us, and also say if the land was wet before it was drained?) which was wet and full of water before draining; in such cases there are frequently grasses that are called subaqueous, which cause a good deal of trouble to the drainer, often requiring a drain to be lifted and relaid after three years. The fault of the ten acre orchard seems to be the same as Mr. Coleman's, but we should like to know more about the condition of the land before draining, subsoil, fall, depth of drains and when laid, and distance apart. Tiles