stamping it well and carefully against the mould, as you would a floor, and smoothing with the trowel, being careful to get a good thickness over the ridge of the mould, and to prevent any large stones in the concrete extending through the wall from outside to inside.

Any old lumber answers to make this mould out of, as it is not removed when the culvert is finished, but rather left there until it decays and falls down in the passage, when it can be pulled or pushed out of the opening, and for all time afterwards the culvert will require no attention other than keeping a good covering of earth over the concrete form.

Now that you have the mould covered with concrete, that part is finished, and you may direct your attention to the ends of the culvert. By shaping a mould inside the outer end boarding, by placing planks or boards at a distance from this wall equal to the thickness of end work desired, say, seven or eight inches, you can build very fancy and durable ends on your culvert, as much higher than the road level as you choose, making them circular or square, or any shape desired, on top. This not only gives an artistic finish to the job, but is also very useful in keeping debris from rolling down that might in time clog the opening of the culvert.

When the concrete has hardened sufficiently, the soil may be filled in, and should form a depth of at least ten or twelve inches over the ridge of concrete.

By careful comparison, I have found that these culverts, constructed on the farm, only cost about one-half as much as when we buy the cement tile from manufacturers and put them in, and I consider that, with the ends, which can be built together with the whole body of concrete, there is a decided advantage over the tile where no ends can be so constructed. Two men can easily put one of these culverts down in half a day.

There is no improvement like a permanent one, and, by installing concrete culverts where they are needed across our farm roadways, lanes, etc., we are making an improvement that will only have to be made once.

C. HAMILTON.

Dundas Co., Ont.

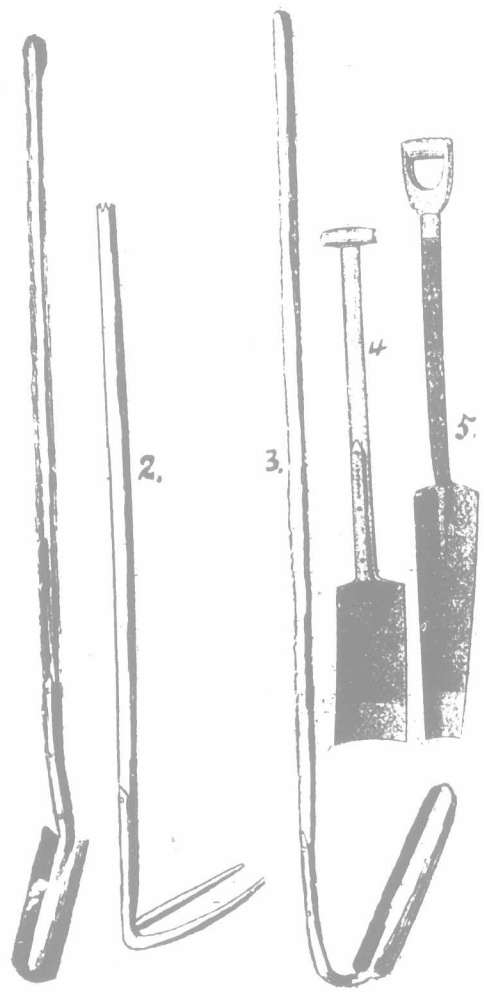
Ditching for Tile.

In view of the awakening interest in tile drainage in this country, the following article, by W. J. Malden, in the English Agricultural Gazette, will be read with profit, containing, as it does, some good practical hints :

To work skillfully in a deep and narrow drain requires considerable experience. To work economically, it is necessary to make the trench as narrow as a man can work in expeditiously, because it is desirable that the smallest quantity of earth has to be taken out. It may not at first sight appear a matter of much significance to avoid taking out an inch less down to the depth of a drain, but soil is heavy, and in the aggregate of a whole field it makes a considerable difference to the drainer's earnings. Moreover, unskilled drainers may require to take out several inches more width than a skilled one requires. A skilled drainer probably exemplifies the greatest economy in labor of any worker on the farm. He does nothing more than is absolutely necessary. A man accustomed only to ordinary digging has much to learn when he starts draining. The tools themselves are different to those used in surface work, and the freedom of action a surface worker has is very different to that where a man works to considerable depth in a trench so narrow that he cannot lie down in it at the surface, and which tapers so that he cannot find room to place his boot at the bottom 3 feet, or much more, below.

THE STANCE OF A DRAINER.

The position of a drainer when working suggests great crampedness; but by practice he has learned to apply his power so that he is working with great effectiveness, and it is certain that a man working in a trench allowing him the freedom which a novice would instinctively require, would not get through the same amount of effective work. In other words, he would not dig out as long a trench. Each tool a drainer uses



Drainage Tools.

1.—Drain push scoop.
2.—Drain mucker, or stone or clod hook.
3.—Drain hoe scoop.
4.—Top graft.
5.—Bottom graft.

requires a special knack to work it effectively, yet he uses these with ease and methodical precision. A newly-dug trench shows the man to be a spade artist. Beyond the precision required to make the trench a perfect V., he has to regulate the depth of the spits, or spadesful, so that he leaves the least possible amount to be taken out by shovels and scoops: and at the same time he must avoid breaking below the line the pipes are to take, because pipes never lie so truly on a bed which has been broken, and it has to be remembered that pipes must lie absolutely true, or there will be loss of drainage power, because where a pipe is not in the true line at the bottom, there will be an accumulation of silt.

TOOLS USED IN DRAINING.

I have before me illustrations of the tools used in cutting drains more than a century ago, and it is very noticeable how little they differ from those in use now. This is more striking because pipe-draining had not then been done. It was not until about 1820 that any reference can be found to tile-draining. But the early tile draining was not done with cylindrical pipes, but with horseshoe tiles, open at the bottom, which were afterwards used extensively, often accompanied with a sole plate or flat tile on which to rest, or sometimes with wide flanges to keep them from sinking out of the level. It was not until after 1840 that pipe tiles were introduced, and there is no doubt that the introduction of these cheaply-made cylindrical pipes gave considerable impetus to land drainage. The only tool missing in the list of illustrations mentioned is the bottom graft, drain spade, or draining tool, as it is variously called.

There are two reasons for this : drains were comparatively shallow, and the material employed required greater space than that needed for pipes. Many theories arose in respect to the drainage, some of which were shown to be correct, others which experience has shown to be wrong. Controversy was strong and arguments heated, for many years, but experience has sifted out the better methods, and there is little controversy respecting it ; but there is sometimes a parrot repetition in respect to some of the features discussed, which have been copied from publications and handed down by writer after writer, which are misleading to the inexperienced to-day. Those, however, with experience have generally come to a pretty accurate recognition as to what is best. The question of depth, in accordance with the drainage powers of the land has been more intelligently regarded. A century ago, comparatively shallow draining was practiced. Half a century or so ago there was an excessive inclination to depth, regardless of draining properties, and this was greatly instigated by what was known as Government drainage, because money advanced by the Government could only be obtained where the drainage was carried at or below a certain depth. Experience showed that there were frequent instances where the pipes were buried, but the drainage was ineffective.

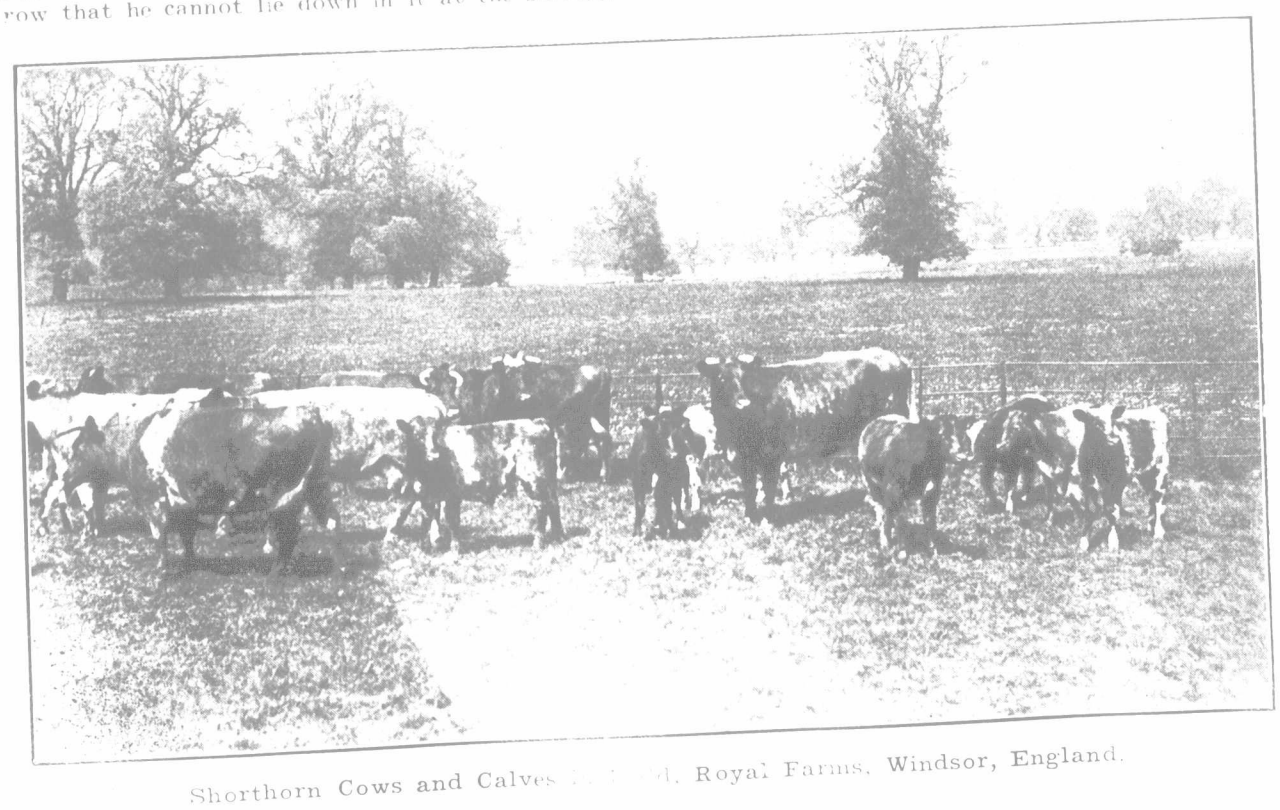
TOOLS FOR DEEP DRAINAGE.

Deep drainage called for tools which would be effective at a considerable depth, and this the bottom graft was well suited for. It is still needed in most cases. There is one feature, however, which bears on this ; another theory prevailed in respect to the size of pipes, and for a time it was strongly held that small pipes were the correct thing—in fact, instead of round cylinders, pipes of egg-section became the vogue, as it was held that the narrow bottom was less liable to silt up, because even the smallest trickle would wash out silt. Experience soon showed there were other features which overruled this, and the egg-section pipe soon disappeared. Narrow pipes, however, called for narrow gauge at the bottom of the drain, and the need for the tools which would readily form it. However, deep drains are often required now ; there are many conditions calling for them. One point not infrequently disregarded in draining open subsoils has been the depth of water that could accumulate below the pipes. Where the impervious layer of earth is considerable depth below the pipes—even where laid deep—the volume of water below may be sufficient to supply moisture by capillarity, even through the longest drouths ; but where the impervious layer is but a little below the pipes, the body of water is evaporated quickly, so that in prolonged drouths there is no water table or line of supersaturation ; in fact, there is no water or moisture left to be drawn up, and all the cropping has suffered.

I have known of instances, on gravel subsoils, resting on clay a little below the pipes, where this happened repeatedly, and where shallower drains would have prevented the ill-effects of drouth, and at the same time would have kept sufficient check on the raising of the water table. I know of instances where drains were put in 6 feet or more deep at wide intervals to take advantage of the free draining of the subsoil, and where the effect has been satisfactory in ordinary seasons, but most harmful in drouth. Had there been a deep body of water below this, no harm would have resulted. Deep draining should, therefore, be a matter of thoughtful consideration.

DIGGING AND GRAFTING.

When draining loams free from stones, the tools needed are few. On arable land, the top furrow may be split back by a plow. According to the depth of the drain, an opening from 9 inches to a foot may be required, and the taper should be constant to the bottom, in accorance with the width of the pipe to be used. The upper spit, or spits, according to the width, can be taken out with an ordinary spade, the loose soil [illegible] thrown out with a shovel. The [illegible] could be placed on one side of the [illegible] that may be put back last when fill-



Shorthorn Cows and Calves [illegible]d, Royal Farms, Windsor, England.