

the character of the soil as on the necessities of the crops to be grown upon it, which are very similar in all soils with those of the same species, which, therefore, points toward a uniformity of depth where this is practicable. What this depth shall be is an unsettled point. Practice is at war with science in reference to it, especially the practice of our countrymen. Scientists, as J. Parks, say to us four feet should be the general average depth. The practice of our countrymen—and we have inquired of many of them—points to three feet and under. In stiff clay lands they incline to a less depth, and only in Mr. Green's and Mr. Malcolm's practice have we met with a greater depth, some of their mains being three and a half feet. The essayist of ten years hence will speak more pronouncedly than we dare to-day. It is not at all improbable that science here, too, will win, as the opinion expressed above is that of science founded at least upon the practice of some in other lands. Waring says, "If any fact connected with 'tile drainage is established beyond a doubt,' (and yet our foremost drainers do doubt) 'it is that in the stiffest clays ever cultivated, drains four feet deep will act effectually, the water will find its way to them more and more freely and completely, as the drying of successive years, and the penetration and the decay of the roots of successive crops modify the character of the land, and they will eventually be practically so porous that—so far as the case of drainage is concerned—no distinction need in practice be made between them and less retentive loams.'"

This is a most joyous proclamation for those who till the cruelly retentive clays which mar the watershed that lies east of the line of the N. and N. W. Railway from Hamilton to Port Dover, and which extends through the counties of South Wentworth, and parts of Lincoln and Welland. But we have not been able to discover that ten rods of underdraining have been done in all that section, other than to prevent the flooding of cellars. If scientists are right here, the drainers of Ontario will certainly have to re-examine their bearings.

We can conceive the importance of coming to a right conclusion on this point. The prevailing idea, that just sufficient depth to escape the action of frost is sufficient, is certainly fallacious. We have to consider the action of the drain in lowering the line of saturation, and thereby keeping out of reach of mischief all water drawn upward through the medium of capillary attraction to the domain which should be given to the rootlets of vegetation. The moment when these reach this line, they at once cease to search for food in what is to them a land of the shadow.

Economy points in the direction of deeper drains, as one four feet in depth, drawing twenty feet each way, will certainly cost less than two drains drawing ten feet each way, providing the one does the work of the two; but in Ontario we wait for light here.

In reference to the distance of laterals from each other, there is no infallible rule, but for complete drainage, Waring—following Prof. Mapes—specifies forty feet as the distance for four feet drains, and (in reference to which there is apparently a consensus of opinion amongst drainage writers) twenty feet as the distance for three feet drains.

Large portions of the land in Ontario where underdraining has been done are but partially drained. In very many instances the mains only have been laid, but with grand results. In other portions the laterals have been put in at wide intervals in a tentative way, and with equally encouraging results. In no instance

have we met with a whole farm, regarding which the owner considered the drainage as complete (although there are a few such in the Province) save the one hundred and ninety-six acre farm of Mr. James Thompson, of Whitby, who commenced underdraining this farm some twenty-five years ago. In conjunction with the late James Dryden, he brought out a tile machine and a tile-maker from Britain, paying him in advance for his work. Supplanting what slab and auger-hole perforated pine-box draining he had done with tile, he gradually extended his operations to his whole farm. The soil is a clay-loam, with a clay, hard-pan sub-soil a little gravelly in its texture. In constructing the mains, tiles from six inches downwards are used, in the laterals two-inch tiles, but he thinks those one and one-half inches would answer, and favors the use of small tile. Where water is plentiful, silt then is not likely to choke them. They are laid one and a half rods apart on an average, and three feet in depth, and have proved not only a source of great comfort but also of much gain to the owner. Canadian practice, however, oftener places them three to four rods apart, some thinking this distance sufficiently near, and others intending, as they get time, to put in an intermediate drain. Most are of opinion that obstinate clays should have the drains frequent and shallow to enable them to draw more readily, which opinion, as we have shown, is at variance with scientific theories, and we have met with no practical work in the drainage of this class of soils in Ontario from which to draw deductions.

To drain land completely, at once, is certainly important. It obviates the collection and removal of the machinery of drainage every time the work is recommenced on the same plot of land, and the work is more likely to be the finished product of one consistent comprehensive plan. Other reasons might be given; but where there is a scarcity of capital we do not object to the plan of running a main here and there—as time and means afford it. In this way the inexperienced will become schooled in the work, and thus mistakes will be avoided when the work is undertaken on a larger scale. It is very much easier to correct a few mistakes than when these have been committed on a huge scale, and the principle is a safe one for those weak in capital to keep out of reach of that interest serpent which is feeding upon itself.

Where a spring is to be drained, the water should be collected in a pit or pits containing stones or gravel, with a large tile in the centre of these, tapped by a line of tile running directly to a sub-main or a main drain.

When quantities of water run over a ledge of rock, as in a rainy time, and thus greatly wet the land below, a ditch should be cut near its base, and filled with stones up to the level of the line intended for the tiles, which are laid on boards and covered with some material before being filled, to prevent the earth from getting in.

Of the four kinds of tiles used, viz., the horse-shoe, the sole, the double sole, and the round, we have only met with the sole and the round in Canadian practice, and the latter, for the Canadian reason that they make better joints, while Old Country and American practice covets them, since a collar may be used with them, which effectually protects the joints from the entrance of earth, and gives more room for the entrance of water which is mainly at the joints. We have not met with the use of collars at all in Canadian practice, which is to be deplored, as they add but one-fourth to the cost of the tile, and certainly add very much to the permanency of the work. The sole tile

has been used most frequently in draining in this country, for the reason that this kind was principally manufactured at the yards, but round tiles are coming into general favor. The chief objections to the use of sole tiles are, that in drying, owing to the more rapid contraction of the top side, the joints are not good, and collars cannot be used in laying them. Our tile manufacturers here turn them out thirteen inches long, but more recent American practice makes them two feet long where the clay is suitable, which lessens the number of the joints, and yet sufficiently admits the water which flows the more evenly in proportion as the number of joints is reduced.

The size of the tile to be used depends much upon the nature of the work required. Canadian practice has used them from six inches down to two inches for the mains, and those from three inches down to two inches for laterals, those two and one-half inches being a favorite size with the majority. English practice often uses one and one-quarter inch tile, but never without collars, and science has shown that this size will carry off the water (as laterals) of the rainfall of any ordinary season. The less the fall, the larger the tile required. The size of the tile sufficient to do the work should be carefully weighed, as more than this is money wasted. No tile should be used that is not well burned, and that will not ring clearly when struck with a piece of steel. One single defective tile may lead to more loss of crop in one season and greater outlay in repairs than would construct many rods of drain.

(To be continued.)

### The Chief Need of Ontario.

[Too late for April.]

EDITOR CANADIAN LIVE-STOCK JOURNAL.

SIR,—As our older woods decrease there will be, apparently, but one means generally used to give the country shelter, that is, long rows of evergreens will be planted. This is what has been found most successful. It is necessarily far more successful than maples or other deciduous trees, for these only give shelter in summer, while it is in winter they will be greatly needed here. The state of Ontario in winter, if the woods disappear as rapidly as they are going, and nothing is planted to replace them, will be far worse than that of a cold prairie country. Many people in Quebec, and some in Ontario, have left their farms because of the bleak winds of winter and spring which now render dwelling in the old homestead disagreeable and unhealthy.

There are ample means of shelter if we use the few years before the old woods are quite gone in procuring it. Young evergreens—pine, cedar, and the spruces—can be had in great numbers in some localities, and will transplant easily when small. When in after years a line of these has arrived at a good growth, it forms a high, solid, beautiful wall of living green, summer and winter, and is of such value to a farm in preventing too rapid drying in summer and in keeping off cold blasts in winter, that I never knew an individual who, having once grown such a protection, would have it cut down for a thousand dollars.

In the States people are beginning to go very largely into these schemes of field protection, and consequently the growth of evergreen seedlings is carried on, on a very large scale, by some of their nurserymen. In Waukegan, Ill., lately, I saw the nursery beds of Mr. Douglas, perhaps the chief evergreen planter of the States, where they are grown by millions, and sold in vast quantities every year. One way in which they are sent great distances is to sell them but four to six inches high, when four or five thousand can be packed in a small space. The buyer getting these plants sometimes in his garden, and transplants in two years, or places them at once in the line where he wants them, and as they can be planted close at first, there are plenty to spare in a couple of years to fill up the gaps, if any fail. These are sold at very low prices—three to five dollars a thousand—and go to all parts of the country. If there were a good demand for Ontario I have no doubt our own nurserymen would grow them as cheaply.