it is carrying off with it, from the soil, various materials that ought to remain in the soil, to aid the growth of the crop, such as manure and chemical ingredients that are found in all soils.

Then, too, a most important object must not be lost sight of, *outfall*. That is, the water borne away from the surface of the land must be allowed to get away freely; as soon as it enters the drain, it must begin to escape, or else the drain is not of any use. This is a matter of such great importance, that it cannot be too strongly dwelt upon. What is it that causes large tracts of lands, such for example as the St. Clair flats, to be unproductive at present and likely to continue so for years to come? Had there been any means of taking the water off the land by open cut ditches, canals or underground drains, would the work not have been accomplished long ago? What is meant by low-lying lands but this, that there is no escape for the water; the water cannot get away, therefore forms into a swale, marsh, or pond?

Now, when an attempt is made to dry that land by draining it, does not the natural feeling prompt a man to seek a place to let the water escape? Water does not require a great fall, it will discharge freely on a perfectly lever surface, that is to say, a level surface understood in the sense of being parallel to the curvature of the earth's surface, not level in the theoretical sense, which means drawing a line to make a tangent to the surface of the earth from any given point. Water will discharge itself on a grade of six inches to a mile, provided the orifice is large enough to allow a sufficient quantity to pass through to overcome the friction in the pipe or drain, or sewer.

But if an outlet, such as a drain in the earth, is to have one end filled up with water, so that the water in technical terms backs on the drain, altering the level of that outlet two or three inches in height, when, perhaps on a field eight or ten chains long, the total amount of fall only amounts to two or three inches, the water will have no chance of escaping, and the field will remain in its old and wet condition—it will derive no benefit from the drains. This matter can easily be understood, if we take a damp cellar as an example. Suppose that, in draining a damp cellar, it was found that on one hundred yards of distance a fall of one inch was obtained, and the drain was carefully laid, so as to present a perfectly uniform surface for the water to flow over; so long as the water in the drain is kept under the level of the high end, which is supposed to be the cellar floor, that floor will keep dry, but the moment the water rises to the level of the floor, the drain becomes useless, and the cellar continues damp.

In like manner, if, in a low-lying or level field, where there is not a large amount of fall for the escape of the water, the mouth of the drain, (be the drain of stone, tile or wood,) is to be stopped up to half or three-quarters of its height, backing water a long way into the drain, only the higher end of that field would be kept dry, while the lower end was in the same, or perhaps a worse condition, than it was in before the drains were laid. A little care and forethought is always required in such cases, as it would be a waste of money, in general cases, to drain only to benefit half a field. There are cases in which, perhaps, the benefits derived from the drying of the upper half quite compensate for the cost of draining; but these are special cases, and do not occur in ordinary every-day practice. Get rid of all the water it is possible to get rid of, and try to let the water run off freely, is the true axiom of draining.

Effects of Salt as a Manure

It supplies soda and chlorine to growing plants. By its attraction for water it imbibes and retains moisture, keeping the soil moist, and so assisting plants to assimilate their food contained in the earth, especially during a continuance of dry weather. It exercises a great influence in rendering soluble some of the more insoluble earthy salts of the soil. When mixed with farm-yard manure or sown upon soils already dressed with dung, it seems by its penetrative and assimilative power to cause many of the salts in the manure to be sooner developed into a state fit for plant food than would be the case if left to the action only of the slower process of natural decomposition.

When added to the manure heap in the barn-yard and thoroughly mixed into it at the rate of about two tons of salt to thirty tons of manure, it kills the seeds of weeds, eggs and larvæ of insects, and greatly promotes the fermentation and decomposition of the whole mass, while at the same time it does not, like lime, set free the ammonia, or volatile salts in the manure.

When added to lime a double decomposition takes place, resulting in the production of soda and carbonic acid, both of which possess greater fertilizing properties than either salt or lime. Combined with gypsum, salt produces soda and sulphuric acid, at a cheaper rate than can be obtained in any other way.

As a general thing, there are few fertilizing materials used on the farm that cannot advantageously have salt added to them.

Drainage in Relation to Temperature

BY ALAN MACDOUGALL, C.E.

Nature has provided that under certain circumstances certain classes of vegetation shall exist: there are many beautiful plants that flourish altogether in the air, others in the water, or in large ponds. If it were tried to make these plants subsist on soil prepared for cereals or green crops, the attempt would be a failure; and in like maner to expect wheat or oats to grow in swampy land will result in a failure. The earth of itself imparts heat and other life-giving elements to all plants according to their situation, and under the laws of nature, plant life is sustained during summer and winter in swamps and ponds as well as in highly tilled land.

The heat of the earth, the great agent in plant life in the earth, is liable to great variations from different causes, such as temperature or climate and depth. In summer the land gets heat from the sun and is warmed, this warmth sinks into the land, to be retained for the use of plant life in winter. In well drained land, the canals, or larger spaces between the particles composing soil, being free to act as water or air ducts, when not perfectly dry, have sufficient moisture in them or are able to draw up enough to sustain plant life, by what is known as capillary attraction. Water being a better conductor of heat than air, draws up by this means, the heat of summer that has been stored in the earth, to the roots of plants during winter; thus feeding them and keeping them in a temperature several degrees higher than the rest of the plant that is above the surface of the ground, which may be covered with snow or frozen over. In undrained land, the canals are either so full of water, that when winter comes, all the heat rises to the surface to be thorougly drawn out in frost; or the canals are full of air, if the soil be dry, and the heat escapes into the atmosphere.

It has been ascertained, from careful observations and experiments, that the heat of summer sinks into the earth until it reaches a point where the ordinary temperature in summer and winter does not vary; where it is at a mean or average. This depth varies from 50 to 100 feet below the surface, according to circumstances. Variation of temperature also takes place in proportion to the depth under the earth's surface: at 24 feet down it was found to be as little as 3 degrees; at a point from 50 to 100 feet down, as before mentioned it was found