

timber-trees, and the shrubs seemed to withstand the very dry weather, I made the following experiments, to ascertain the amount of water present in the dry soils around my house at Croydon. When these specimens were taken, there had been scarcely any rain for several weeks, only 0.43 of an inch of rain having fallen at Croydon in the previous July, and not any in August till the specimens of different soils were collected; and it is remarkable that during five or six weeks, from July 1 to August 6, there were not more than four or five nights that any dew fell. The eight specimens I examined were as follows: No. 1 was a black, gravelly soil, from immediately under the turf of an old park. This soil is about 5 inches in depth, resting upon a bed of coarse gravel about 4 feet thick. No. 2 was from a bank of the Isle of Thanet sand, planted with young timber-trees. No. 3 was from the chalk soil of an old pasture, immediately below the turf. No. 4 was from a kitchen garden whose soil is the Isle of Thanet sand. This specimen was taken from the surface of a bed on which Regent potatoes were growing. No. 5 was from the soil of the same bed, taken 9 inches from the surface. No. 6 was blowing sand, taken from some excavations near the East Croydon station. No. 7 was from a field of the London basin clay. No. 8 was from a bed of black sandy gravel, copiously dressed with cocoa-nut fibre. Equal weights of these soils were carefully pulverized, and exposed for some hours to a heat of 212 deg. Upon again being weighed, they had all lost weight; and calculating that the weight of an acre of soil 10 inches deep is equal to 1,000 tons, then the amount of water contained in these soils (all in appearance quite devoid of moisture) was equal, in these experiments—No. 1 soil under turf, to about 20 tons of water per acre; No. 2, Thanet sand, 10 tons; No. 3, chalk soil, 5 tons; No. 4, potato soil from surface, 5 tons; No. 5, same soil, nine inches from the surface, 30 tons; No. 6, blowing sand, 7½ tons; No. 7, London clay, pulverized, 40 tons; No. 8, cocoa-nut fibre and soil, 41 tons. At the time these experiments were made there had hardly been any rain for forty days. From the 29th of June till the 6th of August it only rained on eight days; and the total amount of rain-water during that time was only fifty-five tons per acre, or on an average about seven tons of water each day that any rain fell. These showers merely moistened the surface of the ground, and were speedily dried off. The water, therefore, which remained in the soils when I examined them would apparently only have been maintained by their absorption of the watery vapour of the atmosphere.

And as I have in another place had

occasion to remark, when speaking of the absorption of the watery vapour by our soils, we must not forget that this deposition of water is not confined to the surface of the soil. Wherever the atmospheric air can freely penetrate, there the deposition of the dew, under favorable circumstances, takes place. This also often occurs in the interior of the soil, when evaporation is taking place from the surface. The amount of dew deposited upon the soil has been estimated by Dr. Dalton to be equal to five inches per annum, or about 500 tons of water per acre. Less dew is usually formed during the first than in the second portion of the night. The amount of water deposited in dew varies at different seasons and localities. Autumn, as Mr. Steinmiz observes, is remarkable for its heavy dews, owing to the depression of the temperature during the night. These are sometimes so abundant as to admit of measurement in the rain-gauge. In one night towards the end of September, Luke Howard got one hundredth of an inch of water from the dew, and in the last six days of October eleven-hundredth from copious dews and mists. We must not then forget that dew is only one form in which the aqueous vapour of the atmosphere is deposited on the earth for the service of vegetation. We have seen that when soils are dried in a temperature of 212 deg., and exposed on their surfaces to air saturated with moisture, they absorb very considerable portions of water. Suppose a soil weighing about 1,000 tons per acre is pulverized so as to be freely permeable by the atmosphere, and that such a soil, after being thoroughly dried, is exposed to the air, then we find from the experiments of Schubler that it will absorb water, in 24 hours (being a still greater amount than in the trials of Davy)—

If a sandy clay, equal to	26 tons.
If a loamy clay	30 "
If a stiff clay	36 "
If a garden mould	45 "

We may conclude, then, that the more deeply a soil is pulverized, the more copious will, in certain states of the atmosphere, be the supply of moisture from the air; and let us not forget that this deposition is commonly in warm weather greater under the surface than on the surface of the land, simply because it is the cooler portion of the soil. To give an instance, when (at Croydon) at 9 o'clock in the morning of the 7th of June, 1869, the temperature of the air in the shade, on a northern aspect, was 78 deg., at a depth of 12 inches the earth was only 53 degs. At Chiswick, when the air was 78 degs., the earth was 68 degs. On the 5th of July, when at Croydon the thermometer indicated 78 degs. in the air, it was only 55 degs. 12 inches in the earth. On the same day at Chiswick, when the temper-

ature of the air was 80 degs., that of the earth at 12 inches was 63 degs.

We may then well concur with Mr. Vallentine when at the commencement of his essay he remarks:

"The most essential step towards causing the retention of moisture in arable land is to obtain a good depth of well-cultivated soil. All clay soils, and all such as rest upon clay or have a hard impervious pan or subsoil within a few inches of the surface, require, in the first place, *draining*, which must be followed by deep cultivation of some sort when the ground is sufficiently dry to crumble into pieces.

"It certainly at first sight appears paradoxical to speak of draining land as a means of enabling it to retain moisture; but when the various effects which drainage has upon land are duly considered, there is no real absurdity in the matter. Without considering it necessary to enter fully into the theory and practice of drainage, I must mention a few leading points on the advantages of draining all impervious subsoils.

"The great object of draining is to relieve the soil of an excess of moisture, so as to allow rain water to filter through the land instead of standing too long, or running over the surface. A good deal of land when being drained is found to have a comparatively dry subsoil to what the surface has, and so dense as to prevent water readily passing through it. After draining, however, air passages are formed, and water follows at once, when there is any pressure from the surface. Thoroughly drained, well cultivated land allows any excess of moisture to pass away during wet periods, whilst it also has the power of retaining a store of moisture for periods of drought.

"All ordinary root crops thrive best with a good supply of moisture, and even oats and barley not unfrequently suffer from drought. The best naturally fertile soils are of such a texture that they require no artificial draining, and seldom become either too wet or too dry. Light sandy soils, on the other hand, have too much natural drainage, and are chiefly a trouble from retaining too little moisture. Clay loams by drainage and superior cultivation are rendered well adapted for root crops, though such soils at one time were considered quite unsuitable for them.

"After the drainage of such land as require it, the next most important step for retaining moisture is *deep-cultivation*. Whether this may be accomplished by steam or horse power is immaterial, so that the operations are carried on at the proper time, when the soil is dry, or comparatively so. To manage this always is next to impossible; but to be able to do so generally requires no more than a full strength of horses or steam properly