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## AGRICULTURAL NOTES.

## DARWIN ON THE EARTHWORM.

When a man has devoted half a century to the careful investigation of a subject, and at the end of that period gives the results of his labours to the world, it might naturally be expected that he would publish something well worth reading; but when that man happens to be Mr Darwin, it may safely be said that a book containing rather such difficulties than his pen would meet with a reception the most kind of which most deserve all opinion. For Mr Darwin is not like other men. Not only, but twice, we get before us the same far more as the opponents of such new theory, or the carriers of some strange and almost incredible facts. His published works now number nearly a score, and every one of them, from the celebrated "Origin of Species" to the one which now lies before us, marks a distinct extension in the realm of knowledge. No living man, perhaps no philosopher whom the world has ever seen, has encountered such furious opposition or met with such severe and bitter criticism as the illustrious exponent of the theory of evolution; but he has lived to see the opposition of old doubts away to nothing, and to see the support and even increased reverence of the most unprejudiced of his critics. And why is this? It is not only on account of his full faculties, of his extraordinary powers of observation, nor is it solely due to his honest expression of conviction or of doubt. More than to either of these it is in consequence of his intellectual love for the truth, and nothing but the truth. This, as it seems to us, is the key to the success which he has won for himself. Years ago it had come to be said, even amongst those who differed from him most widely, that the most powerful arguments against Darwin's views were to be found in his own works. While he continued every fact which had led him to formulate this or that theory, he so honestly and dispassionately discussed every fact of which he was possessed that told against him; and that his opponents, even at the very outset of the attack, found that all their artillery was in the enemy's camp. The brilliancy of his genius is only equalled by the versatility; no subject seems to have more come to him—great facts and relations, zoology and agriculture, fossilising plants, insects and animals, man himself, and now in his latest work the humble earthworm.

As long ago as 1881 Mr Darwin read a paper before the Geological Society of London on the action of worms in the formation of vegetable mould, in which he pointed out that worms were prime agents in the formation of soils, and that the world had passed many times through the labours of worms, and would do so many times again. Like most of his opinions when first announced this one was warmly controverted, and for a space of 40 years the subject has lain dormant, till now in the mind of Charles Darwin. He has had time to test his conclusions and to accumulate facts, and the result is that he adheres firmly to his opinion of 44 years ago.

After a brief introduction, the first two chapters of the book deal with the habits of worms, the third is on the amount of fine earth brought up by worms to the surface, while the fourth treats of the part which worms have played in the build of ancient buildings, such as old Roman cities and villas. The next two chapters are concerned with the fossilisation of the land by the agency of earthworms, while the seventh and last chapter gives, in a space of eight pages, a summary of the work.

Earthworms require for their enjoyment a soil which is not too sandy or gravelly, and which is sufficiently moist. They burrow through the soil, and can live for some months under water if it is not too cold. They are nocturnal in their habits, and escape from their burrows at night, not infrequently leaving them and wandering about, in which case they do not appear capable of finding their way back again. They often go through the day long within the mouths of their burrows, whence they are plucked out and destroyed in large numbers by birds, especially by Magpies and Crows. Though they possess no eyes, they nevertheless have the power of distinguishing between light and darkness, and just ahead of them leading the

blended. Worms enter in various ways, in great numbers, into their bodies, and they are found, when the soil is in a favourable condition. Worms being blind, they are completely lost, as they dig, to the earth with indifference to all objects, whether solid or gaseous. . . . But they do not regard it as a function commensurate to the medium surrounding them. First, when a tuber-pot (potatoes) earth and worms was laid down in a glassed cabinet upon a wire stand, the worms took an interest, but directly the cover-glass was placed on the glass, the circulation ceased them to disappear in their burrows. They possess a feeble power of smell, and related them and children in the matter of taste; thus they readily prefer green substances to red colours, and prefer white leaves to both, and while they are extremely partial to many and sweet leaves, they will leave nothing in its way with eggs and thymus. They eat very largely of earth, both white they digest various animal and vegetable matters, and when their excrement the they illustrate their capabilities by eating them.

The worm's body is made up of a series of rings or segments, the anterior of which is furnished with a mouth, and by means of this latter various objects are seized and drawn along. Insects and leaf-miners are the chief objects to which worms direct their attention, and Mr Darwin mentions they exhibit intelligence, here made as they grasp leaves, &c. by the narrow end, thereby facilitating their passage into the burrows. The flowers which in the morning and they meet especially to guard by the ends of their. Fuller leaves and leaf-miners, small insects are called into circulation, and if they are not of local small patches have to do service. Whatever of these objects may be employed, they are used for plugging up or covering over the mouths of the burrows, apparently for the sake of warmth.

[In making a burrow the worm forms the anterior end into some little circle or curve in the soil; it then comes the immediately succeeding part of the body to rest, thereby pushing away the earth on all sides; a continuation of these operations leads to the excavation of the burrow. But if the soil be very hard, the worm has to cut his way down, passing the soil by its mouth, through the body and ejecting it at the tail end in the form of a casting. Having made its burrow, the worm often covers the bottom with thin slices of roots, and, more than this, it glazes over with its excreta the entire wall of the burrow, so that it is like a little tunnel lined with cement. The castings ejected by a worm must be familiar to everybody who has walked across a grass meadow a moist autumn morning. In some countries these castings answer the use of little mould or loam; here at four inches high, and weighing several ounces. But whatever the height may be, the worm always keeps an open channel through it. Worms are very numerous in fine garden soils, and as many as sixty-four open burrows have been found in a space of 1/4 square feet. Hutton calculates that there are 11,700 worms in an acre of rich land, and Mr Darwin thinks we may fairly take half that number as representing their average abundance on any good soil land. The data are given for estimating that each worm passes through the body and ejects 10 ounces of earth in an average per annum, and this on agricultural land represents 11 tons an acre every year! But even assuming it to be only 10 tons, Mr Darwin says:—

"The estimate a century of the size of Great Britain, which is period not very long in a geological sense, even on a million years, seems to be independent, for the 10 tons of earth lost is to be multiplied first by the acres number of grass, and then by the number of acres fully stocked with worms; and in England, together with Scotland, the land which is cultivated and is well stocked for these animals has been estimated at above 10 million acres. The product is 100 million million tons of earth."

The worm then is undoubtedly a farmer's friend; he is practically a cultivator—not so fast as a steam cultivator or a horse plough, but equally sure and certain in his results, and far more efficient in his work system. In making a soil richer and rich yielding indeed can equal the earthworm. On this point we give another quotation from the work itself:—

"Worms prepare the ground in no excellent manner for the growth of various rooted plants and the seedlings of all kinds. They periodically water the ground in the soil, and fill it so that no stone larger than the particles which they may swallow are left in it. They mingle the white particles together, like a gardener who prepares the soil for the different plants. In this state it is well fitted to receive moisture, and to absorb all soluble substances, as well as for the process of assimilation. The holes of dead animals, the leather parts of insects, the shells of land molluscs, leaves, twigs, &c. are broken long and broken beneath the accumulated castings of worms, and are thus brought in a more or less dissolved state, various parts of the scale of plants. Worms likewise are habitable nurseries of land insects and other parts of plants into their burrows, partly for the sake of shelter from the soil, partly to feed. The larvae which are dropped into the burrows to feed, when being torn into the food chains, partially dissolved, and combined with the soil, and will be

found in the dark coloured soil beneath which almost every plant grows the surface of the soil with a fairly well defined layer of mould. Van Hatten found two worms in a round 10 inches in diameter, which was lined with soil, on which fallen leaves were piled around, and these were soon dropped into their burrows to a depth of three inches. After about six weeks a shallow surface layer of soil, a substance 1/4 inch in thickness, was accumulated into hollows by having passed through the alimentary canal of these two worms.

"Long before now selected," says Mr Darwin, "the food was regularly ploughed, and still continues to be thus ploughed by earthworms." The worm in the previous paragraph, he works so steadily and slowly, in stream and in distance; he does no return for his labour, and too frequently gets trampled on, and trampled as a man, besides the thing, with its numerous little bits of soil. This trampled and trampled alike must be in the lively world, the soil is big, and they cannot take it from him. From this moment on he has told it, and by every right, every-thing, particularly, he will continue to hold in. During the whole of his life, almost all he is doing a great work, feeding the soil in which he lives, and enriching the earth when he dies.

A friend called on me while Mr Darwin's book on worms was lying on the table. He picked it up and turned over the leaves, casually at first, but quickly with interest. He says that on having the only book was that of the pen, and then with a slow breath our friend closed the book, picked up his hat, and said, "I never got a book of Darwin's yet that I couldn't read. I looked in on you for a few minutes, and here I've been reading for nearly two hours about earthworms, animals on whom I formerly believe I never regarded a moment's thought before." There is, indeed, a charm in the work—there must be in any work that both a scholar and a philosopher would read with interest—and we shall not be surprised if, in the course of a short or so, Mr Darwin's latest literary effort is in great demand as a Christmas gift book.