

## CONSTRUCTION, HABITS, AND WORK OF WORMS.\*

The subject of this volume is the share which worms have taken in the formation of the layer of vegetable mould which covers the surface of the land in every moderately humid country. This mould, says Dr Darwin, is generally of a blackish colour and a few inches in thickness. That eminent naturalist was led to keep in his study during many months worms in pots filled with earth, and becoming interested in them wished to learn how far they acted consciously, and how much mental power they displayed. The results, as set forth in these pages, are extremely interesting. Nearly fifty years ago Dr Darwin showed that small fragments of burnt marl and cinders, which had been thickly strewn over the surface of several meadows, were found after a few years lying at the depth of some inches beneath the turf, but still forming a layer. This apparent sinking of superficial bodies is due to the large quantities of fine earth continually brought up to the surface by worms in the form of castings. He was thus led to conclude that all the vegetable mould over the whole country has passed many times through, and will again pass many times through, the intestinal canals of worms.

Earth worms abound in England in many different stations, says Dr Darwin. Their castings may be seen in extraordinary numbers on commons and chalk-downs, so as almost to cover the whole surface, where the soil is poor and the grass short and thin. Even on the same field worms are much more frequent in some places than in others, without any visible difference in the nature of the soil. They abound in paved court-yards close to houses; but on dry, sandy, or gravelly tracks hardly any can be found. During the summer, when the ground is dry, they penetrate to a considerable depth and cease to work, as they do during the winter when the ground is frozen. Worms are nocturnal in their habits, and at night may be seen crawling about in large numbers, but usually with their tails still inserted in their burrows. During the day they remain in their burrows, except at the pairing season. When they do leave their burrows it is on a voyage of discovery, to find new sites to inhabit.

The body of a large worm consists of from 100 to 200 almost cylindrical rings or segments, each furnished with minute bristles. They breathe by their skin, as they do not possess any special respiratory organs. The two sexes are united in the same individual, but two individuals pair together. Worms are destitute of eyes, and at first Dr Darwin thought they were quite insensible to light. Experiments which he made show, however, that light affects worms by its intensity and by its duration. It is only the anterior extremity of the body, where the cerebral ganglia lie, which is affected by light, and if this part be shaded light produces no effect. As they have no eyes we must suppose that the light passes through their skins, and in some manner excites their cerebral ganglia. So that when a worm is suddenly illuminated it dashes into its burrow. Although worms cannot be said to possess the power of vision their sensitiveness to light enables them to distinguish between day and night. Worms do not possess any sense of hearing, but their whole body is sensitive to contact. The sense of smell is apparently confined to the perception of certain odours. "It may be presumed," says Dr Darwin, "that all animals which feed on various substances possess the sense of taste, and this is certainly the case with worms. Cabbage leaves are much liked by worms; and it appears that they can distinguish between different varieties; but this may perhaps be owing to differences in their texture."

Worms are omnivorous. They swallow an enormous quantity of earth, out of which they extract any digestible matter which it may contain, but they live chiefly on half decayed leaves. The half decayed or fresh leaves which worms intend to devour are dragged into the mouths of their burrows to a depth of from one to three inches, and are then moistened with a secreted fluid. The fluid, with which the leaves are bathed, acts on them whilst they are fresh or nearly fresh in a remarkable manner; for it quickly kills and discolours them. "As the leaves which are dragged into the burrows," says Dr Darwin, "are often dry and shrivelled, it is indispensable for their disintegration by the unarmed mouths of worms that they should first be moistened and softened; and fresh leaves, however soft and tender they may be are similarly treated, probably from habit. The result is they are partially digested before they are taken into the alimentary canal. I am not aware of any other case of extra-stomachal digestion having been recorded. The boa-constrictor bathes its prey with saliva, but this is solely for lubricating it."

Worms seize leaves and other objects, not only to serve as food, but for plugging up the mouths of their burrows; and this is one of their strongest instincts. A leaf in being dragged a little way into a cylindrical burrow is necessarily much folded or crumpled; when another leaf is drawn in, this is done exteriorly to the first one, and so on with the succeeding leaves; and finally all become closely folded and pressed together. Hundreds of such plugged burrows may be seen in many places, especially during the autumnal and early winter months. When worms cannot obtain leaves for this work, they often protect their burrows by little heaps of stones. Work of this kind is hourly performed during the night. What advantage worms derive from it is doubtful. Dr Darwin says:—"May not worms, when the mouth of the burrow is protected, be able to remain with safety with their heads close to it, which we know they like to do, but which costs so many of them their lives? Or may not the plugs check the free ingress of the lowest stratum of air when chilled by radiation at night from the surrounding ground and herbage? I am inclined to believe in this latter view; firstly, because when worms are kept in pots in a room with a fire, in which case cold air could not enter the burrows, they plugged them up in a slovenly manner; and secondarily, because they often coat the upper part of their burrows with leaves, apparently to prevent their bodies from coming into close contact with the cold, damp earth." In the way worms seize leaves, in the selection they make of leaves, and in the way they arrange the leaves for this purpose, worms display singular intelligence. "If worms are able to judge," says Dr Darwin, "either before drawing or having drawn an object close to the mouths of their burrows, how best to drag it in, they must acquire some notion of its general shape. This they probably acquire by touching it in many places with the anterior extremity of their bodies, which serves as a tactile organ. It may be well to remember how perfect the sense of touch becomes in a man when born blind and deaf, as worms. If worms have the power of acquiring some notion, however rude, of the shape of an object, and of their burrows, as seems to be the case, they deserve to be called intelligent; for they then act in nearly the same manner as would a man under similar circumstances."

To excavate their burrows worms push away the earth on all sides, and for the same purpose they also swallow it. They also swallow a larger quantity for the sake of extracting any nutritious matter which it may contain. Although they usually live near the surface, yet they burrow to a considerable depth during the long continued dry weather and severe cold. Dr Darwin has often met with worms at a depth of three to four feet. The burrows run down perpendicularly, or more common obliquely. They are said sometimes dug ground and near the surface. They are generally lined with a thin layer of fine dark-coloured earth voided by the worms; so that at first they must be made a little wider than their ultimate diameter.

The amount of work done by worms is most astonishing. In many parts of England a weight of more than ten tons of dry earth annually passes through their bodies, and is brought to the surface on each acre of land; so that the whole superficial bed of vegetable mould passes through their bodies in the course of very few years. From the collapsing of old burrows the mould is in constant though slow movement, and the particles composing it are thus rubbed together. By these means fresh surfaces are continually exposed to the action of the carbonic acid in the soil, and of humus acids which appear to be still more efficient in the decomposition of rocks. "Archæologists ought to be grateful to worms," says Dr Darwin, "as they protect and preserve for an indefinitely long period every object, not liable to decay, which is dropped on the surface of the land, by burying it beneath their castings. Thus, also, many elegant and curious tessellated pavements and other ancient remains have been preserved; though no doubt the worms have in these cases been largely aided by earth washed and blown from the adjoining land, especially when cultivated. Worms prepare the ground in an excellent manner for the growth of fibrous-rooted plants, and for seedlings of all kinds." They periodically expose the mould to the air, and sift it so that no stones larger than the particles which they can swallow are left in it. They mingle the whole intimately together, like a gardener who prepares the fine soil for choicest plants. In this state it is well fitted to retain moisture, and to absorb all soluble substances, as well as for the process of nitrification." Says Dr Darwin:—"When we behold a wide, turf-covered expanse, we should remember that its smoothness, on which so much of its beauty depends, is mainly due to all the inequalities having been slowly levelled by worms. It is a marvellous reflection that the whole of the superficial mould over any such expanse has passed, and will again pass, every few years through the bodies of worms. The plough is one of the most ancient and most valuable of man's inventions; but long before he existed the land was in fact regularly ploughed, and still continues to be thus ploughed by earth-worms. It may be doubted whether there are many other animals which have played so important a part in the history of the world as these lowly organised creatures."

\* The Formation of Vegetable Mould through the Action of Worms. By Charles Darwin, LL.D., F.R.S. London: John Murray.