

## REVIEW

*The Formation of Vegetable Mould through the Agency of Worms, with Observations on their Habits.* By CHARLES DARWIN, LL.D., F.R.S.

This latest volume of Mr Darwin's, although treating on one of the lowest forms of animal life, is one of peculiar interest, giving an insight into the wondrous workings of a creature upon which we were wont to look as if of no importance whatever in the economy of Nature; which, in fact, we not only despised, but did our best to exterminate. The opinions expressed and information communicated have not been hastily formed, as they are the result of patient investigation and study for a period of over 50 years, and are written in a clear and simple style, intelligible to the ordinary reader. Certainly the magnitude and importance of the work performed by these humble creatures as detailed in this little volume give a different idea of their activity and value, raise them from the position of uselessness and insignificance, and show conclusively that by the lowliest agencies important and valuable results are often brought about. Whether the author has succeeded in establishing all his conclusions or no, every unbiassed reader must admit that he has placed his facts, based upon observation, with candour and fidelity upon record; and although in some points he may be mistaken, or the inferences not fairly deducible, yet on the whole the weight of evidence demands assent to his general conclusions.

The volume consists of seven chapters, the earlier being devoted to the structure and habits of worms; and considering the lowness of their organism — that they have neither eyes nor ears, nor sense of smell — the difficulty of the study is at once apparent. For the purpose of proper and complete investigation, Mr Darwin kept the worms in pots of earth in his study, and when approaching them did so with the utmost caution, as the slightest vibration of the floor caused the sensitive creatures to suspend or alter their operations. The patience exercised in watching whether music possessed any influence on them, whether they could distinguish a sudden transition from darkness to light, ascertaining their preference for particular food, and their remarkable instinct in the construction of their dwellings, while in some it may provoke a derisive smile, testifies to the intense earnestness of the man in accomplishing the task he set to himself to perform. The structure of the worm is elaborately described. A good-sized one consists of from one to two hundred cylindrical rings, each surrounded by bristles. The muscular and nervous systems are well developed; it has a mouth, some calcareous glands, and a gizzard, but no jaws or teeth, and breathes through the

1 skin. He concludes that, though eyeless, they  
1 can distinguish between night and day; though  
having no ears, they are extremely sensitive  
to vibrations among solid objects; and have a  
very feeble (if any) sense of smell. Of all their  
senses, that of touch—including in this term  
2 the perception of vibration—seems to be most  
highly developed. To illustrate his meaning  
more closely, the example is taken of the habit  
of a blind man, who forms his idea by  
touch, and by the same method a worm gains  
1 a general notion of the form of an object. In  
taste they have their food preferences as other  
creatures, and although omniverous, live  
chiefly on half-decayed leaves, are very fond  
of cabbages, and revel in onions. In flesh  
they prefer sweet, fresh, not putrid, raw fat,  
and as a digestive swallow great quantities of  
earth, afterwards casting it forth in a highly-  
improved condition. It will be provocative of  
some incredulity when the assertion is made  
that worms possess a degree of intelligence,  
but the well-adapted and carefully carried-out  
experiments render it well worthy of belief.  
Mr Darwin on this point thus reasons: "If  
worms are able to judge whether an object  
they have drawn to the mouth of their bur-  
rows can be taken in, and how it may best be  
done, they must have acquired a notion of its  
general shape, which they have learned prob-  
ably by touching it in many places  
with their anterior extremity, which  
3 serves as a tactile organ, and however  
rude their notion of the fitness of the object  
may be to enter the burrow, they have acted  
as a blind man would do under similar circum-  
stances, and consequently deserve to be called  
intelligent.

Again, in the construction of their holes, or  
burrows, a remarkable intelligence is displayed.  
These burrows run down perpendicularly, or  
more generally obliquely, and are invariably  
lined with a thin layer of fine, dark-coloured  
14 earth, voided by the worm, so that at first they  
are made a little wider than their ultimate  
1 diameter. Some of these holes Mr Darwin has  
found lined to a depth of four and a-half feet,  
and the process by which it is performed seems  
17 to be, that small pellets of soft earth are  
voided on the walls, and are spread out by the  
worm as it travels up and down, and when  
completed closely fits the worm's body. The  
lining also strengthens the wall, and perhaps  
18 saves the worm's body from being scratched.  
2 This was observed when the holes were made  
through a layer of sifted coal cinders, which  
was found to be lined to an unusual thickness,  
2 and the burrows, instead of being mere excava-  
tions, might rather be compared to tunnels  
lined with cement. A very interesting experi-  
ment is very simply and beautifully detailed.  
Leaves of the Scotch fir or pine were given to  
worms kept in confinement in two pots.  
After several weeks the earth was broken  
0 up, when the oblique burrows were found

to be lined down to a depth of, in one instance, seven inches with the leaves or fragments. Glass beads and bits of tile, which had been strewn on the surface of the soil, were stuck into the interstices between the leaves, and these interstices were plastered over with the viscid castings voided by the worms; and so closely did the framework cohere, that Mr Darwin was able to remove one of them for examination, and found it consisted of a slightly-curved cylindrical case, the interior of which could be seen through holes in the sides and at either end. The pine leaves had all been drawn in by their base, and the sharp points of the needles pressed into the voided earth. Had this latter precaution not been taken the worm could not have retreated into its burrow; the structure would have resembled a trap armed with converging points of wire, rendering the egress of an animal easy, but its ingress difficult or impossible. And what was another noted proof of the skill of the worm was, the Scotch pine was not a native of the district from which the worms were obtained.

The worms are most actively engaged during the night, when they issue from their burrows, keeping their tails therein, Mr Darwin doubting whether they could find their way back to their holes again if once fairly out, although he admits they apparently leave their homes on a voyage of discovery, and thus find new sites to inhabit. To their love of warmth is attributed the foolish habit of lying exposed at the entrance of their burrows, as thereby they become an easy prey to the blackbird and other enemies on the outlook for them.

If the conclusions of this learned philosopher are correct—and there can be no reasonable cause for doubt—then the labours of these creatures are of a stupendous character, only surpassed by the still more lowly-organised coral animal in constructing the innumerable reefs and islands in the great oceans. Some of the labours of the worm are instructively particularised: they prepare the ground for fibrous-rooted plants, periodically expose the mould to the air, and sift it so that no stones larger than the particles they can swallow are left in it; they mix the soils together better than the gardener can, and fit it to retain moisture and all soluble substances; they bury bones and decaying matter by their earth-mounds, so that plant roots have them within reach; their burrows promote the drainage of the land, and permit the air to penetrate deeply into the ground; they facilitate the downward passage of moderately-sized roots, which are nourished by the humus by which their holes are lined; to their labour many seeds owe their germination, some being covered by their castings, and others, buried to a considerable depth beneath accumulated castings, lie dormant until they are at a future time uncovered and germinate.

Mr Darwin is not satisfied with assuming

— anything as correct, even on the testimony of  
N very reliable witnesses, and so he tries to ob-  
tain the greatest amount of direct evidence.  
To ascertain the number of worms that live  
within a given space, and to weigh the castings  
thrown up by them in a given time, was rather  
a difficult undertaking. From his statement  
and that of Von Hensen it appears an acre of  
land may contain 57,767 worms, and in one  
case cited, in which a square yard was mea-  
sured, the castings gathered and dried before a  
fire were found to weigh 3½lb, or at the rate of  
7·56 tons per annum per acre. In fact 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, and consequently the term "animal  
mould" would be more appropriate than that

commonly used—vegetable mould. One chapter is devoted to the part which worms have played in the burial of ancient buildings, and in the author's interesting manner shows how Roman villas and the like have been covered up by the agency of worms. He also treats of the amount of denudation of the rocks which form the earth's crust effected by worms, and he thinks the formation of parallel horizontal ledges on hillsides may in some instances owe their formation to the same agency.

The volume concludes with an allusion to the insignificant agencies which are used to secure results of the highest moment. 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 its inequalities having been slowly levelled by the 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 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 have these lowly-organised creatures.

No one can rise from a perusal of this little volume without the most profound admiration of that Infinite Wisdom and Power by whom the labour of this foot-trodden little creature was originated and sustained, of Him at whose command

At once the lion and the worm  
Sprang from the teeming earth.

Coming from this author, this book bears a wondrous testimony to the truth of the Bible record of creation, as opposed to the modern theories promulgated by Mr Darwin and others, and which theories have been espoused by some of the New Zealand *literati* as more consonant with reason and their own ideas. This insignificant creature, hitherto supposed to be of use almost solely for the angler and some of the feathered tribes, is discovered to

be engaged in a stupendous work, which in human view would require the lion's strength rather than the puny efforts of the boneless, limbless worm, silently, steadily working on, age after age, ministering to human comfort and reducing human labour, sustained in its efforts by the same Power which maintains the stars in their courses—another miracle, continuous in its character and wonderful in its nature, presented to our view, and demanding the acknowledgment—

The hand that made them is Divine