

APPOINTMENTS FOR THE ENGLISH WEEK.

Monday	Dec 15	1884	St. Andrew's Day
Tuesday	Dec 16	1884	St. Andrew's Day

HOW true it is that we often do not know our best friends. How humiliating the reflection that we see not only above despoils, but actually wage war upon creatures that are not only unoffending, but are really valuable ministers to our wants. Some such feelings as these must needs, we think, strike the reader of Mr. DARWIN'S latest work,* whose publication we briefly noted last week. Another feeling we can indulge in with more complacency, and that is with reference to the admirable illustration this book affords of the operation of true scientific methods, and the ultimate practical value of well-ascertained facts when observed and marshalled as they are in the work before us. The narrowness of scope, the profusion and complexity of detail observable in other of Mr. DARWIN'S books, may, in some instances, have repelled the superficial reader, and rendered them distasteful to any but profound students. But in the present work we have simpler and less complex lessons, and in consequence a work which will commend itself to the general reader desirous of obtaining an insight into scientific method. Here we have a work devoted to one subject—the natural history of earthworms, and their agency in covering the land with mould—subjects which the superficial thinker would be at first glance disposed to treat with ridicule, or to consider as of little importance. A perusal of this work, the gist of which may be gleaned in an hour's reading, will, however, put a totally different construction on the matter. We have brought before us a whole series of observations extending over half a century, observations individually trifling, as it might seem, but which when grouped with the patient accuracy and fidelity of which Mr. DARWIN has shown so many transcendental illustrations, lead to the most important general conclusions. First is added to fact to observe, with so little apparent effort, that when the time comes to sum up and to draw the necessary inferences, it is found that the great body of cumulative evidence is all but completely unassailable, completely so for all practical purposes, for though it may be possible that some points may have been misunderstood, or do not bear out the inference sought to be drawn from them, yet on the whole the reader is led on from point to point till he is absolutely compelled, from the clearness and weight of evidence, to give his assent to the general conclusion. A more admirable instance of scientific induction could hardly be pointed out, and it is the more valuable from an educational point of view for the reasons we have stated—that the problem, however gigantic, is yet simple and less encumbered with details and cross issues than many others attacked with so much success by the author.

It should, and doubtless will, prove a great encouragement to those who have, in view of feeble-eyes, the faculty of observation to find, as they will find, that a record of three pages, that the simplest, most readily made observations may, if carried out with patience and perseverance, lead to the most important results. Of course, there are few indeed who have the faculty of observation so finely developed as Mr. DARWIN. Few have his unswerving patience, his clearness and freedom of statement; but on the other hand, we think no man of ordinary intelligence can read these pages without feeling that it is in his power also, if he will but give the necessary patience, to add materially to the mass of knowledge, and to arrive at results likely to be

practically useful. The earlier chapters are devoted to the structure and habits of worms. In lively language are they that they have sensitive eyes, no ears, no sense of smell; they are, nevertheless, endowed with a digestive system, delicate sensibility to touch, and powerful muscles—even intelligence is not denied to them. We must refer our readers to the book itself, whereas these facts are substantiated by repeated observations and carefully devised experiments. These observations and experiments are very interesting—most important for the purpose to which they are applied—and valuable from the point of view we have already alluded to, viz. the ease with which they may be made even by unskilled observers; but to allude to them at length here would be as unfair to the reader and author as it would be to pick out the plot of a novel and narrate its development. This is better done by the reader himself.

Briefly, then, we may say that the object of the volume is to show that worms live and do contribute a very large share in the formation of vegetable mould in districts where they exist, and to point out in what manner they do it. This necessitates an examination of these creatures, and a study of their habits. As long ago as 1817, Mr. DARWIN published the results of his first observations, in which he showed that small fragments of burnt stalk, chert, &c., finally appear over the surface of some meadows, disappearing after a few years, and were found in a uniform layer at some few inches from the surface, having beneath the accumulated mass and brought to the surface by worms in the form of castings. "I was then led to conclude," says Mr. DARWIN, "that all the vegetable mould over the whole country has passed many times through, and will pass again many times through, the intestinal canal of worms; hence the term animal mould would be in some respects more appropriate than that commonly used of vegetable mould. In a communication to the *Gardener's Chronicle* so long ago as (May 11, 1817) Mr. DARWIN gives an account of the successive layers of lime and chert which he found in a pasture, and the varying depths at which he found them in succeeding years. At first on the surface, they were found in subsequent years 1, 2, 3, 4, 5, up to 17 inches below the surface. In the present volume evidence of a similar character is given on soils of various characters. Strip by strip, layer by layer, the evidence is given, till, as we have said, the inference becomes inevitable. At first sight it may appear to many as if the agency must be too insignificant to produce such vast results. Mr. DARWIN alludes to this in his introduction, wherein he quotes some remarks made by Mr. FINE (*Gardener's Chronicle*, April 15, 1859, p. 418), in which that writer assumed—we call attention to the word assumed—that such highly endowed creatures could not have accomplished such stupendous work. "Here," says Mr. DARWIN, "we have an instance of this inability to surmise the effects of a continually recurrent cause, which has so often retarded the progress of science as formerly in the case of geology, and, more recently, in that of the principle of evolution." Knowing what we do now as to the "stupendous" work continually carried on by creatures individually the most insignificant, the objection has, indeed, not much value; but it is not in Mr. DARWIN to be satisfied with "assumptions" when direct evidence can be obtained, and he, not content with his previous observations and the large number of similar ones made by himself, or by others at his instigation, he resolved to attack the problem from another side, and to ascertain the number of worms that live within a given space, and to weigh all the castings thrown up within a given time in a measured space, as had been done also

by FINE HIMSELF. As to the number of worms, from his own and HENRI'S statements it appears that an acre of land may contain 25,000 worms! With reference to the weight of earth brought up by worms, numerous experiments were made in different places and under different circumstances. We have no space to cite one case, wherein a quantity of earth derived from some castings in a given time over a square yard, weighing before a day, was found to weigh 24 lb. 5 oz. at the side of 3.25 tons of dry soil per acre per year. In other cases 1; to 10 per acre per year were estimated to have been added, the thickness of mould so accumulated over the whole surface being estimated as from .025 inches in poor soil up to as much as 2.5 inches in the course of ten years.

Space will not allow us to do more than glance to the important and interesting chapters in which Mr. DARWIN has shown how ancient buildings, Roman villas, *1666* like have become covered up by the agency of worms, not to those in which he treats of the assumed decomposition of the soils which form the earth's crust effected by worms, and the formation of parallel horizontal ledges on hill-sides, which he thinks may, in some instances, owe their formation to this agency. What worms do for the farmer and gardener is told in the following extract, which will show that, however objectionable these creatures may be to a flower-pot, their value in a pasture or in an arable field is beyond all that we have previously considered on the subject:—

"If worms prepare the ground in an excellent manner for the growth of the most delicate plants and for seedlings of all kinds. They periodically expose the mould in the air, and stir it so that no stone larger than the particles which are cast into the air. They change the whole infinitely superior. Like a gardener who prepares the soil for his chosen plants. In this case it is well noted to retain moisture and to absorb all soluble matter. The bones of dead animals, the harder parts of leaves, the shells of land animals, leaves, twigs, &c., are better long all buried beneath the accumulated castings of worms, and are first brought in a more or less changed state within reach of the roots of plants. Worms likewise dig to infuse moisture of dead leaves, and other parts of plants into the pores of the soil, and so of plugging them up and partly so laid.

"The leaves which are dragged into the burrows at food, after being seen less the hard shells, partially digested, and saturated with the essential and energy nutrients, are mingled with such work. The earth from the half-rotten, soft leaves which almost everywhere covers the surface of the land with a fairly soft-looking layer or mass of moisture. Mr. DARWIN'S ground was in a road of holes in diameter, which was filled with sand, in which holes were seen several; and these were seen dragged into their burrows to a depth of 1/2 inch. After these six weeks an almost uniform layer of sand, a substance 1/2 inch in thickness, was covered less continuous by having passed through the alimentary canal of these few worms. It is not to be seen in some places that worms, which often penetrate the ground almost perpendicularly to a depth of 1/2 or 1 inch, necessarily act in this manner, notwithstanding that the third castings pile up the remains of the burrows prevent or check the air-water directly entering them. They allow the air to penetrate simply into the ground. They also greatly facilitate the downward passage of rain water, and so there will be water in the houses with which the burrows are lined. They make own their penetration to having been covered by earth, and often buried to a considerable depth beneath accumulated castings in the ground, and as some have seen they are occasionally recruited and permanent.

"Worms are greatly provided with arrangements for the purpose of soil to see, although they see the distinction between light and darkness; they are completely blind, and have only a feeble power of smell; the sense of touch alone is well developed. They can therefore have little about the outside world, and it is surprising that they should exhibit some skill in lining their burrows with their castings and with leaves, and in the case of some species in plugging up their castings into lower-the-connections. But it is far more surprising that they should occasionally exhibit some degree of intelligence instead of a mere blind instinctive impulse, in their manner of plugging up the mouths of their burrows.

* The Formation of Vegetable Mould through the Agency of Worms; and Observations on their Habits. By CHARLES DARWIN, M.D., F.R.S. (London: 1881.)

† *Illustrations of the Natural History of the Earth*, p. 246.