MR. DARWIN ON WORMS.

The Formation of Vegetable Mould through the Action of Worms, with Observations on their Habits. By Charles Darwin. [London: John Murray.]

THIS is one of the most fascinating of Mr. Darwin's many books. Few people, few men of science even, have suspected the part which earth-worms play in the formation and futilisation of vegetable mould. At first sight, indeed, it would seem to be incredible that almost the entire surface of all moderately humid countries passes every few years through the intestinal canals of earthworms. That such, however, is the case, we have Mr. Darwin's many years' of patient research to prove. Mr. Darwin is not an enthusiast in the ordinary sense of the term. He possesses a singular candour, which prompts him to write of nothing as certain until he ascertains that it is so, beyond all reasonable chance of doubt. He is quick to perceive possible objections, and is not satisfied until he has thoroughly discussed them and shown wherein they are defective, and wherein they tend to support his own conclusions. This book has certainly thrown a new light upon the means by which the earth is fertilised. The work of earthworms is a beautiful example of the natural cultivation of the soil, and every one who is told thus much must be eager to know more about the much despised worms which make our crops to grow and our fields so green and smooth. For more than forty years Mr. Darwin has been observing the habits of worms, and experimenting with them in various ways, to ascertain what degree of instinct and intelligence they possess. He has bestowed infinite pains upon the work, and the importance of the result which he has achieved can hardly be over-rated, either as a contribution to general scientific knowledge, or as an aid to understanding the chemistry of the farm.

Earthworms, we learn, abound in England in many different situations. They are to be found almost everywhere—on commons and chalk downs, in the London parks, and even under the floors of damp cellars. 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. They are nocturnal in their habits, and are very shy of leaving their burrows. Their physical structure is complex and the muscular system is well developed. They have neither eyes nor ears, but their digestive system is one of much nicety, and they possess what would seem to be very like a gizzard. They have strongly-defined tastes, for during Mr. Darwin's observations he found that they greatly prefer certain foods over others. Leaves would appear to be their staple of diet, although they are particularly fond of onions, cabbage leaves, and horse-radish. They are timid, and it is doubtful whether they suffer as much pain when injured as they seem to express by their contortions. They are omnivorous, and swallow an enormous quantity of earth, from which they extract any nutritive matter it may contain. Mr. Darwin thinks that worms possess an advantage over certain more highly-organised animals, in that they have the capacity of profiting by experience, for they will try to drag objects into their burrows, first in one way and then in another, until at last they succeed. There are two means by which they excavate their burrows—by pushing away the earth on all sides and by swallowing it. "In the former case," says Mr. Darwin, "the worm inserts the stretched-out and attenuated anterior extremity of its body into any little crevice or hole, and then, as Perrier remarks, the pharynx is pushed forward into this part, which consequently swells and pushes away the earth on all sides; the anterior extremity thus serves as a wedge." Mr. Darwin's observations are conclusive that worms sometimes swallow earth solely for the purpose of making their burrows, seeing that he has sometimes found them to have swallowed earth which could not have contained any nutritive properties. The burrows run down somewhat obliquely, and they are usually lined with a thin layer of fine dark-coloured earth which has passed through their bodies. This lining becomes very smooth and compact when nearly dry, and closely fits the worm's body.

The means by which earth is fertilised by worms is, of course, the most interesting part of the book, and Mr. Darwin is deserving of the thanks of all who are interested in scientific research and in the

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know, Mr. Darwin has not been accused of over-colouring the picture which he has drawn. His book fitly concludes with a paragraph which sums up in very few words the result of nearly half-a-century's observation and research :—

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, have these lowly-organised creatures.

DARWIN ON EARTHWORMS.*

WE have already given an outline of the contents of the new book by Mr. Darwin The fact that earthworms have much to do with the condition of the soil has been commented upon by numerous observers during the last fifty years. As early as 1837 Mr. Darwin read a paper on the "Formation of Mould" before the Geographical Society, and Mr. C. F. Morren published in 1829 his valuable observations and experiments on "Worms." Since then other writers have taken up the subject, notably Von Heusen, who published the result of his researches in 1877. It has been reserved to Mr. Darwin, however, to sum up the knowledge acquired in a singularly succinct form, and to add the account of his own painstaking researches for many years. Mr. Darwin's facilities are almost unique. In his efforts to discover the secrets of nature he has the pertinacity of a ferret. He has, in addition to ample means, four sons inheriting his tastes, and when at a loss for the verification of some statement, or for a fresh examination of evidence, "My son William" or "My son Horace" supplement very ably the labours of their sire. Ramblers on the South-downs must often have noticed the ledges turning along the slopes, and wondered how they originated. Mr. Darwin, coming to the conclusion that the ledges on hill-sides are produced by the castings of earthworms arrested in their downward tendency by blades of grass or other growth, sends "My son Francis" to a chalk escarpment near Lewes, and from the careful report establishes the correctness of his theory. A long life of scientific observation, amounting to nearly or quite half a century, has enabled the veteran philosopher to watch the gradual formation of mould from the castings of earthworms, until it entirely covered a stone path in his garden, thus proving under his own eyes what worms can do. He has corresponded for a lifetime with observers of nature in all parts of the world. No wonder, then, that Mr. Darwin is enabled to unlock a treasure-house of knowledge on the action of earth-worms which partakes of the character of a new revelation.

Earthworms are very considerable factors in the apparent "denudation" of the earth's continents. Before the earth is ultimately consumed by fire, if such is to be the final result, the sea will gradually encroach upon and engulph the vast alluvial plains now existing. Worms on slopes and hillsides are ceaselessly loosening the soil, causing it to slide into the valleys to be carried by rivers into the sea, until it is estimated that the peat valley of the Mississippi, for instance, will be level with the sea in the comparatively short time, geologically speaking, of 4,500,000 years. That is if (there is much virtue in an if) no elevation of the land takes place. But there are counteracting forces in nature. We owe to Mr. Darwin himself the discovery of the marvellous insects whose wonderful accretions are forming the coral islands of the Pacific. As far as recent discoveries carry us, and we are indebted to Mr. Darwin as the foremost leader in careful research, we are still very far from definite conclusions on the value of even the most likely theories of the world's history and future.

Whether intentionally or not, Mr. Darwin supplies new evidence of design in nature. For a million of years, to use his own suggestive calculation, that which we call vegetable mould has been passing through the bodies of earthworms. Not only has the earth been entirely ploughed up every few years, but concurrent with the ploughing has been the fertilising. The soil has been triturated in the gizzards of the tiny agriculturist and mixed with vegetable manure. If we could imagine a plough which turned up the soil and manured it in one operation, it would give a good idea of the action of earthworms. Worms serve the purpose of fertilising ploughs. They have pursued their avocations for ages without change of structure and without variation. They have not evolved into something else, and for aught we know have not been evolved out of a "fortuitous concourse of atoms." If there is any law gradually originating or changing species by "natural selection," or the "survival of the fittest," a million of years has seen no application of it in history of earthworms. The evident design of their structure and work is to make the surface of the earth fit for the growth of all things necessary to man and beast. Are we not driven to the conclusion that there must be an Intelligent Power behind all this ?

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