RECORD: Anon. 1882. [Review of] The formation of vegetable mould through the action of worms, with observations on their habits. *Sydney Morning Herald* (1 May), p. 7.

REVISION HISTORY: Transcribed by Christine Chua and edited by John van Wyhe 12.2019. RN1.

NOTE: See F1357.

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REVIEW.
The Formation of Vegetable Mould through the Action of Worms, with Observations on their Habits. By CHARLES DARWIN, LL.D., F.R.S. London: John Murray, 1881.

The volume published last year under the above title is the latest production of the prolific and erudite pen of the great naturalist whose remains have just been honoured with the highest distinction England can give to departed worth— interment in Westminster Abbey. That is a fitting culmination of a career which began in the Beagle 50 years ago, when the young graduate of Cambridge went on board to begin that course of observation of natural phenomena which led him to the most remarkable scientific generalizations the Baconian philosophy has ever produced.
It speaks well for a nation to have in its heart the disposition to honour literary and scientific merit as much as military, naval, and political success, and at no period of her history was England more generous and impartial in the distribution of this highest national honour than she is at the present time.
Between the most widely renowned of Darwin's books, "The Origin of Species," and the last of his productions, there is an immense difference—one dealing with the most comprehensive subjects of human investigation, and the other with the most apparently insignificant. But in both works the author's method is the same—a simple interrogation of nature, and a faithful attempt to collect, systematize, and interpret her answers. No other work exists so well adapted to explain, in Darwin's own words,

"The share which worms have taken in the formation of the layer of vegetable mould which covers the whole surface of the land in every moderately humid country."

As far back as 1837, the year after the completion of his voyage in the Beagle, Darwin read a paper before the Geological Society of London on "The Formation of Mould," and that paper contains the elements of the book issued by the writer at the advanced age of 72 years. During the interval of nearly half a century, he continued his observations, and of late his four sons—Francis, William, Horace, and George—helped him to an extent which he fully acknowledges in his new work. All through the volume he seems to have had some apprehension that the public might consider the subject too minute for investigation, and he deprecates beforehand possible hostile criticism in passages like this:—

"The subject may appear an insignificant one; but we shall see that it possesses some interest; and the maxim *'De minimis lex non curat'* does not apply to science.
Even Elie de Beaumont, who generally undervalues small agencies and their accumulated effects, remarks:—'La couche tres-mince de la terre vegetale est un monument d' une haute antiquite, et, par le fait de sa permanence, un objet digne d' occuper le geologue, et capable de lui fournier des re-marques interessantes.'"
The care Dr. Darwin took in order to arrive at his facts may be inferred from the following sentence in his introductory chapter:—

"As I was led to keep in my study during many months worms in pots filled with earth, I became interested in them, and wished to learn how far they acted consciously, and how much mental power they displayed."

The result of these minute observations was the conviction that earthworms are blind and deaf, but that their sense of touch is highly developed, and that they are extremely sensitive to vibrations and to changes of temperature. In common estimation they are believed to roam over the soil with no settled habitation, burrowing wherever they may happen to find suitable conditions. But Darwin says:—

"I have never seen two tracks leading to the same burrow; nor is it likely from what we shall presently see of their sense-organs that a worm could find its way back to its burrow after having once left it. They apparently leave their burrows on a voyage of discovery, and thus they find new sites to inhabit."

The function they have to serve in the economy of nature is to cover the globe with a few inches of vegetable mould reduced into fine particles by being passed through their bodies. Usually they are regarded merely as pests to the gardener and agriculturist, with no corresponding benefit to the land they inhabit. Instead of that, they are now declared to be the best earth-workers on the globe, literally ploughing the ground by their millions of burrows, bringing up to the surface many tons of castings every year and triturating the soil by their physical movements, and the requirements of their voracious digestion. In suitable localities they are estimated to number 53,767 to the acre, which would give New South Wales about ten million millions, if that proportion were uniformly maintained throughout the territory. They subsist principally on leaves, which they drag into their burrows, partly for food and partly for warmth, shelter, and concealment, but they appear to be mightily impartial in the matter of diet, for in extremity they will eat anything, even one another. The amount of earth brought up to the surface by worms is a matter of long observation and nice calculation.
In a field belonging to Mr. Wedgwood, of Maer Hall, Staffordshire, "mould to an average thickness of .22 of an inch had been annually brought up by the worms, and had been spread

over the surface of this field."
At the same rate, the whole surface of the globe would be covered with a mould 22 inches deep in the course of a hundred years. But it is not every locality which is favourable to the operations of these natural cultivators of the soil. They require a certain quantity of moisture, and they are
"extremely rare or quite absent in the drier, brown, fibrous peat, which is so much valued by gardeners. On dry, sandy, or gravelly tracks, where heath, with some gorse, ferns, coarse grass, moss, and lichens alone grow, hardly any worms can be found; but in many parts of England, wherever a path crosses a heath, its surface becomes covered with a fine, short sward,"
the work of these voluntary gardeners.

At page 122 a passage occurs in reference to the vermicular wealth of New South Wales. Naturalists all over the world are in the habit of corresponding freely with each other, and making known the particular kind of investigations they are pursuing with a view to mutual assistance and co-operation.
Dr. Darwin had correspondents in every country while his last book was in the course of preparation, and one of these was Dr. G. Krefft, late Curator of the Sydney Museum. In reference to that he says,
"In the dry climate of New South Wales I hardly expected that worms would be common; but Dr. G. Krefft, of Sydney, to whom I applied, after making inquiries from gardeners and others and from his own observations, informs me that their castings abound. He sent me some collected after heavy rain, and they consisted of little pellets about .15 of an inch in diameter, and the blackened sandy earth of which they were formed still cohered with considerable tenacity."
The conclusion at which the author arrives from all the facts collected during half a century from so many parts of the world is that worms play a much more important part in the economy of nature than has been commonly believed hitherto.
"In many parts of England," he says in his last chapter, "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 every few years."
They decompose and disintegrate particles of earth, generate humus-acids, circulate carbonic acid through the soil, and
"prepare the ground in an excellent manner for the growth of fibrous-rooted plants and for seedlings of all kinds."
No theory of evolution is associated by the author with the results of his latest observations. He is content to submit plain facts, leaving them to speak for themselves, and disciples of Dr. Paley will not be slow to point out the marvellous adaptation of means to ends in this inferior

region of animated nature as a proof of the supremacy of reason in the universe and of the existence of an intelligent First Cause. Nothing is more remarkable in the whole of Darwin's career than his utter indifference to controversy. Hundreds of books have been written in opposition to him, and the tide of battle has raged around him like the turbulent surge of the sea. But in the midst of it all he kept on quietly studying nature, and issuing book after book as soon as mature study led him to valuable results, apparently unconscious of the storm of prejudice his work was creating. Seldom has such an example of complete self-conquest been given to the world. His fame will lose nothing by it in the end, and society has been the gainer by several valuable works which could not have been written had their author descended into the arena of literary warfare. Professors Huxley and Tyndall have fought his battles well, and but for their powerful championship of the foremost naturalist of the age, it is doubtful whether his remains would have been now resting in West-minster Abbey, side by side with those of the greatest men whose names adorn the annals of England.