

surface. Now this is entirely due to earthworms, as the following will clearly show. In a great number of instances it was found that certain materials had at different times been spread over the surface of pastures, and that after a few years they all disappeared, or as people were used to say "sunk into the ground." But it was found that they sank uniformly over the whole surface of the fields, and that this was not due to specific gravity was plainly seen from the fact that light cinders and small bodies sank at exactly the same rate as large and heavy stones. Moreover, added to this it was found that if all the worm casts were collected for the space of one year from one acre of good pasture land and were then dried thoroughly so as to be as light as possible, there were no less than the enormous amount of ten tons of earth annually thrown up by earthworms. And even these figures are not surprising to anyone who will carefully watch a small area of damp pasture land for a certain time, and notice the large quantities of earth thrown up. There are in different parts of the world worms of enormous size which throw up a proportional amount of prepared mould. One found in the Nilgiri hills, in south India occasionally throws up a tower, which when dried weighs a quarter of a pound. It must not be forgotten either that the earth of worm-casts is of the same nature as earth with a large proportion of decayed vegetable matter mixed with it; because the acids which form when leaves decay are formed much more quickly inside the worm, and are to a certain extent modified by the alkaline secretions of the worm's body. These humus-acids, too, have a decided effect in decomposing the small particles of rock and other hard mineral matters which are too small to be acted upon by the usual mechanical action of water, but which are swallowed by worms in large quantities.

Worms have effected what must to all seem cyclopean tasks, they have slowly undermined large stones, old pavements, low walls and even ancient cities, these little by little, as centuries have rolled by, have kept gradually subsiding until at last they have disappeared out of sight. The action of worms is not always perceptible where it occurs, for when castings are thrown upon the sides of hills they are liable to be washed down into the valleys by rain, or to be blown away in the shape of dust, when they have dried and became pulverized.

The burrows of worms do not often penetrate deep into the earth, but in winter and very hot weather they occasionally descend as deep as six feet from the surface. Worms must always have a large amount of moisture in the soil, and in fact so much is this the case that they may be called semi-aquatic. Perries kept a specimen entirely immersed for nearly four months, and the castings are always extruded in a semi-liquid state. The habit of lining their burrows with finely triturated earth, small stones and leaves, is thought by Dr. Darwin to be as a protection for their bodies against the cold of the earth; and for this reason they probably plug up their holes with small heaps of stones or leaves, pieces of string, feathers, and any other small objects which are not all certainly dragged in as food. Besides, by these tunnels materially helping the drainage of land and ventilating the ground, passages lined with fertile soil are opened for the roots of plants to descend, and also seeds are taken down by worms, and thus preserved for a long time to germinate and continue a species perhaps hundreds of years afterwards; and who can say that this is not the case, for do we not see plants spring up after forests have been cleared, where certainly the trees were hundreds of years old, and where these plants had not been able to grow from the time the country gradually turned by the increased growth of trees from a clearing into a forest. In this instance worms would prevent the germination of seeds, but sometimes they facilitate it by heaping their castings over small seeds and partially dragging large ones down their burrows.

I was much interested in seeing one of my worms dragging a small tuber of *Nymphaea tuberosa* down into the mouth of its hole, and it was curious to see that at first it was drawn across the pot by the air-tight sucker method, but when it would not fit conformably on the hole it was left alone for some time, and when a few hours later I looked at it, it had been turned half round and the neck was dragged down the hole which was thus tightly closed. I cannot finish this account of the working of these interesting creatures better than by giving part of the concluding paragraph of Dr. Darwin's important work.

"When we behold a wide turf-covered expanse, we should remember that its smooth-