WORMS AND THEIR WORK.

IT is a happy thought that the earth which fills our lap with beautiful things and things for life is a servant sent of God to dispose of His bounty, that all its gifts are fresh with the glow and warmth of His presence. All things gain singular beauty and joy when the truth of the Good Giver of them all enters into them and us. What charm is it to know that our flowers are as it were roses growing over the wall of heaven; the lark's trilling rapid song, dizzy with exquisite delight, is but drifted music through the gates of the palace above; the smiles which, rippling up out of the hearts of friends, break in the light which never shone on brightest sea or transfigured land, are the caught and mirrored rays of the Uncreated Loveliness? By such truths nature gains here colour and is glorified. We do not doubt that she has beauty apart from all such thoughts. Roses and songs and smiles are ever lovely. But there is one glory of the terrestrial and another glory of the celestial; there is the glory of the earth without the feeling of a beautiful bountiful God, and without the strong transcendent hope the sight of Him and His fair ways inspires; and there is the glory of the earth with Him and His hope colouring and illuminating it all.

Let us summarise the principal facts given by Mr. Darwin, in his recent book on "Vegetable Mould and Earth Worms." He tells us that earth worms are found throughout the world. There are but few varieties of them, and these closely resemble one another. The vast majority of them bring up earth to the surface in the form of little spiral castings. These are found in many different stations: on chalk downs, in boggy peat, in country meadows, London parks, and court-yards of houses; but wherever they are found there are invariably a layer of fine earth and moisture, both of which seem necessary to a worm's existence.

Worms are too wise to go where they cannot live. Even where the surface of the ground would meet the conditions of their life in summer, they do not settle unless it would also meet them in the depth of winter. Where suitable soil covers rock into which, of course, they could not burrow to escape the dangers of frost, they are never found.

They carry on their work at night, and seldom entirely leave their holes. They reach out for objects which surround their burrows by stretching the body to its full length, keeping the tail still inserted in the burrow. They live chiefly in the fine mould which they have made and brought to the surface, which varies in thickness from an inch or two at its least to about half a yard at its most. Their burrow runs down into the earth to a much greater depth than this. But their home, their dwelling, and resting-place, is the upper story, where they prefer to lie just inside, with their head near the level of the ground. This they do probably for warmth, for which reason, too, they line these quarters with leaves. They do not appear to object to cold, damp earth while at work, but they avoid contact with it when at rest. Except when sick and at pairing time they always pass the day in their burrows. Occasionally by night they leave their burrows "on voyages of discovery," and in these cases they never attempt to return to the home they have left.

The body of a large worm consists of from one hundred to two hundred almost cylindrical rings, which act as a sort of "flexible telescope," and each ring is furnished with minute bristles. By the use of these rings worms can go backwards or forwards. They have a mouth which serves to swallow food and to lift objects by suction. Behind the mouth is a pharynx; behind that is an œsophagus (or gullet), and in this, dividing it into two parts, are calciferous glands, which Mr. Darwin says are "highly remarkable, for nothing like them is known in any other animal." These organs are followed by a crop which leads into a gizzard, and this, again, is followed by an inner and an outer set of intestines.

Worms have neither jaws nor teeth of any kind. They swallow small stones, by which their food is triturated as the miller by his larger stones triturates his corn. Some kinds of worms live in mud and water, and though they feed on vegetable matter as earth worms do, they have no duties to discharge towards the soil. These have no gizzards, and do not swallow small stones. The virgin particles of soil swallowed by the earth worm are ground down between the stones, moved about by the tough lining membrane of the gizzard, and, mixed with the fertilising secretions of the worm, they are passed out again.

Worms breathe through their skin. They are blind, and have no kind of eyes. But their mouth-end is sensitive to light. When

artificial light is suddenly thrown upon them as they lie in the darkness near the tops of their burrows, they will generally retreat down into them. They do not all act alike, —some, seeming more timid and nervous than others, "scamper off" at once; some remain a moment, then quietly withdraw; while others raise their heads (if we may be allowed to call the place where some kind of cerebral ganglia exists, a head) from the ground, peer about as if, like startled blind people, they were trying to understand the situation. Though without eyes, they distinguish day and night. There are clear signs, too, that they possess some sort of mind. When busy, their attention is not easily attracted. They are preoccupied, a fact which Mr. Darwin says relates them to "the higher animals." They have no sense of hearing, but they are extremely sensitive to vibration, and are still more sensitive to contact. They shrink from being handled as much as a sensitive person shrinks from handling them. They have a limited sense of smell, which is also very feeble, by which they discover their savoury dishes. They are decidedly possessed of a sense of taste. And when feeding they prefer the textures which are most palatable and tender. They are eager for certain kinds of food, and appear to enjoy the pleasure of eating. This point please bear well in mind for use a little farther on. They have their social pleasures and family life. Their parental relations are peculiar. Each worm is both father and mother; father to its neighbour's children, and mother to its own.

In the winter, when their season is over, they plug up their burrows, plunge deep enough down into the earth to be beyond the reach of frost, have little meetings, roll themselves together into balls, and await the time of spring. More than a passing word must be given on the intelligence of worms. When engaged they neglect impressions to which, when not engaged, they attend, and absorption, says Mr. Darwin, clearly indicates the presence of mind. But worms also exercise judgment. It is their habit to seize leaves and other objects, not to serve as food only, but for plugging up the mouths of their burrows. This action they perform instinctively, that is, all the individuals, including the younger, perform it in the same manner. They seize the leaf with their mouth, drag it a little way into the burrow, which is cylindrical, by which process it is crumpled and rolled up a little. The first leaf is the centre one and the next is drawn into its place outside of it, and so on till sufficient leaves have been arranged, when the whole are drawn deeper down into the burrow and become closely forced and packed together. The submerged end is then covered with moist earth and the burrow is securely plugged against cold and rain. Failing to obtain leaves or sticks for this purpose, they often make a covering of a little pile of stones. The intelligence of the worm is, however, not shown in the ordinary practice of this habit, but in its practice under strange and difficult conditions. These are Mr. Darwin's words on this point.

"If a man had to plug up a small cylindrical hole with such objects as leaves, footstalks of leaves, or twigs, he would drag or push them in by their pointed ends; but if these objects were very thin relatively to the size of the hole, he would probably insert some by their thicker or broader ends. The guide in this case would be intelligence. It seemed, therefore, worth while to observe carefully how worms dragged leaves into their burrows; whether by their tip, or base, or middle parts. It seemed more especially desirable to do this in the case of plants not natives to our own country; for although the habit of dragging leaves into their burrows is undoubtedly instinctive with worms, yet instinct could not tell them how to act in the case of leaves about which their progenitors knew nothing. If, moreover, worms acted solely through instinct or an unvarying inherited impulse, they would draw all kinds of leaves into their burrows in the same manner." Then Mr. Darwin proceeds to give the results of patient experiments and observations which he made with worms, which show far more than a blind following of instinct, viz. a sensible and purposeful adaptation to novel and varying circumstances, a decided disposition to experiment, and a profiting by the lessons of experience; all of which shows that although standing low in the scale of organization, worms possess some degree of intelligence; a result which, Mr. Darwin says, has surprised him more than anything else in his study of worms.

A curious fact incidental to the work of worms is their preservation of ancient relics and buildings. By bringing up soil to the surface of the ground they have slowly covered, and by excavating soil from underneath they have slowly sunk down into secret places much which, being discovered, is precious to antiquarians and historians.

The active life of the worm is divided into two distinct parts, its activities when feeding

and its activities when working. For though the worm, like most of ourselves, works to live, it also lives to work, and this fact opens up to Christian believers in God all the pleasures of new delight. Side by side with the glorified instincts of prophets of Israel, heathen sages, and Christian poets, the very *mould* joins to praise the foreknowledge of an Almighty Benevolence.

Here, then, is a summary of Mr. Darwin's facts—for my *conclusions* from them Mr. Darwin is in no way responsible.

1. The worm, as I have said, works to live. It seeks nourishment; has a hearty relish for certain foods; shows evident signs of pleasure in palatable things.

2. The worm also lives to work. Nourishment is not the end of its existence, but labour. It feeds to get strength, it gets strength to transform useless into useful soil. Its food lies near the surface of the soil, but instinct compels it at certain times to leave the surface and all that it enjoys there, and plunge, like a collier after his morning meal, down into the bowels of the earth, to dig out and to bring up to the surface what is needed there. On the surface of the earth there is already what suits the worm: there its home is and there is its food; but what suits the cultivator is not there. It plunges down, therefore, into the raw soil below, bores its way, filling itself with it, sifting the finer from the coarser particles, mingling it with vegetable débris, finely grinding it between stones taken into the gizzard for the purpose, and saturating it with intestinal secretions. Then crawling upwards, it casts out upon the surface a little pile of earth transformed into fine vegetable mould. The plant-nourishing matter the worm has left above is, from a cultivator's standpoint, a totally different substance from the raw, chiefly mineral, material out of which it has been made. Thus the worm is a miner to excavate, a miller to grind, a chemist to change the substance.

Mr. Darwin finds that on an average each English worm plays these parts to about 20 ounces of matter in the course of one year. He further estimates that each suitable acre of land in England contains from 20 to 30,000 worms, and that there are 32,000,000 of such acres. Now at the rate of each worm 20 ounces, each acre annually receives on its surface from below 10 tons yearly, which gives 320,000,000 tons of worm-soil made in England alone. With these figures before our minds, let us conceive, if we can, the results of worm-labour throughout the world. What would they be for one year?

Now to my point. Here are animals endowed with instincts which compel them to transform the useless into useful, to grind and mix with secretions peculiarly their own, for the secretion of which they are endowed with glands expressly peculiar to themselves. And this not for their own use. Some authorities have doubted whether the worm derives any nourishment whatever from the raw materials which it thus transforms; but Mr. Darwin is of opinion that it does derive some, but it seems that this is only in the way of accident, as a cook may pick a currant while making her mistress a cake, or as the ox may snap a stray ear of corn while treading the mill-round of the threshing-floor. But when it swallows mere mineral earth, it is not for purposes of nourishment or of the palate. At the surface, nourishing vegetable fare is near at hand; fare which is rich and palatable, for which, be it remembered, it has a relish and evident enjoyment, yet this it deliberately leaves behind, and works for something outside of itself—for the soil, for the fruits of the earth, and for man! The whole of what is known as vegetable mould of the surface of the earth has passed and will repass, Mr. Darwin says, through the bodies of worms every few years through the world's history. Nay, more, long before history, before even man appeared on the earth, says Mr. Darwin, "the land was, in fact, regularly ploughed, and still continues to be ploughed, by earth-worms. It may be doubted," he continues, "whether there are many other animals which have played so important a part in the history of the world as have these lowly-organized creatures."

What thoughts and feelings should such facts stir! Long before the appearance of man upon the earth, the earth-worm was patiently and skilfully preparing the soil in which man's lilies and roses were to bloom, the herbs were to grow for his camels and sheep, and corn and wine, to make glad man's heart. If born of these facts there does not succeed to the first sense of wonder at the forethought and goodness of the great Father a sense of gratitude, overwhelmed by a sad, almost tearful, sense of unworthiness, we must indeed be "past feeling." Whenever we look at the earth-worm and the little spiral coil of mould it erects upon the ground, our feeling should be one of reverent love to the Eternal Glory from whom, by these unsuspecting means, such good gifts descend.

B. W.