The Biological Rôle of the Earthworm

E. E. Pfeiffer

Humus is the basis of the fertility of the soil. But not all substances called humus are "humus." There is only one kind which provides the most valuable substances and a desirable soil structure. The scientist calls it the neutral colloidal humus, neutral with regard to its reaction as compared with an acid or alkaline state. All cultivated plants thrive best in a neutral soil, while with increasing acidity more and more cultivated plants cease to grow. They dislike alkaline soil just as much.

The term colloidal signifies a state of matter in between solid and liquid which exists in all living organisms. Only in this state can the "living matter" be maintained. The presence of neutral colloidal humus therefore is a necessity in order to maintain the soil life as well as the proper plant growth. In a soil rich in this kind of humus, plant roots develop the finer hair roots which contribute so much to the intake of nourishment. The humus is produced by a fermentation process which takes place in a living soil. It is composed of decaying plant matter, leaves, dead roots, stems, straw, and also of manure, compost and of the bodies of microbes, bacteria and algae living in the soil. One animal is devoted exclusively to the humus production—the earthworm. Charles Darwin, in his book about the earthworm, said: "Without the earthworm, no tillable soil." This little innocent and rather helpless-looking animal is our best soil friend. Due to its activity we have a tillable, rich soil. Otherwise, the earth would be covered with rocks, stones, silt and all kinds of diluvial and alluvial deposits, but very little higher plant life could develop. The study of the earthworm is fascinating because of its value to farming and gardening. The presence of the earthworm and the quantity thereof indicate the quality and state of cultivation of a given soil. Its absence indicates serious trouble, an "unhealthy" state of life, less productivity or even a tendency towards a sterile and unfertile soil.

It is clear that the earthworm does not belong in a hotbed, a cold frame or a flower pot, where it may do occasional damage by uprooting or drawing down small plants or seedlings, but otherwise no harm comes from the earthworm's activities. Should it happen that in a garden earthworms attack live roots or seedlings, then something is utterly wrong with the state of affairs in this garden. A deficiency in humus, a one-sided fertilizing with excessive minerals or lime, fresh manure in bad shape (putrification) may disturb the proper living conditions for this little friend of ours.

The earthworm is a specialist, and as such needs proper attention. Of the different varieties and species, two groups are of particular interest to the gardener. Type number one is a long bluish, rather thin type, which transforms all organic matter in the soil into humus, and particularly so if the soil has already undergone certain changes. Type number two is rather short, thick, reddish and is the manure and compost worm. Its main duty is the transformation of fresh manure and compost and other matter that is just in the first state

of rotting. Type number one would not touch, for instance, fresh manure, but makes the best possible use of decomposed manure and compost.

How does it work out, this transformation of organic matter into neutral colloidal humus? The worm eats earth and small parts of leaves, straw and all kinds of organic particles in the soil. Both earth and organic matter are mixed in the mouth and intestines and digested with the help of an intestinal juice rich in hormones and digestive ferments. One peculiarity speeds up this process, namely, "saliva" glandular juice with an organic calcium compound. The final result of the rather complicated digestive system, full of wisdom, is the neutral colloidal humus. The earthworm excrements, the so-called castings, are the richest and purest humus matter in the world. Analyses have shown that they contain more than ten times as much of valuable plant nutriments such as nitrogen, phosphates, calcium, etc., as the surrounding soil. A Polish scientist, Niklewski, has devoted much study to the humus contained in the earthworm castings and has stated their richness in humus colloids and their importance for the development of fine hair roots.

As to the efficiency of humus production, we look upon it as a sample of the highest possible grade of perfection. In a soil in good healthy condition, for instance, a pasture rich in clover, or an alfalfa or clover field at its best, as many as 300 pounds of earthworms to the acre have been counted, producing about 30,000 to 40,000 pounds of humus an acre per year. No other means of fertilizing or manuring would ever be able to maintain and improve the fertility of a soil to the same degree as the earthworm.

If we figure out that one acre of topsoil to a depth of seven inches weighs about three million pounds, a proper earthworm population digests about 1 per cent of this soil per year. Besides the humus production in castings there is the forming of little channels, which increase the porosity and aeration of the soil. This helps other kinds of soil life, stimulating, for instance, about 600 pounds of bacteria per acre a year to contribute their share. Experiments have shown that through earthworm activity the volume of a soil is increased by one-third, which gives an idea as to the loosening up or crumbling of the soil.

Furthermore, the little fellow penetrates downward to about five or six feet, transporting lime, minerals and salts gradually to the upper layers. Many substances previously washed out are in this way brought back to the topsoil. This may explain why soils rich in worms have a considerable increase in calcium content.

Under these circumstances, nobody will doubt that the proper use of earthworms is one of the most important questions of any biological farming or gardening method. But how can we preserve or increase these helpers of the soil?

Unfortunately the life cycle of the earthworm is rather limited. The little fellow is highly specialized. A type number one worm will not propagate in a fresh manure heap; neither will it migrate and accustom itself to a clay soil from a sandy soil or vice versa. It is locally soilbound. The type number two, the manure earthworm, will not multiply in soil except if sufficient manure or compost is present. It is in our interest, therefore, to assist the worm's life. Proper tillage and aeration of the soil, together with the right moisture con-

ditions, facilitate the reproduction. If well-rotten manure or compost is added to the soil, you will see the little fellows multiply as long as they find moisture and warmth. In the fall before frost and during an extended drought they migrate to deeper quarters and remain inert. But before that time, if well provided with rotten manure and compost, they will propagate and at least the egg capsules may remain for future activity. The crop rotation also influences the development of the earthworm. Old pastures and fields with leguminous plants like clover, alfalfa, beans, peas, soybeans or lupins are usually rich in earthworm life; while a crop rotation with few of the above-mentioned plants and with successive crops of grain gradually depletes the humus and therefore also the soil life. Too great an acidity or alkalinity has a similar effect.

The manure-compost earthworm develops best in the manure or compost if the heap is in direct touch with the soil and covered with earth, and in the case of compost heaps if earth is interlayered with the compost. As long as proper moisture and warmth conditions are maintained this type of worm will propagate and gradually transform all manure and compost material into humus. The limits of the worms' lives depend upon drought, low and high temperatures. Heaps which heat up too much, above 125° F., are destructive to the worm, as well as frozen heaps and soil. While the Southern climate in general is less favorable to the "earth" type of worm because of its periods of drought and heat, it is very helpful to the compost type as long as there is enough moisture, and this can be maintained by watering the manure or compost heap.

The earthworm population of a compost or manure pile can be increased by adding earthworm egg capsules. The late Doctor G. S. Oliver, of Los Angeles, California, and his successors have developed a process which is very successful for breeding worms. If proper conditions in a heap are maintained the worms will propagate by the thousands. The capsules are produced by a peculiar process. The worm hatches the eggs first in the mouth, then produces by means of perspiration a kind of membrane around the head part of the body like a hose. Into this hose about six to twelve eggs are placed by gradually backing out of it and sealing it up. While worms cannot be transplanted from one kind of soil or compost into another, it is very easy to ship the egg capsules and insert them wherever they are needed. Areas in which there is an abundance of roots and of certain plants and trees are preferable as breeding grounds of both types of earthworms. Particularly oak, birch and locust trees, elder and alder shrubs belong to this group. Of annual and biennial plants the already mentioned leguminous family, as well as chicory, onions and valeriana, attract the worms. The addition of leaves or root earth from these plants to a compost heap will greatly reinforce the biological activity. The author has made interesting experiments in order to study the growth and living conditions of worms which squeezed out from the experimental boxes and disappeared. When valerian blossom juice in a high dilution was sprayed onto the surface of the earth no more trouble was encountered due to the worms escaping. As a matter of fact, the worms not only propagated more abundantly, but they also migrated towards those areas sprayed with valerian extract. The Bio-Dynamic treatment of compost and manure reckons with all these peculiarities of the earthworm and stimulates its growth and reproduction.

It remains to say a few words about intensive application of insect sprays containing lead, arsenic or copper. These are biologically poisonous and counteract the development of earthworms. In vineyards or orchards treated intensively for many years with these sprays no earthworms can be found.