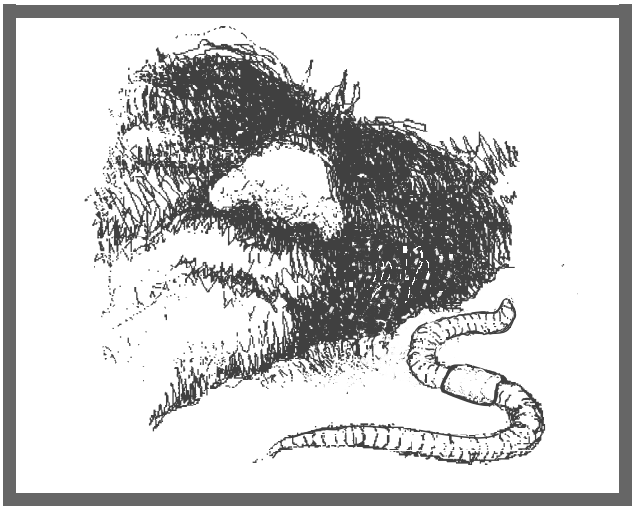
Patuxent Research Notes

Understanding earthworms

The year was 1871. The French had just lost the Franco-Prussian War, and Bismarck had united Germany. These might seem like important events to an educated Englishman. To one of the world's greatest observers, however, these events were insignificant compared to the goings on beneath his toes. Charles Darwin was in a pasture by his house in Kent England, with his noggin down a hole. He was thinking about earthworms. He had just calculated that each year earthworms move a layer of soil 0.24 inches thick to the surface of that pasture. And he alone understood why that was important.

Most people consider earthworms insignificant creatures, easily crushed by a careless foot. Earthworms have no brains and are not much to look at. But Darwin understood them. Earthworms can be appreciated only by a patient person, one who can observe life closely and can see how small changes gradually add together to change the world. Most of us are interested in mammals or birds. We may be attracted to an animal by its cuteness, its colors, or perhaps by its behavior. Earthworms are different. Earthworms do not just decorate our world - they are much more important. They help create the soil that supports life.

An earthworm's body is relatively simple. Earthworms are soft, having neither a backbone, like mammals, nor an outer skeleton, like insects. Their bodies are divided into segments, generally from 50 to 200 per earthworm, depending on the species. Each segment has a set of bristles that may anchor the earthworm in a soil tunnel.



Portrait of Charles Darwin thinking about an earthworm. The naturalist Comte de Buffon wrote that "Genius is nothing else but a great aptitude for patience." Charles Darwin's patience allowed him to understand how earthworms gradually create soil.

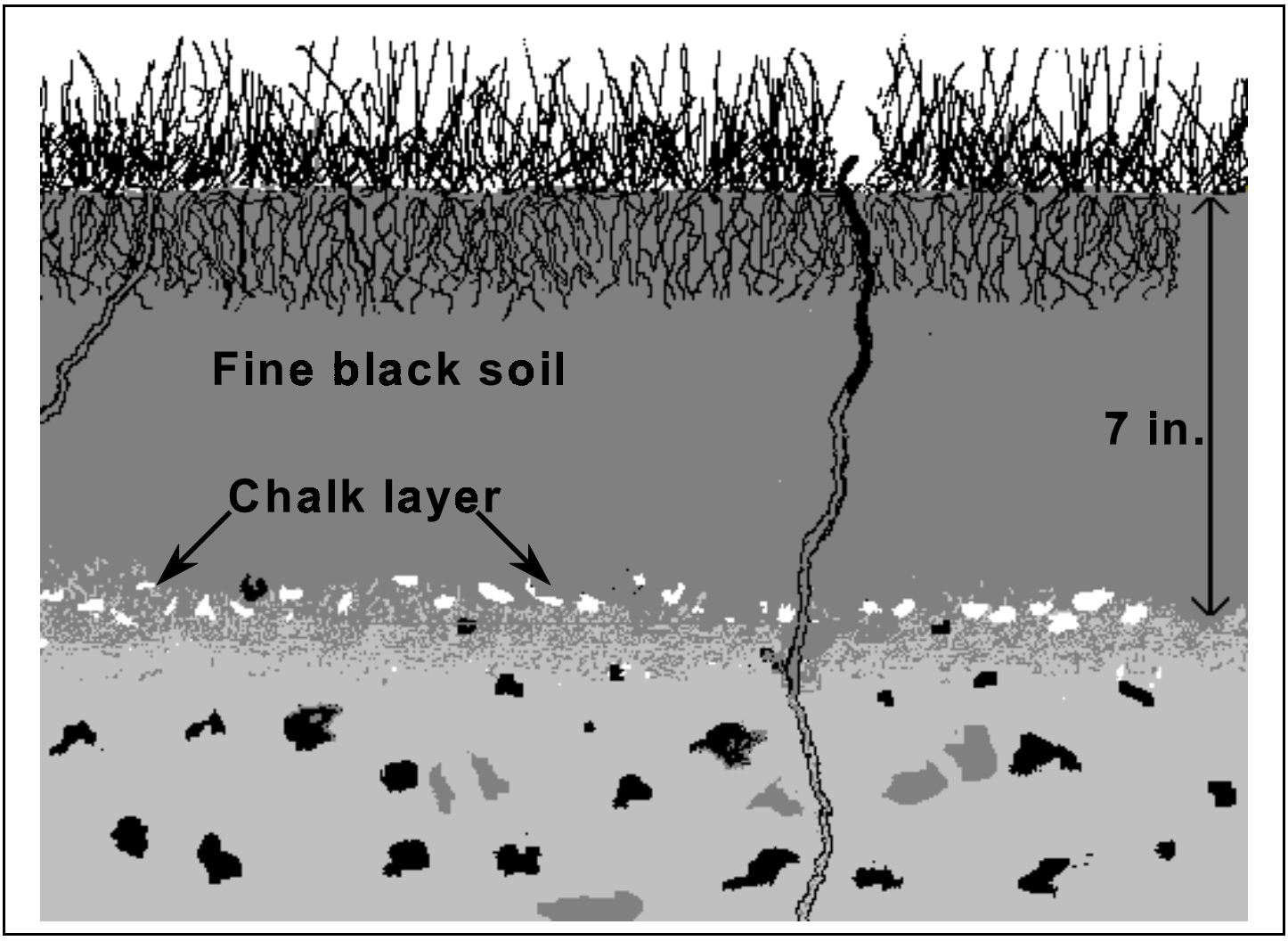
Mature earthworms have a ring around their bodies, called a clitellum, which secretes a cocoon over their eggs to protect them. An individual earthworm should never be referred to as "he" or "she" - only as "it," or perhaps "they." Earthworms are both male and female at the same time.

Lacking skeletons, earthworms depend on the fluid in their bodies to support themselves and to move. They have a set of muscles that run lengthwise through all of the segments. When these muscles contract the earthworm becomes shorter and fatter. They have a second set of muscles that run around the outside of each segment. When they contract the segment becomes thinner and longer. Contracting the segments in sequence, the earthworm slowly inches forward through the soil. Imagine yourself a bionic water balloon, trying to work your way along. Animals living underground are rarely in a hurry.

Earthworms have no eyes, which makes sense, since their tunnels are dark. They have cells that can detect light, though, which helps when they come to the soil surface. They

have no ears or sense of hearing, but they can detect vibrations. They have no lungs, but exchange air directly through their skin. This arrangement works well enough for an earthworm, and they can even survive for a long time underwater, as long as the water contains air. Instead of a heart and a brain they have several small simple hearts and clusters of nerve cells. But most important of all, earthworms have a whopper of an intestine - when it comes to eating soil, the earthworm is champion.

Earthworms eat soil because it contains organic matter. Organic matter comes from living organisms. A banana peel, a tree root, a deceased armadillo - all of them decay and become part of the soil organic matter. If an animal can digest organic matter or the microorganisms living in the organic matter, it can obtain energy from soil. The bulk of soil is quartz mineral particles. Plants need more than mineral soil. A small amount of partially decayed organic matter mixed into mineral soil gives it a good structure and makes it come alive. Without organic matter, the soil may harden like a brick if it dries out, or puddle into goop if it becomes wet. But organic matter coats the particles and holds them together into breakable clumps. Pores form which contain air and allow excess water to drain. A soil rich in organic matter can usually be identified from its dark color. Gardeners know how important it is to add organic matter to their soils, usually as leaves, compost,



Profile of soil studied by Charles Darwin. A white chalk layer had been spread on the soil surface in 1842. By 1871, earthworms had buried the chalk seven inches deep with a layer of castings. Note the absence of coarse fragments from this rich, dark layer that Darwin called "vegetable mould."

peat moss or manure.

But let us return to Kent, England. Darwin observed what he called "vegetable mould," a layer of fine, black, fertile soil on top of the deeper soil. He recognized that this material was basically digested soil that had passed through earthworms, again and again. Earthworms mix the grains of soil with organic matter to produce "casts," which are ideal for plant growth. Organic matter would eventually decay without earthworms, but it would remain on the soil surface. Darwin recognized that **earthworm casts are a valuable natural resource.**

In 1842 Darwin had spread a layer of chalk over part of the field. By 1871, the layer was covered by 7 inches of fine black soil. By dividing 7 inches by 29 years Darwin calculated that earthworms had covered the chalk by an average of 0.24 inches of fertile soil per year. In just a hundred years, a short time to a soil scientist, earthworms move about two feet of soil. Given a few thousand years earthworms can bury a city. In fact, Darwin wrote about how ancient Roman ruins in England had been preserved because they had been covered by castings from earthworms.

Darwin realized that the rich soil he held in his hands had passed through earthworms many times in the last hundred years, and that was the reason it was fertile. No one else had the patience to realize what was happening beneath their feet. Darwin became famous for his theory of evolution by natural selection. The formation of vegetable mould by earthworms and the evolution of species have a common theme. Small gradual changes, that seem insignificant to most observers, may actually be the most important forces changing the world.

Nelson Beyer
Anna Morton
Patuxent Wildlife Research Center
Albin Beyer
University of South Carolina

U.S. Geological Survey--Biological Resources, Patuxent Wildlife Research Center
and
U. S. Fish and Wildlife Service, National Wildlife Visitor Center