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Earthworms
Master Caretakers of the Soil

The common earthworm, part of the Annelid phylum, (Annelida is Latin for little rings) plays a critical part in producing and maintaining fertile soil. Its role includes forming channels in the soil to allow for effective aeration, a critical process necessary for most soil dwelling life forms. The channels that earthworms produce also allow the soil to hold the large amounts of water that provide for plant survival (Johnson, 2002).

As Charles Darwin concluded, "It may be doubted 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" (Darwin, 1881, p. 316). Earthworms even till the soil like a small plow and play a critical role in recycling nutrients by feeding on decaying organic matter and small live organisms, such as protozoa and bacteria. This recycling is required in order to produce a high-grade fertilizer (Conniff, 1993, p. 86). Earthworms can consume about 30 percent of their own weight in plant matter daily, effectively transforming barren soil into high quality fertile soil in a matter of months (Conniff, 1993, p. 88). They also commonly exist in numbers of around one-million per acre of top soil (Stewart, 2004, p. 10).

By Jerry Bergman

It was once believed that earthworms were "vermin" (vermis is Latin for worm), a nasty soil problem that one needs to get rid of (Conniff, 1993, p. 87). The first major detailed methodical study of earthworms was Charles Darwin's last published book, titled *The Formation of Vegetable Mould* in 1881 (Meysman, et al, 2006). Darwin's worm book was surprisingly very popular and Darwin "found himself besieged by correspondence from backyard philosophizers of the worm" (Conniff, 1993, p. 88). Furthermore, Darwin discovered from his research that worms are incredibly numerous and transform the earth by eating their way, over and over, through the entire upper soil layer. Much of their waste ends up excreted on the ground surface in the familiar coiling heaps called worm casts.

Continued on Page 6

Friends in the Scientific News

Secular scientists usually do not like to mention discoveries or achievements of people who support Biblical creation. Recently however, some creation supporters have come to the attention of many scientists and even the secular media.

Mark Armitage, for example, recently published an article on soft un-fossilized tissue in one of the largest Triceratops horns ever found in Montana. Mr. Armitage had found the dinosaur fossil himself in 2012. Then in February 2013 he, along with biologist Kevin Lee Anderson of Arkansas State University-Beebe, published a technical article on this find in a mainstream European scientific journal Acta Histochemica (115, 603-608, 2013). Entitled "Soft sheets of fibrillary bone from a fossil of the supraorbital horn of the dinosaur Triceratops horridus." The article established this find as "the first report of sheets of soft tissues from Triceratops horn bearing layers of osteocytes [bone forming cells], and extends the range and type of dinosaur specimens known to contain non-fossilized material in bone matrix." (p. 603)

© Photo: Edgar Nernberg

Mary Schweitzer, a palaeontologist from North Carolina State University, and herself famous for discoveries of soft (un-fossilized) tissue in dinosaurs, provided peer review of the Armitage document. However Dr. Schweitzer's job is not in jeopardy, while Mark Armitage, who managed the biology department's electron and confocal microscopy suite at California State University Northridge, lost his job within two weeks of the publication of the technical article. A news item in Nature on this issue (November 6, 2014 vol. 515 p. 20)

Continued on page 2

Friends in the Scientific News

Continued from Page 1

suggested that while Mr. Armitage was good at his work, some colleagues were unhappy about his frequently stated support for the idea that life began only a few thousand years ago and that dinosaur fossils are recent. The published material certainly supports that idea. Now that Mr. Armitage has published in a recognized scientific journal, his views may have gained credibility in the eyes of the students, even although the article itself assigned no age to the artifacts. Common sense however suggests that unfossilised material could not last millions of years without either turning to rock, or decaying. Mr. Armitage has since filed a wrongful dismissal suit against the university.

More recently, during the spring of 2015, Vance Nelson, director of Creation Truth Ministries (in Alberta) and Brian Thomas of the Institute for Creation Research (in Texas), published a technical article in the Creation Research Society Quarterly (vol. 51 pp. 299-311). Entitled "Radiocarbon in dinosaur and other fossils," this study follows other studies published in 2003 (J. Baumgardner et al from Proceedings of the Fifth International Conference on Creationism) and 2005 Baumgardner in Radioisotopes and the Age of the Earth (RATE): results of a young earth creationist initiative (pp. 587-630). This is also on line at <www.icr.org/article/carbon-14-evidence-for-recent-global/> These earlier studies established that while radioactive carbon should all disappear within 100,000 years from an artifact which contains material from once living organisms, there are in fact no carbon containing fossils which lack radioactive carbon. Thus all these specimens must be only thousands of years, not millions of years old. They also found that no matter the assumed age (whether dated at hundreds of millions of years, or only tens of millions of years), all had about the same amount of measurable radioactive carbon.

© Photo: Edgar Nernberg

Thomas and Nelson continued this research tradition with a similar dating survey of carbon containing fossils of various assigned ages. The collection of fossils included two different kinds of fish, a lizard, plant material (wood and fruit) and various dinosaur specimens from various locations. According to standard dating techniques, some were from the Paleozoic erathem (eon), some from the Mesozoic and some from the Cenozoic erathem (eon). The estimated conventional ages ranged from 290 million years to 10 million years. Nevertheless all had similar measured amounts of radiocarbon, indicating that all these fossils were formed at about the same time. All the specimens were dated at a recognized professional laboratory which specializes in such measurements. The study authors concluded that the measured carbon was most probably integral to the samples and not outside contaminants. Thus this study is another major problem for conventional estimates of fossil ages.

On a more lighthearted note, Edgar Nernberg of Calgary, made a fossil discovery that shot him to international fame at the end of May. Mr. Nernberg is a long time amateur fossil collector. He has purchased fossils from large shows in the United States and he has served on the board of the Big Valley Creation Science Museum. If any member of the public were going to recognize a fossil, it would be him.

Apparently Mr. Nernberg was excavating a basement for a house in northwest Calgary. His backhoe extracted a block of sandstone which displayed (to his astonished and trained eye), five beautiful complete specimens of fish preserved in the rock. Fish fossils are actually uncommon, because their corpses decompose so fast. So these complete specimens indicate that they were buried and preserved very quickly. Each fish is about the size of an iPhone, and they were lying at a level in the rocks which is slightly higher than the highest dinosaurs found in Alberta.

In Alberta, by law, all fossils belong to the province. Although he would dearly have loved to own these priceless specimens, Mr. Nernberg rightly called a palaeontologist. The University of Calgary and the Royal Tyrrell Museum all acknowledge that they are indebted to Mr. Nernberg.

Some media commentators were not so polite. Rachel Feltman, for example, writing in the Washington Post (May 28, 2015) could not figure out how anyone digging up such a fossil, would not immediately be convinced of evolution. She was sure that the various techniques for dating fossils provide absolutely solid proof of the age of such artifacts. However as we have seen in the events mentioned above, the dating of fossils is controversial indeed. We can certainly look forward to more studies designed on similar lines in the years ahead.

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EYE-DEAL EXAM-PLE OF DESIGN

By Margaret Helder

The ability of fireflies to glow in the dark, delights those who have seen these insects in action. It really seems like a special talent. However a recent issue of *National Geographic* (March 2015) declared about bioluminescence: "Evolving to make light seems to be relatively easy -- it has happened independently in at least 40 different lineages." (p. 84) Just because we find a special talent in a number of very different creatures, does not mean that the talent was easily developed by chance. *National Geographic* is not aware that this unusual ability is much more reasonably explained as the choice of God, the creator. There are many examples where we can see the problem for evolution of special talents in very different creatures. And the camera eye is an ideal example.

Everybody knows that our eyes are wonderfully designed. All the parts are special and each is important for vision. The bulging cornea consists of clear material which bends light toward the pupil. The iris consists of a thin circular muscle which acts like a camera diaphragm. The iris expands or contracts the pupil opening in order to control the amount of light entering the eye. Behind the pupil is the lens which focuses light onto the retina (composed of light sensitive cells and nerve cells).

The oval-shaped lens is made up of water soluble proteins, many of which are very large molecules. These proteins are tightly packed together in such a way that they are not only transparent, but they bend the light so that the rays are focused into a sharp point. This provides a clear image. Ideally the lens focuses on the retina (the receiver), but if the focal point is in front of the retina (or behind it) then corrective lenses are required to adjust the focus onto the retina. It is also most important that the proteins in the lens retain their special tightly packed arrangement, otherwise the lens becomes cloudy thereby disturbing vision.

The other particularly important component of the eye is the retina. It consists of certain receiver cells which contain light sensitive pigments called rhodopsins. These are composed of a form of vitamin A and a large protein molecule called opsin. Different precisely shaped opsins are sensitive to specific wavelengths of light. Before the light gets to the rods and cones (in the retina), it passes through the nerve cells which lie on top of the light sensitive cells. Some people suggest that this is backward wiring and not the most efficient arrangement of parts. But what do they know? Others suggest that this arrangement protects the sensitive tissue from too much light. The nerve cells lying on top of the rods and cones, then conduct an electrical impulse (generated by the rods and cones) to the optic nerve and to the brain. The brain, for its part, puts the electrical signals together into images which are communicated to the person's consciousness.

There are other important components of the camera eye too, like the dark layer lining the inner eyeball, which prevents light rays from scattering inside the eye, and jelly-like material which allows the eye to keep its shape. When we consider the special properties of all these component parts, we have to conclude that the camera eye is indeed a wonderful organ.

Among living creatures there are other eye designs as well. Some single celled animals and even some much larger creatures make do with clusters of pigmented cells. In some many celled animals, these are often associated with nerve cells. Creatures with jointed outside skeletons (exoskeletons) like insects, are famous for their composite eyes. These bulbous structures are made up of many tiny eyes all of which focus on a central point. While these eyes are very good at detecting motion, they probably do not have the same sharp focus as the camera eye.

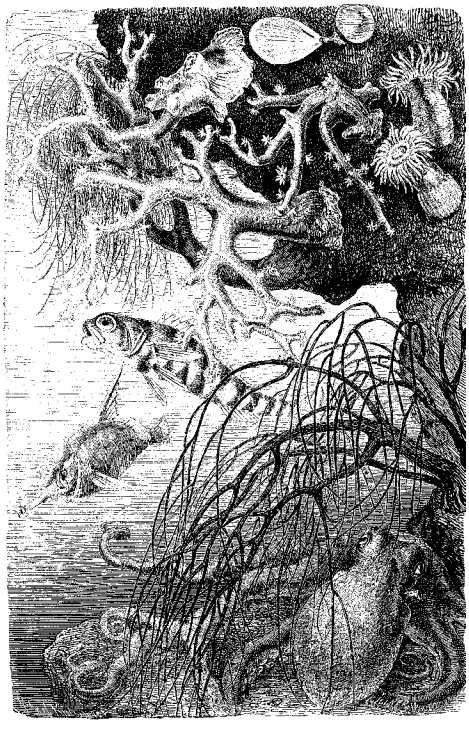
All creatures with backbones (vertebrates) enjoy camera style eyes. Most of us know that! But what about a jellyfish, octopus and a single celled animal which closely resembles algae that cause toxic red tides in the sea? Do they have camera style eyes too? Yes, yes and yes!

Octopus and squid are perhaps the best known animals without a backbone (invertebrates) which enjoy the benefits of a camera-style eye. Octopi are particularly intelligent, some say as intelligent as a housecat. The term cephalopod means brainy foot and it denotes a subgroup of mollusks which include squid and octopus. The cephalopod camera-type eye includes an iris, circular lens, gel filling the eyeball, pigment cells and photoreceptor cells that send an electrical signal to the optic nerve which is connected to the brain. In the case of the cephalopods, the light sensitive rods and cones are in front of the nerve cells (not behind as in vertebrates). Moreover the crystal proteins in the cephalopod lens act the same way as our lens does, but the proteins are not the same. In that the cephalopods have a body design (plan) which is far different from that of vertebrates, and in that the chemical components of the eye are different, not even mainstream scientists see any kind of evolutionary connection between us and the octopus.

We are all familiar with earthworms. These creatures have a complete digestive tract with a mouth at one end and an anus at the other end. They have strong muscles and a few projecting bristles, but no obvious sense organs although they react strongly to odours and the drying effects of light. This body plan possessed by a group called the annelids, does not seem promising for fancy sense organs. However there are marine annelids called polychaetes (meaning many bristles) which lead more vigorous lifestyles. Among the polychaetes is an obscure group called alciopids. These are slender swimming creatures with conspicuous eyes. They actively pursue and catch prey. Most surprisingly, the eyes of these worms are camera style eyes complete with cornea, lens

and retina, and like cephalopods, the wiring of the retina features the light sensitive cells first with the transmitting nerve cells behind. Obviously there is nothing in the body plan of these annelids that is at all similar to vertebrates. So nobody imagines that there is a shared evolutionary history between the two groups.

Even the annelids have some small concentrations of nerve cells at the front end of the body. If there is going to be any interpretation of the images detected by the fancy eye, it would be in this "brain". Jellyfish however have no central nervous tissue (which could function as some sort of brain). These creatures therefore do not look like promising candidates for any benefit from camera-style eyes. Nevertheless box jellyfish indeed possess camera-style eyes. One commentator called attention to the surprising occurrence



of this eye design in any creature with a jellyfish body plan: "…. -- a box jellyfish or cubomedusa -- is equipped with eight surprisingly sophisticated lens eyes of the camera-type, but there is no common brain behind them. In nearly every respect, these lens eyes resemble those of animals such as fish or cephalopods, but the 'central nervous system' behind the eyes consists only of a diffuse nerve net accompanied by a marginal nerve ring." (Rudiger Wehner. *Nature* 435 (7039) May 12, 2005 p. 157)

Jellyfish mostly drift or swim in the open sea in such a way that their trailing tentacles occasionally encounter suitable prey. Specially designed stinging cells entangle and kill the prey and the tentacles pull the victim to a central opening that serves both as the mouth and anus. However the box jellyfish actively hunt prey in shallow water habitats like mangrove swamps which are full of obstructions like tree roots.

Despite the unexpected nature of the box jellyfish sensory organs, expert Dan Nilsson insists: "All major components of a typical camera-type eye are present: a cornea, a lens, a retina, a pigment layer and an iris." (*Nature* 435 (7039) May 12, 2005 p. 202) Not only do the jellyfish eyes have all the appropriate parts, but it transpires that the jellyfish lens produces a very sharp focus. Dr. Nilsson and team declare that such lenses are not only rarely encountered among the variety of animal body plans, but the jellyfish lenses are unique by virtue of special proteins: "From the unique crystalline proteins we know that at least the lenses have evolved independently in box jellyfish. Making good lenses seems to be a demanding task because only a few animal phyla have accomplished it." (p. 202)

Despite the sharp focus of the jellyfish lens, the retina is positioned too close so that a blurred image results. Nilsson and colleagues however suggest that the eyes are "'purposely' underfocused" (p. 202) so that the creature is not confused by too much detail. The lack of brain may also suit the lifestyle of this animal as commen-

tator Rudiger Wehner reports: "… box jellyfish have clearly not had the need to feed the information provided by their total of 24 eyes into a central processing unit, or brain." (p. 159)

In its body plan the box jellyfish is completely unlike other animals with camera-style eyes which typically possess some sort of central brain. In its body plan a jellyfish exhibits minimal body parts, but in the case of the box jellyfish we also see a sensory organ which follows a precise sophisticated blueprint. The great differences with other creatures of similar eye design mean that no evolutionary relationship is imagined between eye-possessing box jellyfish, polychaete worms, octopi and vertebrates. It was in some other way that they came to possess the fancy eye blueprint.

If camera style eyes in a jellyfish are unexpected, how weird would it be to see the same design in a single-celled animal? A recent article in *Nature* however communicated the astounding news that there are some single celled protozoans that have a sensory structure "so complex that it was initially mistaken for a multicellular eye." (523 (7559) July 9, 2015 p. 204) The component parts include a cornea, lens, iris and retina. It is these parts, which, declares Gregory Gavelis and colleagues "so resemble the camera-type eye of some animals that they have been speculated to be homologous [related through evolutionary descent]." (p. 204)

Warnowiid dinoflagellates are very rare and unusual marine organisms. Their cell design is like the algae that cause toxic red tides in oceans. These dense concentrations of algae can kill fish and render shellfish (which consume the algae) poisonous to people. Most dinoflagellates are dark brown and photosynthetic (manufacturing their own food). The warnowiid dinoflagellates however are colourless and need to consume food. Presumably these cells use their ocelloid (eye-like structure) to catch suitable prey.

Commenting on the dinoflagellate study (which came from University of British Columbia), commentators declare: "evolution has stumbled on similar solutions to perceiving light time and time again." (*Nature* July 9. 2015 p. 167) It is true that in the course of this survey of creatures with camera-style eyes we have observed that (apart from vertebrates), the possessors are rare specimens from diverse body plans. Obviously there was no line of descent. The creatures are too different to even contemplate such an idea. Mainstream scientists instead contemplate the separate surprising appearance of the same blueprint/design in wildly different organisms by means of evolutionary processes which converge from highly different sources on the same solution to lifestyle problems. However in the cases which we have discussed, the lifestyles are not even remotely similar, so it would be surprising to see similar solutions, especially through chance processes. Alternatively what we see is common design (conscious choice by the Creator) rather than descent with change from a single ancestral population (common descent) or separate spontaneous appearances in diverse creatures. When we see these examples as the work of God, our appreciation of the creation becomes much more profound.

Quality Programs For FREE

There are some useful and visually attractive programs available on YouTube. For example, Privileged Species (previously reviewed in Dialogue) at 32 minutes, has already recorded 33,300 views. However for better quality display, a DVD is required which CSAA sells for $15.00 each.

Several years ago CSAA distributed free copies of the DVD Programming of Life which runs 44 minutes and is produced by LaBarge Media (with Don Johnson). We distributed this to high school and university students, teachers, and pastors. This program examines mathematical issues concerning the living cell. In this context, information is a critical feature of living cells. The kind of information required (prescriptive) involves instructions. From that discussion we proceed to protein manufacturing which is illustrated with beautiful graphics. We then learn the essential features of a computer and how the cell demonstrates these capacities.

The discussion now moves into the definition and proper use of statistical terms relating to how probable an event might be. We learn that many statements concerning the origin of life, in fact convey an inaccurate confidence that the process ever took place. We find that the chance of life spontaneously evolving is operationally impossible. Indeed what is required to produce life is an intelligent mind.

A new video Programming of life2: EARTH runs 36 minutes .This program considers life on a larger platform than the previous video. We look first at the chemical elements, building blocks of all compounds. We see how water and carbon dioxide are particularly important for life (by virtue of their special features). (Privileged Species also discusses this topic). There follows discussion of hundreds of parameters which must be precisely right in order for life to exist. (This part of the discussion comes from Hugh Ross, many of whose conclusions we do not support -- but this part is OK.) Lastly the video discusses topics which do not fit evolutionary scenarios, such as population genetics, vestigial organs, the ENCODE study on the functional status of DNA, and the Cambrian explosion.

These videos are free for viewing on YouTube, and they may be shown for free also to audiences for educational purposes. This seems like an excellent opportunity to enjoy good graphics and good discussions at a price that is hard to beat!! (Access Programming of Life 2:EARTH through the first version).

Earthworms Master Caretakers of the Soil

Continued from Page 1

Darwin won popular acceptance for the view that worms make the ground suitable for plants. They aerate and drain the soil with their burrows, drag down leaf fragments to grind up for food and "mingle the whole intimately together, like a gardener who prepares the fine soil for his choicest plants." Long before the advent of the plow … Darwin wrote, "the land was in fact regularly ploughed" by earthworms." (Conniff, 1993, p. 89).

Anatomy

Earthworms are small, but are not at all simple creatures. Like humans, they have a complex central nervous system (CNS), a peripheral nervous system (PNS) and a sympathetic nervous system (SNS). The central nervous system consists of two ganglia (clusters of nerve cells) located above the mouth connected to a nerve cord running along its entire length to motor neurons and sensory cells located in each segment. Much is still unknown about earthworms. They do not have ears, yet seem to sense vibrations, and do not have eyes yet somehow can sense light. A large numbers of chemoreceptors are concentrated near the worm's mouth to allow it to select its food sources and push aside non-food detritus (Stewart, 2004, p. 11). They have definite food preferences. Melon is a favorite, as are most fruits and many vegetables, but fats, meats, dairy are all strongly avoided (Stewart, 2004, p. 83).

Its digestive system, which was effectively designed to process a wide variety of decaying organic matter types, runs through the entire length of its body. It uses a set of muscles that line the gut to move the digesting food toward the worm's anus for disposal. It uses calciferous glands that open into the esophagus that maintain the worm's calcium balance by secreting calcium carbonate, which assists in helping to adjust the pH of their food.

To allow it to wiggle through the soil, worms lack both an internal skeleton and an exoskeleton. Rather, they maintain their proper shape by employing many fluid-filled coelom (body cavity) chambers that effectively function as a hydrostatic skeleton. Circumferential and longitudinal muscles on the periphery of each segment enable the worm to wiggle through its dark soil world.

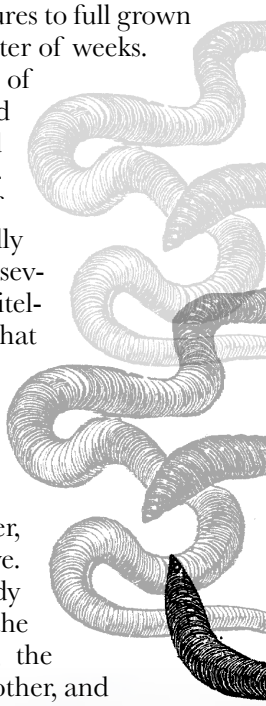
Earthworms have 8 or 12 specially designed bristles called setae in each segment of its skin. The setae, when extended, allow them to resist being pulled out of the ground, such as occurs when a robin tugs on a worm (Conniff, 1993, p. 89). The setae also allow locomotion by anchoring the earthworm in the soil, then its muscles stiffen, pushing the worm forward. Setae are also used to help earthworms hold on to each other when they mate.

A worm moves to the soil surface from its burrow to eject its "castings" in a small mound around the burrow's entrance (Stewart, 2004, p. 11). Darwin calculated that earthworms annually brought up 18 tons of soil to the surface per acre. In Europe, earthworm annual turnover rates range from 6 to 100 tons per square acre (Johnson, 2002). In the Nile delta, an extreme case, earthworms annually deposit *1,000 tons* of casts per acre—a weight equivalent to 500 modern automobiles. They can even drag leaves, pine needles and other plant parts into their burrows so effectively that an entire fall dropping of tree leaves can be carried into the worms' burrows in a few months.

An earthworm's circulatory system is composed of coelomic fluid that moves within its fluid-filled coelom and its closed blood circulatory system. It breathes through pores in its skin so effectively that it does not require a lung respiratory system.

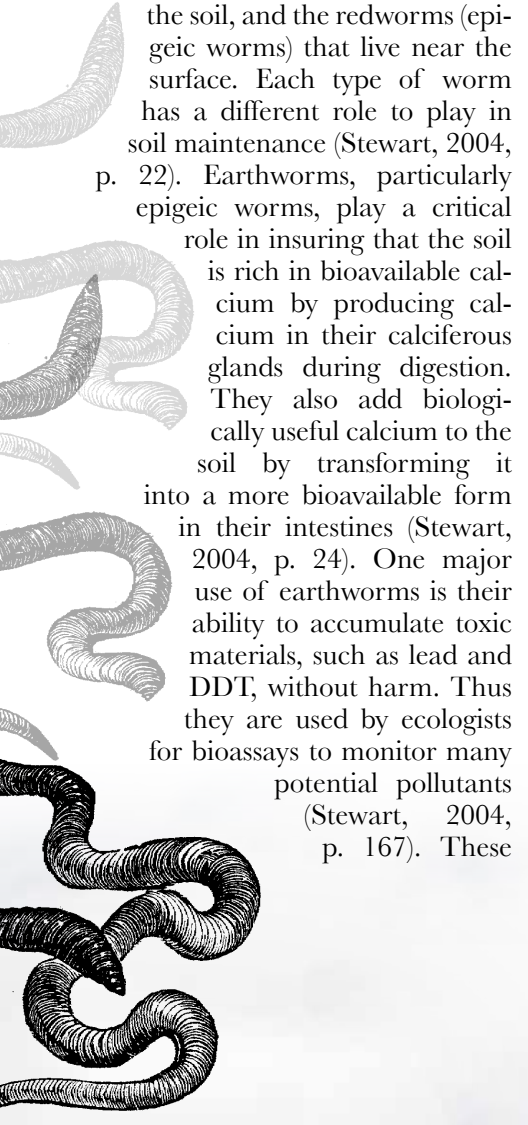
Earthworms are hermaphrodites, meaning each worm has both male and female sex organs, allowing it to reproduce both sexually and asexually (Fernandez, et al., 2012). It thus can exploit the best of both worlds, able to have the advantages of sexual reproduction, but it can reproduce asexually if a mate is not present in its environment. Their young, called cocoons, grow from tiny creatures to full grown earthworms in a matter of weeks.

If the posterior of the worm is severed and the worm's head survives, it will regenerate the rest of the body, but normally only if the animal is severed behind the clitellum, the wide band that encircles the earthworm's body. If two worms are cut in half and the front of one is connected to the tail of another, they can often survive. One laboratory study sutured together the head of one worm, the middle section of another, and the tail from yet another worm, and the combination sur-



vived. They also have five hearts that may partly explain this feat.

Over 4,500 species of earthworms exist, including the most well known, the night crawlers (anecic worms) that live as much as 8 feet deep in the soil, and the redworms (epigeic worms) that live near the surface. Each type of worm has a different role to play in soil maintenance (Stewart, 2004, p. 22). Earthworms, particularly epigeic worms, play a critical role in insuring that the soil is rich in bioavailable calcium by producing calcium in their calciferous glands during digestion. They also add biologically useful calcium to the soil by transforming it into a more bioavailable form in their intestines (Stewart, 2004, p. 24). One major use of earthworms is their ability to accumulate toxic materials, such as lead and DDT, without harm. Thus they are used by ecologists for bioassays to monitor many potential pollutants (Stewart, 2004, p. 167). These biomonitors have proved critical to reduce the harmful effects of many dangerous pollutants.



It is worthy of note that worms are part of a complex ecosystem with bacteria, fungi, nematodes and protozoa (Stewart, 2004, p. 60). Loss of a major part of this ecosystem could cause the entire system to collapse. Also, "in spite of all the microscopic creatures living alongside earthworms and inhabiting their guts, they seem to have few enemies in the soil" (Stewart, 2004, p. 61). Their main enemies are above ground where they spend very little time anyway, and include humans, birds, mice and rats. They are mostly unharmed by parasites of any type.

Origins

Although earthworms are not very common in the fossil record because they lack hard parts, such as teeth, that preserve well, some ancient earthworms have been found in Amber, which are, as far as can be determined, identical to modern earthworms (Grimaldi, 2003, p. 108). We also have fossil evidence of both their castings and distinctly shaped burrows. The fact is, "we know little about their origins" which have been "buried in distant evolutionary time" (Arendt, 2011, p. 44). Furthermore:

> "Annelids are global players in terrestrial and freshwater environments, and in marine ecosystems, where they live in and on the sea floor. But the identity of their nearest relatives (maybe mollusks, maybe flatworms), and even their affinities within the phylum, has remained a puzzle." (Arendt, 2011, p. 44).

Evidence for the putative last common ancestor of all annelids, the 'urannelid,' "has yet to be found" (Arendt, 2011, p. 44). In addition: "the deep-level evolutionary relationships of Annelida are still poorly understood, and a robust reconstruction of annelid evolutionary history is needed … Surprisingly, the evolution of Annelida is still poorly understood, and it's uncertain how well these model organisms represent the ancestral character traits in Annelida." (Struck, et al, 2011, p. 95).

Another problem for evolution is that earthworms are constructed as if they were first assembled by a committee that selected structures from various animals to produce the finished product. For example, they have ovaries like mammals, a crop and gizzard to help grind up food like a bird, chloragogen cells that surround the intestine which function in a similar way to the vertebrate liver, blood containing hemoglobin like mammals, and a paired nephridium, an invertebrate organ that functions similarly to the vertebrate kidney. Earthworms are extremely well designed for their critical role in agriculture, and without them life on earth as we know it would not be able to survive for long (Brady, et al., 2009). For this reason they must have existed when all life was first created.

Summary

The earthworm is an "unsung hero" that is a "uniquely well designed" recycler that is essential to produce the quality of soil that is required to grow our food and allow plant life to thrive (Stewart, 2004, pp. 21, 23). It is also an ideal "canary in the mine" organism that serves as an excellent biomonitor. As far as we can determine, it has existed unchanged since creation. The first earthworm was an earthworm.

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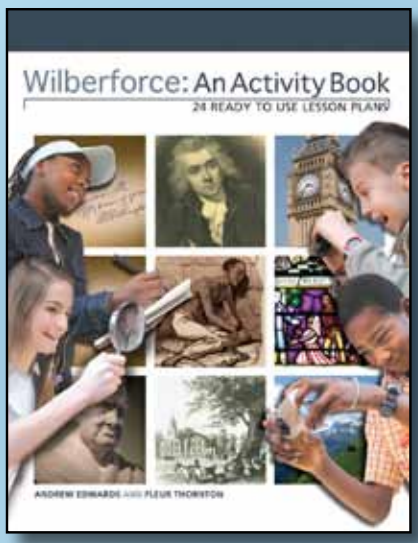
We can't lead someone else to the light while we are standing in the dark... these resources are helpful !



Wilberforce: an activity book

Andrew Edwards and Fleur Thornton

Upper elementary age children will enjoy the information and activities provided in two page spreads. Each features an account of part of William Wilberforce's life, with a related puzzle or word-based activity on the second page. What better way is there to introduce youngsters to the importance of history and concern for one's fellow man If the story is read aloud, then somewhat younger children can do the puzzles. A fun learning opportunity!

Paperback/32 pages/black and white

$3.00

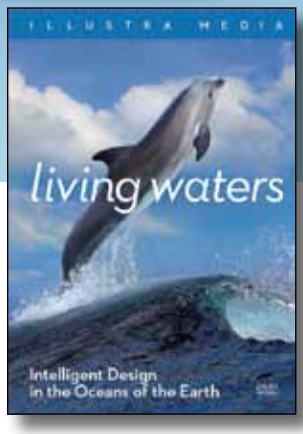
One Big Family

Gary and Frances Bates

This book looks like a simple introduction for young children to the close relationship of all humanity since we are all descendants of Adam and Eve. The message however comes in many layers. The illustrations themselves are designed to encourage discussion, even from the youngest viewers. In addition footnotes reference more in-depth articles available online, which in turn recommend other articles at various levels of readership interest.

Hardcover/47 pages/full colour

$8.00



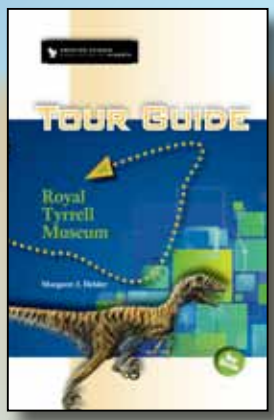
Living Waters

Illustra Media

This new video, third in a series on Design of Life, describes the remarkable features and behaviours of dolphins, sea turtles, salmon and humpback whales. The significance of these features is discussed with excellent film footage and graphics.

DVD/68 minutes

$15.00



Tour Guide

Margaret Helder

Don't be caught without a creation based tour guide when you leave for Drumheller. Our new edition provides commentary on new and older displays at the Royal Tyrrell Museum. Excellent for school groups or general interest.

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