Individual cracks surrounding the radioactive inclusion are randomly distributed and evidently occur quite suddenly in the form of an explosive fracture and not a slow expansion. Figure 1 shows a photograph (due to Ramdohr) of such a phenomenon wherein the isotropic central inclusion fractures the non-isotropic outer zone. The occurrence of this phenomenon is worldwide in extent.

Conclusions

While there might be other alternatives, one possible explanation of these "fractures" or "blasting" halos is that the rate of radioactive decay was at one time greater than that observed today. The isotropization of the host minerals would have occurred very rapidly due to an anomalous decay rate, and hence fracturing of the outer mineral would be expected.

Whether further investigation will prove this hypothesis correct or not, it would seem premature to claim that all the problems relating to the invariance of λ over geological time have been solved. There is, then, *no conclusive* evidence that isotopic ratios of radioactive decay nuclides represent elapsed time as is usually considered the case.

Acknowledgment

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A PALEOECOLOGICAL MISINTERPRETATION

HAROLD G. COFFIN*

The small marine tubeworm, Spirorbis, is abundant in the fossil record. No member of this genus is found in a fresh water habitat. Since Spirorbis tubes are found as a constituent of Carboniferous coal, they are strong evidence for the allochthonous, or transported, origin of much of the coal. This is contrary to the presently popular view that coal originated in swamps and marshes due to the accumulation of plant materials over long periods of time.

In attempting to understand the environments and relationships of ancient living organisms, a discipline called paleoecology has developed. Interpretations, which of necessity must be tentative because of the subjective evidences on which they are based, are unavoidably influenced by the researcher's concepts of time and geological processes during the earths past history.

A strained interpretation has been given the small marine tubeworm, *Spirorbis.* This worm, which secretes a calcareous tube for protection of its fragile body, is ubiquitous in the modern oceans of the world. Because the diameter of the whole coiled tube, which has the appearance of a small snail, is not usually over 2 mm., it can be easily overlooked. It is a sessile organism which attaches on one side to any suitable substrate such as corals, mollusks, bryozoans. and other invertebrates. Floating sargassum or gulf-weed is also covered with many *Spirorbis* tubes and furnishes a planktonic environment[1].

Description and Classification

This worm is hermaphroditic, spawns during high spring tides, and releases its larvae a certain number of days later.[2] In keeping with other organisms of this class, it produces free-swimming trochophore larvae, which move by means of bands of cilia which circle the oval-shaped body[3]. They are positively phototaxic when first released into the water, but usually become negative about three weeks later when metamorphosis commences. A negative reaction

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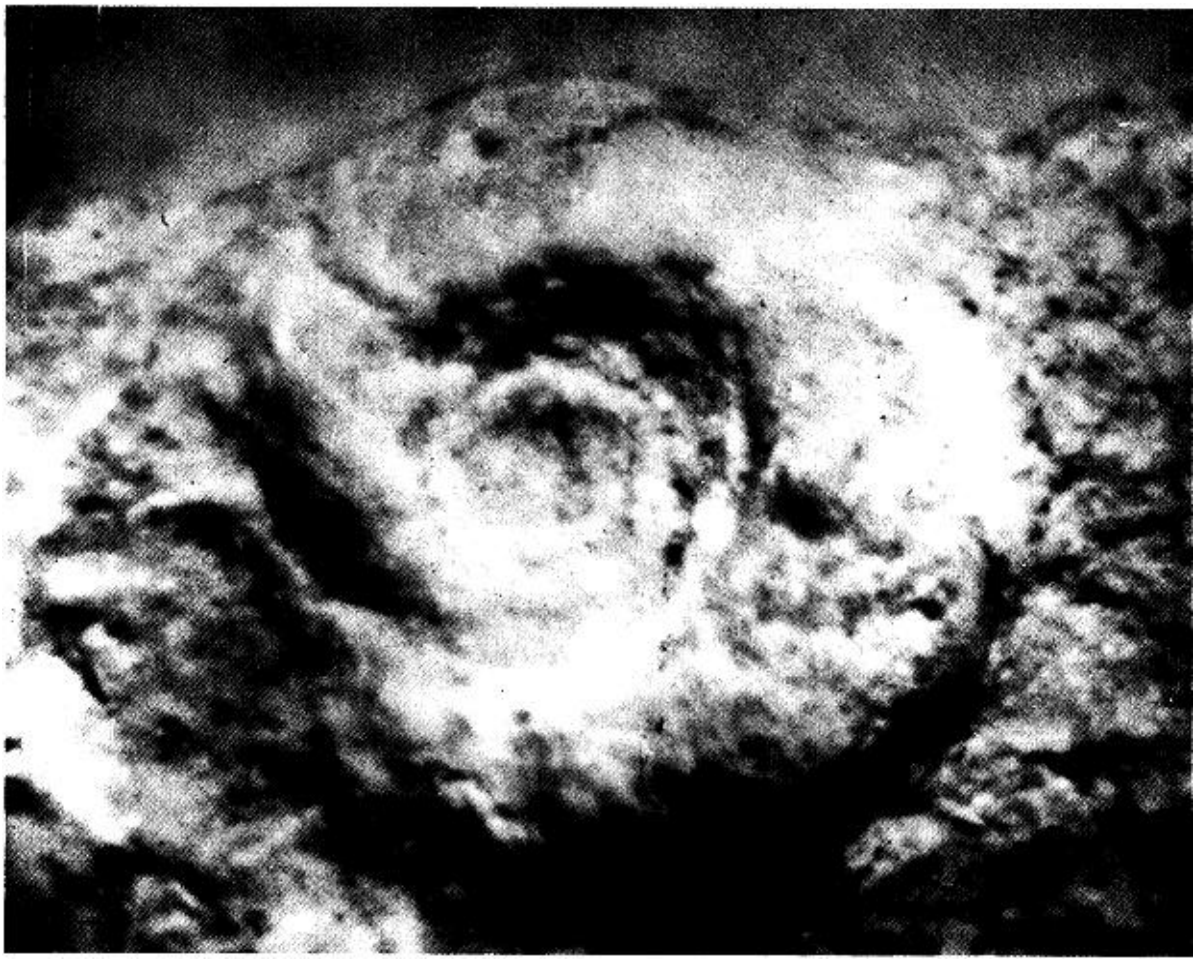

Figure 1. Enlargement of white calcareous tube of *Spirorbis* in fossilized condition.

to brackish or fresh water prevents the larvae from settling in unfavorable environments[4].

No member of the family Surpulidae, to which *Spirorbis* belongs, is found in an aquatic (freshwater) habitat, although the small coiled tubes of *Spirorbis* are abundant along the shores of the Black Sea, which has a salinity of approximately 18% at the surface, as compared to an average of 35% in most oceans[5]. In fact, the whole class, Polychaeta, is marine except for a few rare examples. Certain other groups of marine invertebrates in other phyla also have trochophore larvae, but *no examples of freshwater organisms with trochophore larvae have ever been reported.*

Abundant Samples in Fossil Record

Spirorbis is abundant in the fossil record, being found in all periods from the Ordovician to the Recent. The white calcareous tubes are so similar to those now living in the oceans that there is no hesitancy about placing them in the same genus. Attempts to designate species among fossil specimens have not been very successful.[6] Marine fossils often carry attached *Spirorbis* tubes. Their arrangement on some pelecypods suggests a commensalism whereby the worm benefited from the water currents caused by the feeding of the clam.[7]

If coal deposits are not allochthonous (transported), but have originated from swamps and marshes where plant materials have accumulated to considerable depths over much time–the present popular view, then the discovery of marine organisms within the coal would not be expected. Usually coal is quite devoid of animal fossils, although there are numerous exceptions. However, *Spirorbis* is a frequent constituent of Carboniferous coal-measures. They are found attached to plant debris and mixed into coal seams. They also may be cemented to any marine organisms that are present.[8] This has been known from the time when coal and associated strata were beginning to receive detailed attention over 100 years ago.

Initial Incredible Interpretation

The swing in the early eighteen-hundreds by geologists to concepts of uniformity and geological ages influenced the paleoecological interpretation of *Spirorbis.* Obviously the "bog theory" of coal formation cannot accommodate the abundant presence of a marine organism. Through the years this small annelid has been declared a salt-water worm throughout the geologic column except in the coal measures, where the supposed evidences for the *in situ* origin of coal made difficult the interpretation of *Spirorbis* at its face value.[9,10,11,12]

Consequently, seemingly without much question on the part of geologists and paleontologists through the decades, this worm when found in coal and coal-bearing rocks, has been designated a *fresh-water* dweller. This position has been taken despite the facts:

(a) that *Spirorbis* today is completely limited to the marine environment,

(b) that it reproduces by means of a trochophore larva, which, though characteristic of several marine phyla, is unknown for any fresh water invertebrates, and

(c) that it is associated with obviously marine organisms throughout the geologic column, including the Carboniferous period.

This highly questionable interpretation is a good example of the influence of a prevailing (ruling) theory.

Conclusion

Taken at face value, *Spirorbis* in coal and on plant fragments gives strong evidence for the allochthonous origin of much of the coal. Even as today the drifting Sargassum seaweed provides an attachment surface for *Spirorbis, so* flotsum of *Sigillaria, Lepidodendron, Calamites, Cordaites* and other coal-forming plants became spotted with the coiled tubes of this small worm. When depositing conditions buried the masses of vegetable material under sand and silt, the worms were buried also.

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ray-produced neutrons before they had opportunity to react with nitrogen in the atmosphere;

(3) removal by rains during and after the Flood of a large portion of the carbon dioxide characteristic of the pre-Flood atmosphere and conversion of this carbon dioxide to precipitated carbonates and carbonates carried in solution by the post-Flood oceans. (It has been reliably estimated that the carbon in the Earth that is not presently contained in minerals or fossils is distributed: 86.2 percent in solution in the oceans in a chemical form not directly associated with organic material, 8.7 percent in organic material contained in the oceans, 3.5 percent associated with organic life on land, and 1.6 percent in the atmosphere).

Thus it seems that continuing developments in the investigation of radioactive dating are certain to bring yet broader and more firm support for the information God has given to us through the written word.

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