LICHENS: A DILEMMA FOR THE EVOLUTIONARY MODEL

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Lichens are a class of organisms in which a fungus and an alga live together in an association frequently cited as the classic example of symbiosis. Only certain fungi and certain algae form lichens. No naturalistic means has been found for supposed evolutionary development of such an association, and attempts to synthesize lichens from component organisms have usually led to death of the alga. Where lichenization has actually occurred in the laboratory, conditions have been carefully and intelligently contrived to bring about the association. The creationist view of the lichen association is the one which best fits lichen synthesis data.

Introduction

A number of terms are used commonly to describe relationships between organisms: (a) "Antibiosis," "parasitism," and "predation" describe relationships in which one organism is antagonistic to another. (b) An association of two organisms producing effects not caused by either alone is referred to as "synergistic."

(c) Relationships between organisms where at least one organism is benefited while the other *may* be benefited (at least not hurt) are referred to as "mutualistic." The mutualistic relationship is called "commensalism" where one organism is clearly benefted while the associated organism is not inhibited (although not necessarily helped). (d) If an association is beneficial to both partners, but not really essential to their survival it is labeled "syntropism."

(e) Where two organisms rely on each other for survival and both organisms are clearly benefited (although one may benefit more than the other) the relationship is called "symbiosis." Interdependence of the partners is a *requirement* if the association is truly symbiotic.

Numerous examples are given of true symbiotic relationships. They include the association of herbivorous animals and ruminant flora, nitrogen-fixing bacteria and leguminous plants, and mycorrhizae (the non-disease-producing association of a fungus with the roots of certain higher plants). Perhaps the classic example of symbiosis is the association of a fungus with an alga, commonly known as a "lichen."

Lichen: Special Biological Relationship

A lichen is a very special biological relationship. It is an association which forms a discrete, identifiable, morphological entity distinct from either of the partners. In a lichen, the cells of the fungal partner (the mycobiont) and the cells of the algal partner (the phycobiont) are intimately associated histologically and physiologically. An alga simply growing over the top of a mushroom is not a lichen, nor is it likely to become one. Lichen gross morphology and histology are consistent and dependable, so much so that until the middle of the 19th century they were considered to be a distinct group of plants.

A key feature of the lichen relationship is the tremendous survivability of this fungus-alga association. Lichens are found in nearly every environment from arctic to tropic, from desert to rain forest. Lichens are sometimes the only organisms to withstand the rigors of certain environments, e.g. high altitude and arctic sites where vascular plants and even many lower plants are unable to survive.

Roughly 26 genera of algae have been found as members of lichen associations. Of these 26 genera, 17 genera are green algae (*Trebouxia* spp. being most common), 8 genera are blue-green algae (*Nostoc* spp. being most common), and one genus is a yellow-green alga.[1]

Much is known of the contributions of the phycobiont to the lichen system. *Nostoc*, for instance, fixes nitrogen and excretes large amounts of nitrogenous compounds into the immediate environment. It produces a number of vitamins, including nicotinic acid, biotin, riboflavin, and thiamine, as well as several polysaccharides.[2] The major contribution of the algal partner would appear to be nutritional. The uptake of these nutrients by the fungus has been confirmed by C^{14} studies.[3]

Fungi forming lichen relationships come predominantly from the class Ascomycetes, orders Caliciales (subseries Loculomycetes) and Lecanorales (subseries Discomycetes). A few lichen fungi come from the class Basidiomycetes (family Thelephoraceae). All fungi entering into a lichen partnership with an alga are either totally or partially dependent on external sources of thiamine. Some require both thiamine and biotin. Others require thiamine, biotin, and any one or more of a number of other vitamins. The major contributions of the fungus include protection of the alga from dessication and injury, providing the alga with ideal light intensities for maximum photosynthesis, and supplying the alga with adequate minerals and water.[4]

Speculation, Studies on Lichen "Origin"

The special nature of the lichen symbiosis has led to considerable speculation on the part of lichenologists as to how this relationship could have "developed."

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Some workers propose that the fungus actually parasitizes the alga and that only those algal cells which survive the parasitism form the lichen relationship. This notion is superficially plausible except that once isolated in pure culture as separate entities, it is nearly impossible to get the two components back into an associated state.

In a series of papers by Henriksson, the lichen *Collema tenax* was separated into mycobiont and phycobiont components and an attempt was made to bring them back together. Instead of forming an association with the alga, the fungus destroyed any algal cells in the vicinity of the fungal hyphae.[5, 6, 7, 8] In other studies by Ahmadjian and Henriksson, the fungal partner of *Collema tenax* was brought together with *Trebouxia impressa* (the phycobiont of another lichen). Again, instead of a symbiotic association developing between fungus and alga, the alga died and dead algal cells were filled with fungal hyphae.[9]

Ahmadjian, a world authority on lichens, reports "some success" in lichenization by bringing phycobiont and mycobiont together on media on which *neither* partner could grow independently.[10] Some of Ahmadjian's synthesized lichens were transferred from the laboratory to natural habitat and survived. Lichens synthesized in this manner progressed very slowly and required a carefully controlled program of environmental alterations.

While this may appear to solve the dilemma of how lichens began initially, there remains the question of what environment existed before the partners became associated. All evidence to date indicates that the lichen relationship *breaks down* when the partners can exist independently in the environment. If the environment becomes incompatible, both partners die. The association is not favored in either case. If the fungal partner cannot exist independently, in a certain environment, it would be imperative that germinating fungal spores "find" the critical algal partner immediately.

One Man's Views on "Origin"

D. G. Scott fully realizes that to propose "evolutionary" beginnings for lichens is to go out on a "scientific limb." He realizes that botanists do not have clues to such beginnings.

Scott states that if chance processes are accepted as the *modus operandi* of the lichen association, then numerous remnants of abortive attempts should be evident in the natural historical record. That this is not so indicates (to Scott) that unsuccessful "experiments" in lichenization are immediately eliminated or that whatever determines success for the lichen relationship functions at a very early stage.[11]

There are few, if any examples in nature of "trial and error" lichenization in progress. Lichenologists retain a certain optimism over the anticipation of finding such a half-way association. Some consider that new lichen species may be forming constantly in nature and that the environment harbors fungi and algae in all degrees of lichenization. Unfortunately, the large gap in lichen "evolution" remains unfilled. Only thousands of successful associations are known and scanty evidence of any "evolutionary progression" leading to them.

A so-called evolutionary approach to lichen formation is based upon the postulate that separate existence of the partners preceded symbiosis. Since many lichenized fungi bear very close morphological resemblance to certain independent fungi, the assumption that mycobionts were once free-living is rarely questioned. Scott, by his own admission, *accepts* this *postulate* as *fact* because he cannot conceive of two genetically different organisms "evolving" simultaneously (i.e. in the same space and time) from a common ancestor as a physiologically interdependent unit.[12]

Matters are actually even more complex. In order to uphold an evolutionary model for lichens, unless one assumes that all phycobionts had a common ancestor, and that all mycobionts had a common ancestor, one *must* conclude that associations (unlikely as they would appear to be anyway) would have to have been attempted by *more* than one fungus and by *more* than one alga (perhaps up to 26 genera), with similar mechanisms probably in operation to make the symbosis work.

Only Two Choices Open

When scientists who are Christians appeal to divine creation as the only rational answer to this dilemma of lichen origin, they are usually charged with using God as a catchall for everything not yet fully understood. Considering the lichen association, however, scientists really have only two choices.

The first choice is to surmise a sequence of what lab data indicate to be highly improbable events, using scientific vocabulary to lend plausibility. Faith that the evolution model is the correct one and will ultimately be a means to an answer is a necessary part of this choice.

Choice two is to cease resisting that which is accompanied by a body of reasonable evidence, that the components were intelligently assembled and associated. Choice two is the simplest model which fits all known data without contradiction, hence is most consistent with the scientific method.

That a scientist can induce lichenization to a limited degree in the laboratory in no way dis-

credits the creationist model of lichen synthesis. It simply shows that even man can achieve a *somewhat* successful lichen association through *intelligent manipulation* of the organisms and their environment.

References

[1]Moore-Landecker, E. 1972. Fundamentals of the fungi. Prentis-Hall, Inc., Englewood Cliffs, p. 383.
[2]*Ibid.*, p. 384.
[3]*Ibid.*, p. 385.
[4]*Ibid.*, pp. 384-385.
[5]Hendriksson, E. 1957. Studies on the physiology of the lichen *Collema*. I. The production of extracellular nitrogenous substances by the algal partner under various conditions, *Physiologia Plantarum*, 10:943-948.
[6]Henriksson, E. 1958. Studies on the physiology of the lichen *Collema*. II. A preliminary report on the isolated fungal partner with special regard to its behavior when growing together with the symbiotic alga, *Svensk Botanisk Tidskrift*, 52:391-396.
[7]Henriksson, E. 1960. Studies on the physiology of the lichen *Collema*. III. The occurrence of an inhibitory action of the phycobiont on the growth of the mycobiont, *Physiologia Plantarum*, 13:751-754.
[8]Henriksson, E. 1961. Studies on the physiology of the lichen *Collema*. IV. The occurrence of polysaccharides and some vitamins outside the cells of the phycobiont, *Physiologia Plantarum*, 14:813-817.
[9]Ahmadjian, V. and E. Henriksson. 1959. Parasitic relationship between two culturally isolated and unrelated lichen components, *Science*, 130:1251.
[10]Ahmadjian, V. 1962. Investigations of lichen synthesis, *American Journal of Botany*, 49:277-283.
[11]Scott, G. G. 1973. Evolutionary aspects of symbiosis (in) The lichens. Edited by V. Ahmadjian and M. E. Hale. Academic Press, New York, p. 591.
[12]*Ibid.*, p. 582.

WAS THE ICE AGE CAUSED BY THE FLOOD?

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A previous article on the connection between the flood and the ice age received considerable attention, and led to a number of questions.† In view of the importance of this matter for the doctrine of a young Earth, it has seemed worth while to answer some of the questions and to enlarge on certain points.—Editor.

"Water, water - - - everywhere"?

There is only one way to solve the problem of "Where did the floodwaters go?" and that is by reading and believing that "God made a wind to pass over the earth and the waters asswaged," that is, by evaporation which is the natural result of a strong wind.

The objection is often raised that the earth's atmosphere could not absorb more than a "3-inch layer of water," or a maximum of "30 centimeters," according to one calculation, even if calculated at "100% saturation and 90° F." In reply, it is only necessary to read once again *and believe* the record that "the waters returned from off the earth continually." That is, the rain came "from heaven," not from the clouds which are admittedly totally inadequate as a source, and the waters "returned," away from this planet entirely.

If the objection is raised that no known wind has ever attained the escape velocity necessary to overcome the earth's gravitational pull we need only believe the record that this was a supernatural wind made for this purpose, for "God made a wind to pass over the earth and the waters asswaged."[1-3]

Once the supernatural origin of the flood is acknowledged other pieces of the puzzle begin to fall naturally into place. The ice age follows as the natural aftermath of the flood. Each cubic centimeter of water that evaporated removed 540 calories of heat from the surroundings. A layer of water five miles deep, covering the earth's 197 million square miles of surface would lower the temperature by 2.2×10^{27} calories which is more than sufficient to explain the ice age on the land, and also the 25° fall in temperature of the oceans as stated by Sir Arthur Holmes:

> The mean annual temperatures . . . were 25° C. . . . The general fall in temperature since the Chalk was deposited has been estimated from pollen and other plant remains as well as by the oxygen-isotope method . . . the cooling affected the bottom waters of the open Pacific until they were reduced nearly to the freezing point. . . . Today the oceans are cold because of the vast amount of melted ice they received . . . but at the onset of the Ice Age there was no melting ice to cool the oceans. Nevertheless, cool they did.[4]

The words "since the Chalk" means of course, according to Holmes, since the Cretaceous Age of Chalk, 65 million years ago, but according to flood geology, since the heavier calcium carbonate of chalk was precipitated in the closing days of the flood.

The record states that "the mountains were covered"[5] and this implies that Antarctica's ice-

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†Daly, Reginald. 1973. The cause of the ice age, *Creation Research Society Quarterly*, 9 (4):210-217.