

THE PRE-FLOOD FLOATING FOREST: A STUDY IN PALEONTOLOGICAL PATTERN RECOGNITION

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ABSTRACT

The sessile status and high preservability of plants make them good taxa for studying fossil record order and discriminating among the various mechanisms creationists have advanced for explaining fossil order. Although the creation model does not make specific predictions about the order of fossil appearance for the plants, evolutionary theory does. The first appearance of higher plant taxa occur in an order strongly correlative with the order of evolutionary branching predicted from published cladograms. The higher plant taxa represent a strong stratomorphic series. The probability that this pattern could be arrived at randomly is so low as to suggest that an explanation is required in the young-age creation model.

The synapomorphy sequence of plant cladograms is consistent with a character trend up the cladogram towards increased resistance to desiccation (or increased terrestriality) and is highly correlative with the stratigraphic order of both first appearance and maximum diversity. It is proposed that the Flood destruction of pre-Flood floating forest biome would explain this data. In a fashion analogous to the plants of a quaking bog, it is suggested that the floating forest biome grew out over the ocean through an ecological succession of rhizomous plants of steadily increasing size generating and thriving upon an increasingly thick mat of vegetation and soil. It is suggested that the plant succession from open water inward began with hornophytes, and continued with a sequence of rhyniophytes, zosterophyllites, and progymnosperms. This was followed in turn by a full forest biome including herbaceous lycopods and ferns on the forest floor, seed ferns in the understory, and arborescent sphenophytes and lycopods making up the canopy. It is also suggested that living in the floating forest was a succession of animals (the Paleozoic 'land' animals). This would have included the large Paleozoic insects as well as the Devonian aquatic tetrapods (like *Ichthyostega*) in pools on thinner portions of the forest floor and a wide variety of large amphibians (including the labyrinthodonts) on the thicker sections of the forest.

Not only does the Flood destruction of the floating forest explain the first appearance and maximum abundance order of fossil plants and animals, it also explains the strong association of Paleozoic plants with marine sediments and how the pre-Flood world could support the plant biomass represented in the Carboniferous coals. It also incorporates the pre-Flood floating forest theory of Joachim Scheven, and the floating logmat theory of Steven A. Austin for the origin of coal. It is further suggested that the residual catastrophism of the post-Flood period prevented the restoration of the antediluvian floating forest biome and resulted in the extinction of most of the Paleozoic plants and 'land' animals.

INTRODUCTION

Somewhat paradoxically, it has been common for creationists on the one hand to reject any claimed order in the fossil record (e.g. [4] [29, pp. 140-152] [31, pp. 610-642] [54]) and on the other hand to claim that the order in the fossil record can be explained by Noah's Flood (e.g. [5, pp. 53-5] [50, pp. 273-330]). Sometimes both of these claims can be found within the same work (e.g. [50, compare pp. 271-1, 132-6, and pp. 169-211 with pp. 273-330] [47, compare pp. 102-9 with pp. 109-113]). To explain any order which is admitted, one or more of four theories are usually invoked: differential mobility (e.g. [7, pp. 73, 81] [26, p. 288] [50, pp. 275-276, 281, 285]), hydrodynamic sorting (e.g. [50, pp. 273-276]), differential flotation (e.g. [7, p. 81]), differential intelligence, and ecological zonation (e.g. [5] [7, pp. 73-81] [26, p. 288] [50, pp. 273-288]). Unfortunately, some combination of these claims can be utilized to explain any order (or lack thereof) that could ever be imagined for the fossil record. As a result, *ad hoc* appeal to such theories does not provide adequate explanation of fossil record order.

To develop a creationist explanation of fossil record order, a several-step process is recommended. First of all, the fossil record should be carefully studied to determine if there is an order to be explained. One of the most effective means of doing this would be to test the observed order of the fossil record against various reasonable null hypotheses of randomness. Second, if statistically significant order is found (i.e. that not

normally expected with random process), then that order needs to be characterized. Third, once the order is characterized, then (and only then) should creationists search for explanations of that order. Finally, explanations should be preferred which are reasonably inferable from multiple lines of evidence and/or testable. This paper seeks to apply this methodology to a portion of the fossil record as an example of how future research in the fossil record can and should develop.

CHOOSING THE TAXA

Given that there are four major theories creationists have used to explain order, it would be preferable to control for as many of the variables as possible. Optimally, taxa might be chosen which, *a priori* eliminated one or more of the possible order-generating mechanisms. To control for the variable of ecological zonation, for example, we might choose geographically ubiquitous organisms. However, our currently limited understanding of antediluvian biogeography makes the identification of an organism's pre-Flood biogeographic distribution very challenging. Various creationists have claimed everything from extreme (e.g. [5]) to essentially non-existent (e.g. [50, pp. 64-5, 239-258]) terrestrial biogeographic zonation. It is too early in our study of the pre-Flood world to be certain we are choosing organisms with wide geographic distributions. To control for the variable of hydraulic sorting we could choose organisms of similar size, shape, and density. Although such studies are possible, they would likely be somewhat challenging. First, it would tend to be difficult to identify organisms with similar hydraulic response. Secondly, given the wide disparity in organismal form, it may be difficult to gather a statistically significant sample size for a given hydraulic response. Finally, hydraulic sorting experiments would probably have to be performed to confirm the assumption of similar hydraulic response. To control for the variable of differential intelligence, we might choose organisms of similar intelligence. Although innumerable debates might arise about relative intelligences of various animals, choosing organisms which are generally thought to lack intelligence entirely (e.g. bacteria, protists, algae, fungi, plants) might be an easy control for this variable. Finally, to control for the variable of differential mobility, we might choose sessile organisms. Sessile organisms which are thought to lack intelligence – e.g. fungi and plants – not only allow for easy identification but control for *two* of our variables – differential mobility and differential intelligence.

Given that we are examining fossil record order, those sessile groups which not only are thought to lack intelligence, but which have high likelihoods of preservability would be preferred as subjects of study. Given a global Flood, virtually all organisms were more or less subjected to similar environments of burial, so life environment may have had little impact on probability of preservation. As a result, the first-order factor in differential preservability is most likely resistance to decomposition – *i.e.* possession of hard parts.

'Higher' plants are probably the best choice for this sort of study. First, their sessile nature controls for both differential intelligence and differential mobility. Second, cellulose and lignin, which are primarily responsible for vascular plant hard parts and thus the quality of the land plant fossil record, are fairly ubiquitously employed by plants across the kingdom. As a result, aside from the second-order effects of a trend in increased lignin content up the stratigraphic column, the vascular plants *sensu lato* (polysporangiophytes of [22]) may possess a fairly constant probability of preservation. Third, the vascular plants are very diverse (over 200,000 species in the present) and rather common in the fossil record in layers where they are found (e.g. the world's coal beds). Fourth, although hydraulic sorting could certainly impact the distribution of vascular plants, it may have impacted them more uniformly than it impacted other organisms. Most vascular plants probably began their diluvial history in a similar manner – floating – and then sank at rates related to their physical disaggregation and waterlogging rates. Finally, since plants were created to be food for man and animals (Gen. 1:29-30), pre-Flood plant biozonation probably effected pre-Flood animal biozonation. Establishing biozonation patterns of plants might eventually permit an understanding of the biozonation of non-sessile organisms in the pre-Flood world. As a result of these considerations, this paper will study the vertical distribution pattern of vascular plants in the fossil record.

Biblical considerations [21], basic type studies [38], and baraminological studies [34] [35] [36] [37] [52] [53] suggest that the biblical 'kind' most often lies above the level of the genus and below the level of the class. It is most likely that land plant divisions and classes are taxonomic levels *above* that of baramin. The substantial morphological gap which usually separates the divisions and classes would strongly suggest that they (like the animal phyla and classes) are each apobaraminic [52]. Creation theory usually denies the possibility of baramin origin after the Creation Week (e.g. [26, pp. 161-181]). As a result, all the plant apobaramins (e.g. vascular plant divisions and classes) found as fossils and in the present co-existed on the earth in the antediluvian world. This paper, then, will study the vertical distribution pattern of fossils of living and fossil plant divisions and classes.

ESTABLISHING A PATTERN

A complete re-evaluation of the stratigraphic column is beyond the scope of this paper. As a result, following [44], this study will assume the validity of the conventional biostratigraphic column as providing a first-order approximation of the true relative order of fossils. Based upon that biostratigraphic column, fossils are not uniformly distributed with respect to higher taxa – *i.e.* many higher taxonomic groups are restricted to particular levels of the stratigraphic column and not to others (*e.g.* several vascular plant classes are restricted to Paleozoic sediments). This suggests that something is generating fossil order in the Flood sedimentation.

Unfortunately, the young-age creation model currently has few predictions about what the fossil record order *should* be. We lack relative waterlogging and settling rates for various taxa to predict the order generated by hydrodynamic sorting. Current Flood models (*e.g.* [2]) suggest that the pre-Flood terrestrial biota was overcome by waters transgressing over the land, picking off one terrestrial community at a time. Thus, if the order of fossil burial was primarily determined by order of inundation, then the biogeography of the pre-Flood world would produce a first-order prediction of fossil record order. However, our current ignorance of pre-Flood biogeography prevents such predictions from being made.

In contrast, predictions of fossil record order *can* be made from evolutionary theory. Any hypothesis of evolutionary phylogeny predicts a particular sequence of first appearances for taxa. If the sampling of taxa by the fossil record can be assumed to be more or less constant, and the evolutionary phylogeny is true, then the order of first appearance of taxa in the fossil record should correspond to the order of first appearance of taxa in evolutionary phylogenies. The more or less constant distribution of cellulose and lignin across higher taxa of vascular plants suggests that their probability of preservation should be more or less constant. Biostratigraphic first appearances and taxonomy for plant divisions and classes are recorded in Table 1 from [22] for non-seed plants, [6] for gymnosperms, and [8] for angiosperms. A first-order approximation of the evolutionary phylogeny of vascular plants is provided by the cladistic studies of [10], [13], and [22]. The predicted first appearance order of the higher taxa is shown in the simplified cladogram of Figure 1. The rank order of fossil record first appearance and the rank order of cladistic (evolutionary) branching is also included in Table 1.

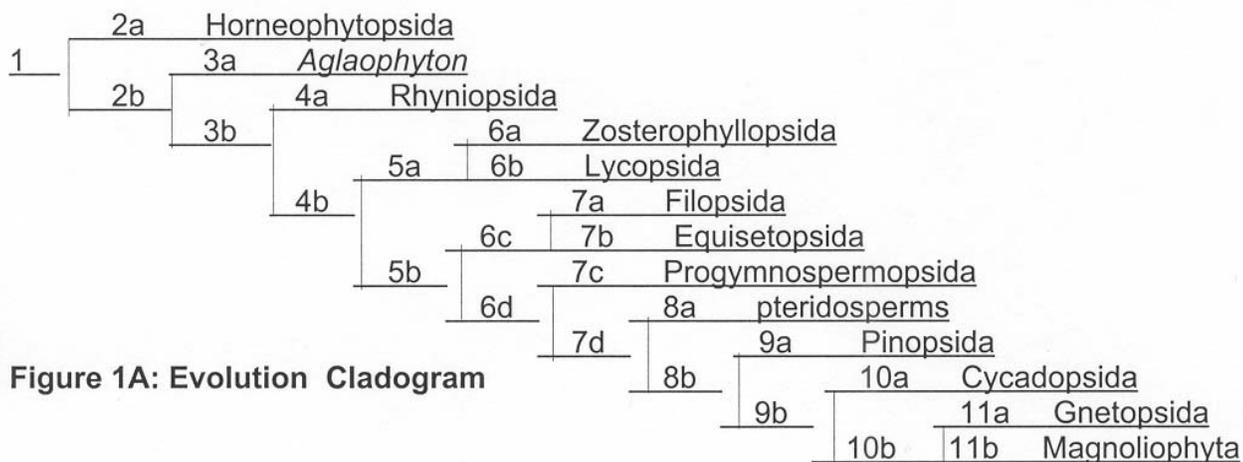


Figure 1A: Evolution Cladogram

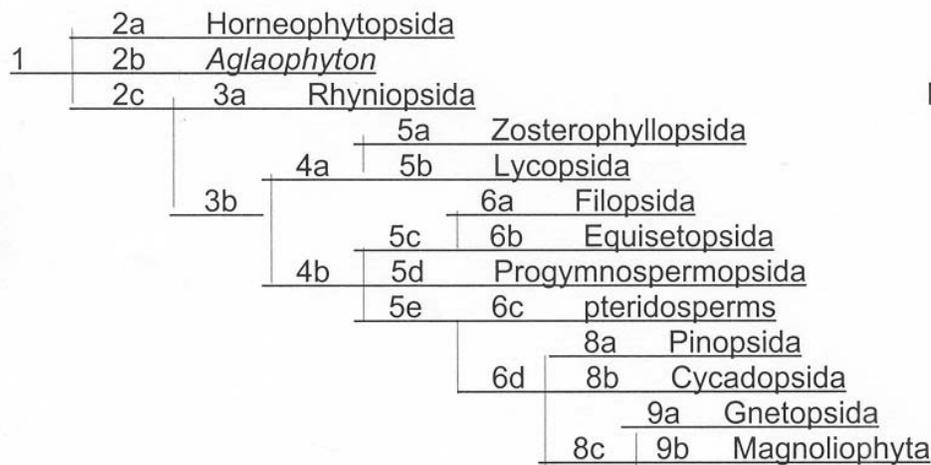


Figure 1B: Dessication Cladogram

Plant Taxa	Biostratigraphic First Occurrence	Biostratigraphic Max. Diversity	Evolution Rank	Terrestriality Rank
Horneophytopsida	Pridoli (1)	Lochkovian (1)	1	1
<i>Aglaophyton</i>	Pragian (2)	Pragian (2)	2	1
Rhyniopsida	Pragian (2)	Pragian (2)	3	2
Zosterophyllopsida	Lochkovian	Emsian (3)	4 or more	4 or more
Lycopsida	LUD?; LOK	U. Pennsylvanian	4 or more	4 or more
Euphyllophytina	Emsian (3)	Emsian-Eifelian (3)	4	3
Equisetopsida	Givetian	U. Mississippian	5 or more	5 or more
Filicopsida	Tournasian	M. Pennsylvanian	5 or more	5 or more
Progymnospermopsida	Givetian (4)	Frasnian (4)	5	4
Lagenostomopsida	Famennian (5)	Tournasian (5)	6	5
Mz pteridosperms	Hastarian	Lower Triassic		
Cycadopsida	BRI?; ARN (6)	Jurassic (6)	7	6
Pinopsida	IVO?; ALP?; KIN?; MRD (7)	Albian (7)	8	6
Gnetopsida	Carnian (9)	Mid Cretaceous (7)	9	7
Magnoliophyta	Lo. Cretaceous (10)	Recent (8)	10	7

Table 1: Plant classification and first appearance data is from [6], [8], and [22]. Maximum diversity is from [30], supplemented by [6], [22]. and [45]. Rank is indicated in the fossil determined from oldest certain occurrence and (because of limited cladogram data) Lagenostomopsida is combined with Mesozoic pteridosperms. Fossil ranks for taxa with a cladogram-predicted order are indicated in parentheses after the occurrence data. KEY: ALP: Alportian; ARN: Arnsbergian; BRI: Brigantian; IVO: Ivorian; KIN: Kinderscoutian; LOK: Lochkovian; LUD: Ludlow; MRD: Marsdenian.

The rank orders of the fossil record and evolutionary branching favorably agree (Figure 2). The correlation coefficient is 0.994, which is highly significant ($p < 0.001$) with the Spearman Rank Correlation - in other words the high correspondence between fossil record and evolutionary branching order would not be expected to come about randomly. This strongly suggests that the fossil record of the vascular plants has a pattern which needs to be explained in young-age creation theory - at least it strongly verifies a pattern which evolution predicts.

FINDING A CREATIONIST EXPLANATION

Given that vascular plants are sessile, it can be assumed that differential mobility and differential intelligence did not produce any part of the fossil record pattern we see. An examination of the major features of vascular plant fossil record suggests that hydrodynamic sorting is not responsible for the first-order pattern. First, arborescent forms with secondary wood are separated in the fossil record according to their higher taxonomic classification (Progymnospermopsida vs. Gymnospermophyta vs. Magnoliophyta) and not buried together and separate from herbaceous forms as one might intuitively expect with hydrodynamic sorting. Second, although one might expect the pitch-laden gymnosperms to float longer than angiosperms, the opposite order is seen in the fossil record. Third, one might expect that understory plants such as herbaceous lycopods and ferns would be grouped together in a particular stratigraphic level, whereas these groups are scattered through virtually the entire fossil record of vascular plants.

Transgressing Flood waters might be expected to collect and deposit entire communities in succession. Since most present vascular plant communities possess a high disparity - everything from ground plants to understory plants to canopy plants - a biogeography-driven fossil record should produce a uniform distribution of herbaceous versus arborescent forms through the fossil record. Since this is more or less what is seen in the fossil record (see, for example, Figure 3), biogeography may be the primary determinant of the fossil record of vascular plants.

If biogeography is generating the first-order fossil record pattern of the vascular plants, then we might expect the plants to be distributed according to Walter's Law. This means that the vertical fossil distribution of plants reflects a horizontal biogeographic distribution of the same plants in the pre-Flood world. The general correspondence of first appearance order and evolutionary branching could be explained if pre-Flood plant biogeography was primarily determined by a plant's terrestriality - *i.e.* its ability to thrive outside of water and to reproduce independently of standing water. Increasing terrestriality would generate a natural water-to-land biogeographic order which transgressing Flood waters would inundate (and bury) in the same order. And, since the evolutionary theme of the plant kingdom is the gradual development of higher plants from marine

algae, one might expect evolutionary phylogenies to show an increase in terrestriality with time, which should then translate into increasing terrestriality up the stratigraphic column.

This hypothesis can be tested. First, although evolutionary theory might not necessarily expect the maximum diversity of a group to be strongly correlated with the time of first appearance, one might expect a high correlation in first and maximum occurrence in a geographic transect. The biostratigraphic position of maximum species diversity was estimated from [30] supplemented by [6], [22], and [45] and entered into Table 1. A high correspondence is found ($r=0.993$) between order of first appearance and order of maximum diversity.

A second test would be to use cladistics to arrange taxa according to characters which affect the terrestriality of plants. The resultant cladistic branching order should be a first approximation of the degree of terrestriality dependence in the respective taxa. This order should correspond to the fossil record order - both the order of first appearance and the order of maximum diversity.

Designs which enhance terrestriality include 1) increased verticality to raise and maintain plant tissue in the terrestrial realm (*i.e.* above water and/or ground level); 2) increased rigidity and stability to support the tissue volume being held above water and/or ground level; 3) increased water absorption and conduction to supply water to terrestrial plant tissues which cannot absorb water directly from a surrounding aqueous environment; 4) increased photosynthesis to supply energy needed for the greater tissue volume of a terrestrial organism; 5) increased water retention to minimize water loss into the dry terrestrial environment; 6) increased water- independence in fertilization mechanisms which allow fertilization to occur without exposure to the atmosphere and associated evaporation; and miscellaneous 7) survival mechanisms for increased survivability in high- stress environments. Specific synapomorphies from the evolutionary cladogram which seem to enhance terrestriality include (coded to branch points on the cladogram of Figure 1A):

- 1 **sporophyte generation independent of gametophyte:** increases verticality (of one generation) while the plant's gametophyte remains small to release gametes directly into water. **dichotomously-branched sporophyte** (Mishler & Churchill, 1984) increases photosynthesis. **multicellular rhizoids** and **rhizomes** increase water absorption.
- 3b **lignin deposition** and **annular or helical thickenings in water-conduction cells** increases rigidity and inhibits tracheid collapse, allowing increased water conduction
- 4b **thick, decay-resistant tracheid cell wall by lithification** increases rigidity and inhibits tracheid collapse, allowing increased water conduction
pitlets between thickenings or within pits in tracheid cell walls increase water conduction between adjacent tracheids.
sterome (thick surface cell layer) increases water retention.
- 5b **pseudomonopodial or monopodial branching** increases verticality.
small, 'pinnulelike' vegetative branches & multicellular appendages (spines) increase photosynthesis.
- 6b **microphylls** increase photosynthesis.
pitted tracheids increase water conduction between water conduction cells. **true roots** increase stability, water absorption, and water conduction.
- 6d **bifacial cambium producing secondary xylem, phloem, and wood rays** increases rigidity. **true roots** increase stability, water absorption, and water conduction. **3-D branching** increases photosynthesis.
- 7a **(fern) megaphylleaves** increase photosynthesis.
true roots increase stability, water absorption, and water conduction. **7b microphyllleaves** increase photosynthesis. **cambium** increases rigidity.
- 7d **integument** increases water retention.
micropyle (hole in integument for pollen entry) increases water-independence in fertilization.
heterospory & a single megaspore per megasporangium increases nutrition available to each egg, increasing survival probability in the face of increased environmental stress. **leaf webbing** increases photosynthesis.
- 9b **thick nucellus** (thick layer about the egg) increases water retention.
pollen tube & non-dehiscent megasporangium increases water-independence in fertilization.
- 10b **secondary xylem with vessels** increases rigidity and water conduction.
decrease of pollination-fertilization interval increases water-independence in fertilization. **double fertilization** is a clever survival mechanism for situations of failed fertilization.

11b **flower** increases water-independence in fertilization by further protecting the embryo.

When the desiccation-resistance synapomorphies are utilized in constructing a cladogram, nodes 2 and 8 in the Figure 1 A cladogram collapse and the cladogram of Figure 1 B results. Rank orders are included in Table 1. The correlations between terrestriality ranking and both first appearance rank order ($r = 0.995$) and maximum diversity rank order ($r = 0.984$) are highly significant ($p \ll 0.001$). The strong correlations between first appearance and maximum diversity order in the fossil, and between each of these and terrestriality ranking suggests that pre-Flood biogeography is generating the first-order fossil record pattern of Paleozoic plants.

FLOATING FOREST BIOME

Traditional interpretation of Paleozoic plant environments has always been challenging. All the Silurian and the Lowermost Devonian plant fossils, for example, are preserved in sediments which lack any evidence of terrestriality - *i.e.* they seem to be fully marine [22, Fig. 7.15]. Although chemical evidences of terrestriality are found beginning in the Mid Devonian, marine sediments are never far from any Paleozoic plant fossils - including marine benches commonly found in the midst of Carboniferous coals (*e.g.* [1]). These evidences, along with the absence of large, undoubtedly terrestrial animals, suggests that the Paleozoic plants may somehow be intimately associated with the marine realm.

Since sediment volume per radiometric year of the chronostratigraphic column is approximately constant in the Paleozoic, radiometric year can serve as a first-order proxy for stratigraphic position of Paleozoic plants. According to Walter's Law, the vertical fossil sequence of taxonomic composition should then serve as a proxy of the sequence of taxonomic composition in a horizontal geographic transect of the pre-Flood world (see Figure 2). The correlation of stratigraphic order and terrestriality suggests that the transect represents an increase in terrestriality. Further examination (see Figure 2) suggests the plant transect involves an increase in size, an increase in diversity, an increase in disparity, a transition from rhizomous to true roots, and an increase in ecological tiering from ground cover to a fully tiered groundcover/herbaceous/understory/canopy flora. This transect agrees in each trend with transects from open water onto floating vegetation mats in the present world. This would include the ecology of quaking bogs (*e.g.* [9], [11], [12], [14], [16], [17], [20], [32], [33], [49]) and the vegetation mats which grow onto and occasionally float down rivers and tributaries of the Orinoco [25] [28], Amazon [15] [25], Congo [25], Ganges [25], and Mississippi [25] [46] rivers. The first part of the ecological transect (without the full forest ecosystem) is found on tropical African *Papyrus* mats [18], North American cattail mats [19] [24], and floating peat batteries in the Okefenokee ('land of trembling earth') swamp of Georgia [23].

To explain all this I would like to propose the existence of an extensive floating forest biome in the pre-Flood world. Its association with otherwise marine fauna of the Paleozoic suggests it floated atop ocean water. The huge volume of Paleozoic plants (*e.g.* the Carboniferous coals) suggests that the biome was huge - perhaps subcontinent to continent-sized. The highly disruptive waters of the Flood would be expected to destroy such an ecosystem from the outermost portions inward, explaining the sequence of Paleozoic plants we see in the fossil record as well as the exclusively marine nature of the first enclosing sediments and then the fact that later fossils are often interbedded with marine fauna and sediments. Post-Flood catastrophism would also explain both why the ecosystem never developed after the Flood and why most of the Paleozoic plants are extinct and the remainder are found only in low diversity in relict localities. The destruction of the floating forest by Flood waters would also generate the extensive floating log mat of Paleozoic plant debris that [1] has proposed would explain the Kentucky 12 coal in western Kentucky - a model which may turn out to be successful at explaining other Carboniferous coal deposits. A portion of this floating forest biome, of course, has already been envisioned by Joachim Scheven [39] [40] [41] [42] [43] [51]. Scheven observed that the hollow and rhizome-based anatomy of the arborescent lycopods is most similar to the anatomy of aquatic plants of the present. Largely based upon this evidence he proposed that the coals were produced from the Flood-destruction of a pre-Flood floating forest. Scheven's floating forest makes up a portion - the core - of the floating forest biome proposed in this paper.

Living among the flora of the floating forest was an associated fauna. This fauna would have ranged from fish which lived in the pools in the forest floor, to amphibians which inhabited the aquatic/terrestrial interface, to insects and small animals which lived in the terrestrial environment of the understory and canopy. The permanent destruction of the floating forest biome would explain why virtually all Paleozoic 'land' animals are extinct. It would also provide a reasonable explanation for the stratigraphic position, the environment, and the morphology of the animals which appear to be fully functional morphological intermediates between fish and amphibians (*e.g.* *Ichthyostega*).

Unlike Scheven claimed, however, I would like to suggest that the floating forest biome may have floated atop marine waters and may have generated a fresh-water water table in the mat. The possibility must be considered and investigated that the design of the mat itself, the microorganisms which inhabited it and even the unique morphology of the plants of the floating forest might have been designed as a complex saline pump system, providing fresh water to the plants and feeding fresh-water pools on the forest floor. There is also the possibility that rain and even fresh-water springs beneath the forest might have contributed to the recharging of a fresh-water water table.

CONCLUSION

Evolutionary theory suggests that land plants evolved from marine green algae and that land animals evolved from marine fish. The first appearances of fish, amphibians, and reptiles as well as the position of morphological intermediates between fish and amphibians are in exactly the order predicted by evolution. Statistically examined, the first appearance of higher plant taxa is too consistent with an evolutionary branching order to be explained by randomness. As powerful as these fossil record explanations are, intuitive expectations of evolutionary theory do not so easily explain why the stratigraphic order of maximum diversity should also be consistent with evolutionary branching order or how Carboniferous coals could be so widespread and so often interbedded with marine sediments. Nor does it provide explanation for the rhizomous nature of arborescent lycopod 'roots' which do not seem as if they could penetrate traditional soils.

The Flood-caused destruction of a pre-Flood floating forest biome such as described here can explain the first appearance order of the higher taxa of Paleozoic plants and animals at least as well as evolutionary theory does. It can also provide explanation for the stratigraphic order of maximum diversity as well as the widespread deposition of interbedded coals and marine sediments, and the aquatic-plant-like anatomy of the coal plants which are not so readily explained by evolutionary theory. Furthermore, this theory provides a creationist explanation for why these Paleozoic taxa are extinct to rare in the present world, and how the huge biomass of Paleozoic coals could have been supported in the pre-Flood world. It also provides a reasonable explanation for the stratomorphic series of higher plant and animal taxa in the Paleozoic.

The floating forest biome theory suggests research projects for the future. Enigmatic plant-like tubular Silurian and Lowermost Devonian taxa (*e.g. Prototaxites, Nematasketum, Pachythea*) may be functioning as many aquatic algae do in present quaking bogs - namely establishing a 'false bottom' on the outer margin of the vegetation mat for the future expansion of mat communities. Saline pump mechanisms should be investigated - perhaps in the strange anatomical features of Paleozoic plants or in mat structure and microbiota. Coal deposits can be examined to estimate the extent of the pre-Flood forests, the structure of the mat, and the mat's thickness at various places in the floating biome. The blowing of floating forest remnants across North American and European continents during the Flood may also provide a useful model for the generation of Carboniferous cyclothems. The possibility needs to be investigated that microorganisms in or beneath the mat may have been responsible for the generation of the limestones, the organic limestones, and the black shales of the cyclothems along with common Carboniferous mineral deposits (*e.g. elemental sulfur, pyrite, siderite*) and rapid fossilization (*e.g. the Mazon Creek fossils*). Given the role methane gas plays in buoyancy of modern mats (*e.g. [19] [23] [46]*), gas retention, production, and release should be examined for what potential role it might have had in both the buoyancy of the pre-Flood forest and in the sinking of mat material during the Flood to produce the coal deposits (rather than to have to beach them as proposed by Scheven).

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FIGURE 2: ECOLOGICAL ZONATION IN THE FLOATING FOREST. The upper diagram is a representative cross-section of a quaking bog from [12]. The lower diagram represents species diversity in higher plant taxa at various levels of the stratigraphic column (scaled in millions of radiometric years) - all modified from [30].

Figure 2

