

## CONDUCTING VESSELS IN PLANTS: PROBLEMS FOR EVOLUTIONISTS AND CREATIONISTS

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*Most land plants have, as one complex feature among others, a conducting system. It would be inappropriate to call such a system a circulatory system, in analogy to that of many animals; for one reason, plants do not have circulation, but transportation one way. The conducting system in plants consists of tubes in the xylem and phloem which are formed during growth by special development of certain cells. All attempts to explain how such features could have "evolved" have been unsuccessful; it is much more reasonable to believe that the various kinds of plants were created as functioning entities, with many special features.*

### Introduction

Most land plants have conducting systems and by this trait differ substantially from the algae. Food molecules move through a complex land plant tissue known as phloem, whereas water conduction occurs largely in the xylem. Plants with phloem and xylem are called "vascular plants."

The conducting portions of xylem and phloem develop through definite patterns of cell differentiation. Immature phloem cells stacked one above another at first resemble other cells in the young plant quite closely; but, as phloem cells mature, they undergo elongation, formation of holes in the end walls, and loss of cell nuclei; so that, when mature, a phloem "sieve tube" is formed. A sieve tube is thus composed of several cells called sieve tube elements, one atop another, that form a cytoplasmic channel allowing conduction of materials such as sucrose and amino acids from one cell to the next. Likewise xylem cells undergo various patterns of differentiation which transform them into conducting tubes.

### Rhynia—A Phloem Link?

*Rhynia*, an extinct fossil vascular plant from the Devonian chert beds of Scotland, had no leaves but possessed systems of upright, dichotomously forked, branches sometimes called "telomes" which arose from an underground stem in a manner not unlike the relationship between underground and aboveground stems in the horsetail plant (*Equisetum sp.*) of today. Because of small size, dichotomous branch pattern, leafless condition, and apparent lack of phloem, *Rhynia* was suggested as a prototype for the "evolutionary" origin of other land vascular plants.

Evolutionists have proposed a scheme in which the forked branches of *Rhynia*, or some such ancestral plant type, are supposed to have undergone fusion and modification to yield leaves and other plant organs through "evolution." However, as pointed out several years ago in this *Quarterly*,<sup>1</sup> the telome scheme is of little help in explaining the origin of vascular plants because:

1. *Rhynia* was a complex vascular plant, having guard cells, terrestrial spores, and xylem conducting structures easily visible under the microscope.

2. Leaves were already present in the fossil data as deep (Devonian), or even deeper than the *Rhynia*, which is supposed to be ancestral to leaf development.

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But still evolutionists have argued that *Rhynia* was "ancestral," or at least "primitive," because phloem tissue was not found in the fossils. In 1971, however, Donna Satterthwait and J. W. Schopf published a study of *Rhynia* fossils under the revealing title, "Structurally preserved phloem in plant axes of Rhynie chert."<sup>2</sup>

Satterthwait and Schopf found, in well-preserved condition, the perforated walls of what they believed to be phloem sieve tube elements. "Their occurrence seems to indicate that Rhynie axes contained true phloem, functionally and anatomically similar to that of modern plants."<sup>3</sup> Thus another blow was struck at the idea that *Rhynia*, or something like it, served as ancestor to the vascular plants. Since 1971 it has been recognized that *Rhynia* had typical phloem tissues and was by no means a "link" between plants with phloem and those without.

### Vessel Origin Unclear

Xylem conducting elements include both the "tracheids" and the "xylem vessels." During differentiation certain cells in the xylem area form pores through the side walls and end walls, lose protoplasm, and become spindle shaped units known as tracheids through which water may move. In some plants, other xylem cells stacked on top of each other elongate, also lose protoplasm and end walls.

In this manner a tube or xylem vessel forms much as a series of stacked oil barrels would yield an upright oil pipe, if some one knocked out the end walls separating the barrels. During such differentiation of vessels and tracheids, the cell walls thicken in one of several characteristic patterns: scalariform, pitted, spiral, ring, etc. The finished tracheid is a long, single-celled conducting channel, while the xylem vessel is a multicellular tube through which water or solutions may move.

Certain evolutionists have maintained that vessels evolved from tracheids because most of the gymnosperms (plants which bear seeds nakedly, usually in some type of cone) have only tracheids and no vessels in their xylem. Therefore the most "primitive" vessels are thought to be those in which the individual vessel elements are long and thin like tracheids.

For this reason, members of the Ranales (buttercup order of flowering plants) have been designated as "primitive." However, Eames and MacDaniels in their text on plant anatomy have pointed out that vessels ". . . are present in some species of *Selaginella*; among the ferns, in two species of *Pteridium*; among the gymnosperms, in the Gnetales."<sup>4</sup>

*Selaginella* (moss fern plant) is a very simple, non-seed bearing type which differs at many points from the true ferns and the gymnosperms. Thus it is clear that vessels are widely distributed in many very diverse types of terrestrial plants and there is not even a hint of an "ancestral tree" that might be devised. Eames and MacDaniels concluded, "In each of these groups the vessel has clearly arisen independently, in the angiosperms probably more than once."<sup>5</sup>

Two other plant anatomists, A. S. Foster and E. M. Gifford, confirm the facts of Eames and MacDaniels as they discussed the anatomy of *Selaginella*:

Several years ago (Duerden, 1934) certain species were shown to possess vessels, a feature considered formerly to be one of the distinctive characteristics of angiosperms. Not only do certain species of *Selaginella* have vessels, but this type of tracheary structure is found at least in one genus of the ferns and in certain gymnospermous genera (for example, *Ephedra*, *Gnetum*).<sup>6</sup>

Eames and MacDaniels concluded that vessel "evolution" must have taken place independently in several widely distinct lines—most fern versus flowering plant, for example. But Armen Takhtajan, who is also a non-creationist and Chief of the Department of Higher Plants, Komarov Botanical Institute of the Academy of Sciences, U. S. S. R., concluded that although various forms of angiosperms may differ considerably from one type to another, they must all be considered as branches of one family tree.

This is because the odds are very much against two or more lines of evolutionary descent independently producing plants with several characteristics in common, such as stigmas in the female flowers, double fertilization in the embryo sac, endosperm formation, and sieve tubes in the phloem of angiosperms. For this parallelism to occur in several otherwise independent lines, Takhtajan concluded, would be:

... comparable to the so-called "dactylographic miracle" whereby given enough time, a work of literature, such as a Shakespearean sonnet, would be produced by chance alone.<sup>7</sup>

And with this same argument in mind, it is surprising that Eames and MacDaniels would grant polyphylogeny of vessels in many separate groups—even several separate times among the angiosperms. It would seem unlikely enough to ask that vessels arise only once by chance through "evolution," but to require that this happened independently by chance in several separate lines simply compounds the improbabilities involved.

Since creationists assert that God gave the various plant forms parallel systems for physiological, ecological, or other functional purposes, it would be commendable to devise experiments to test such proposals. For example, one might search for a reasonable or possible purpose for the fact that gymnosperms (*e.g.*, pine or hemlock) have stems that are devoid of xylem vessels, but possess tracheids only. For what physiological reasons might elms, maples, and oaks (angiosperms) have such vessels as well as tracheids in their xylem? Are there functional relationships behind the fact that the lowly *Selaginella* plant has vessels as well

as tracheids? Answers to questions like these would not only supply support for creationistic scientific theories, but might also further man's comprehension of plant physiology beyond its present status.

### Monophylogeny, Polyphylogeny, or Kind Creationism?

Takhtajan proposed a monophylogenetic scheme because of the significant similarities between diverse life forms. Yet Eames and MacDaniels were led with equal vigor to a polyphylogeny because of the numerous differences which the same assorted groups manifest. In the creationist view such unnecessary monophylogenies and dubious polyphylogenies disappear because each plant kind is seen as a unique genotype, created separately, with genetic structure and ecologic niche adaptations intact from the time of its formation with a minor, but significant variability potential incorporated at the time of creation.

Criteria for recognizing the boundaries or limits of these created kinds or "baramin," as they have been called by Dr. Frank L. Marsh, have been proposed,<sup>8</sup> but very little research has been directed toward applying such criteria to the various types of living and fossil creatures. It is simplistic to assume that boundaries of the baramin will lie consistently at the species level, because "splitting" has been altogether too common among taxonomists. Criteria for erecting species groups have varied widely between individual specialists and also between workers in various branches of biology—botany versus zoology or microbiology.

The actual work of revising taxa along creationistic lines, to the best of my knowledge, has not been done for any single group, although steps in that direction were taken among animal taxa by Arthur Jones<sup>9</sup> and the late J. J. D. De Wit.<sup>10</sup> Until cytogenetic and taxonomic analyses are undertaken along creationist lines, the baramin concept will remain somewhat vacuous as regards all creatures except man.

### Problem of Angiosperm Evolution

Although a devout evolutionist, Takhtajan made several very frank admissions of weaknesses in his scheme:

The origin and dispersal of the flowering plants is one of the most troublesome and complex questions of biological history, touching as it does upon many of the general problems of organic evolution. Much is uncertain and much is in dispute. There are so many different hypotheses of the origin of flowering plants, and so many different attempts at morphological interpretation of the flower, that even a brief resume of them, let alone a critical review, would require a whole volume.<sup>11</sup>

Angiosperms are supposed to have evolved from the gymnosperms because only a few gymnosperms have vessels, while most angiosperms do. However, Takhtajan pointed out that the vessels of the primitive angiosperms are more primitive than those vessels found in certain gymnosperms because they have a type of wall thickening (scalariform pattern), which was considered most primitive by Dr. Bailey.<sup>12</sup>

At the beginning of his third chapter entitled, "Ancestors Unknown," Takhtajan included these uncertain remarks:

The identity of the ancestors of the flowering plants is a most difficult problem which is as yet far from being solved. It would be hard to find a group of plants that has not at some time been postulated as ancestral to the flowering plants; not only the various gymnosperm groups, such as the pteridosperms (including the Caytoniales), cycads, Bennettitales, Cordiales, conifers, *Gnetum*, and *Ephedra*, but even ferns, equisetophytes, lycopodiophytes, rhyniophytes ("psilophytes") and algae have been considered as possible precursors (see Tikhomiriv, 1965). Yet these very diverse hypotheses have on the whole been given little justification by their authors; indeed, some have not even bothered to accord their views any factual basis whatsoever. Most have not withstood the test of time and have been discarded, but some do continue to command support. Can we find which in fact comes closest to the truth?<sup>13</sup>

### Monocot and Dicot Dilemmas

This basic problem concerning angiosperm origins is made more vexing by virtue of the fact that two very different groups of flower-bearing plants exist—monocots and dicots. The monocots have flower parts in sets of three or multiples thereof, veins parallel to the main leaf vein, and stem vascular bundles in a scattered pattern (see Figure 1). The dicot flowering plants have flower parts in fours, fives, or multiples of these numbers, veins of the leaf not parallel but branched in a network, and the stem vascular bundles arranged in a neat peripheral ring (see Figure 2).

Many evolutionists have attempted to explain the origin and integration of monocots and dicots via some "evolution" scheme; and, recently, a significant review paper was produced by Hatsume Kosakai, M. F. Moseley, Jr., and Vernon I. Cheadle of the University of California at Santa Barbara. Many evolutionary botanists have held that woody dicots, (such as *Magnolia*) were the ancestors of the dicot herbs such as buttercup. Furthermore, evolutionists have conjectured that somehow the dicot herbs then produced the monocot herbs and in their 1970 paper, Kosakai *et al.* have summarized the evidence and have attempted to correct inherent misunderstandings.

According to these workers, certain early evolutionists suggested that monocots came from herb members of the dicot Ranales order—buttercup, for example. Yet, they have noted, it is unlikely that monocot herbs arose from dicot herbs, because certain monocots have "less advanced" xylem elements than their supposed ancestors—the dicot herbs. To sidestep this issue, some botanists have proposed water lotus (*Nelumbo lutea*, shown in Figure 3), a dicot herb of the Nymphaeaceae family as probable ancestor for the monocots, because they thought *Nelumbo* had no xylem vessels at all:

Takhtajan (1954) considered that the Nymphaeaceae were originally vesselless. He felt that, since many other aquatics possess vessels in

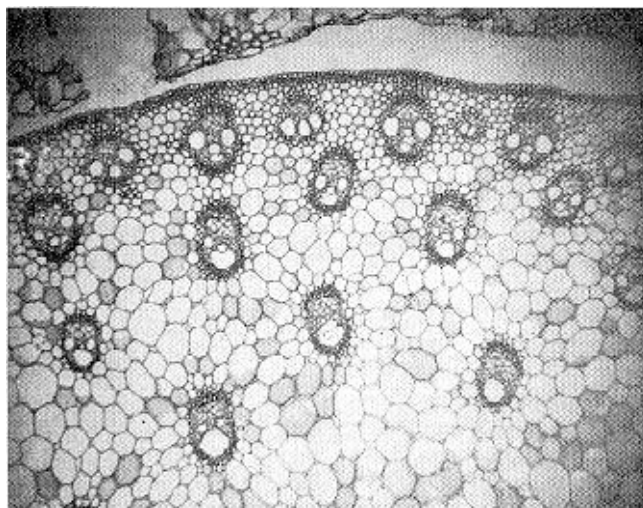


Figure 1. Photomicrograph of corn (monocot) stem cross section. Note that vascular bundles are not present in one peripheral ring, but are scattered throughout the stem cross section. While some evolutionists have held that monocots "evolved" from dicots, no evidence exists to support such an idea. Magnification is approximately 40X. (Photo by George Howe.)

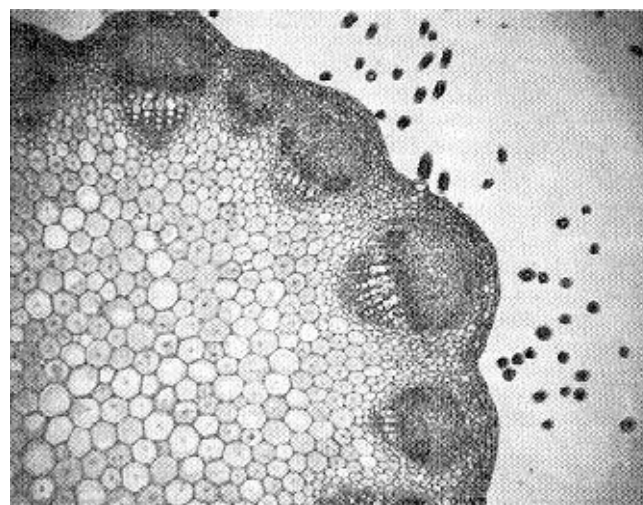
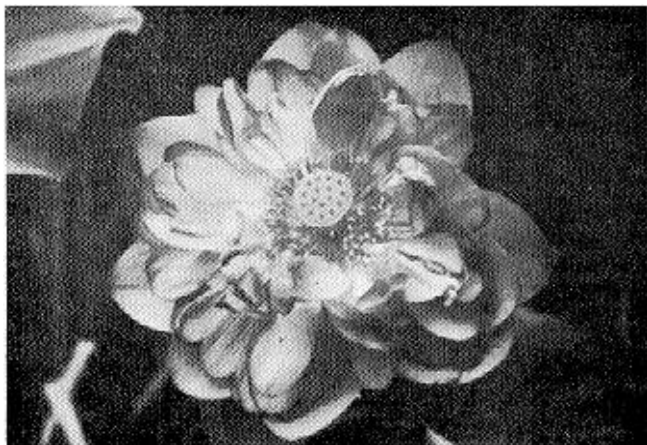


Figure 2. Photomicrograph of clover (dicot) stem cross section. Note that vascular bundles of this typical herbaceous dicot are arranged in a peripheral ring. Although dicots are supposed to be the ancestors of the monocots in "evolutionary history," dicots have separate specializations and appear to be composed of many separate kinds created as distinct entities. (Photo by George Howe.)

their roots, Nymphaeaceae would probably have them now if they had had them previously. Later, Takhtajan (1959) stated that it was more likely that the Nymphaeaceae were primitively vesselless because they still have only long, scalariform tracheids, a primitive character.<sup>14</sup>

But in the Kosakai paper, the authors demonstrated that *Nelumbo* has xylem vessels, and is not a likely ancestor for the monocots. According to Takhtajan's scheme of monocot "evolution," aquatic families of the monocots "evolved" from a *Nelumbo* prototype of dicots and, subsequently, these aquatic monocot fami-



**Figure 3.** Flower and portion of leaf of *Nelumbo lutea*, the water lotus. Evolutionists once believed that this beautiful aquatic dicot angiosperm was the link between dicots and monocots because they believed that *Nelumbo* had no xylem vessels. According to recent findings by a University of California (Santa Barbara) research team, however, *Nelumbo* does have xylem vessels and is by no means a valid evolutionary link. *Nelumbo* is also important as a plant involved in certain aquatic ecological successions evident in the midwestern United States and elsewhere. (Photo by George Howe.)

lies then yielded all other monocots through “evolution.” But Kosakai *et al.* have shown that although the aquatic monocot families do show striking flower similarities to aquatic dicot herbs, the aquatic monocots could hardly have produced the terrestrial monocots.

This is because the supposed aquatic monocot “ancestors” have more highly “advanced” or “specialized” xylem than their terrestrial monocot descendants, which have only very “primitive” vessels in the xylem of their roots. Likewise, they maintained that the *Nelumbo* group of dicots is an unlikely ancestral type for monocots, because the *Nelumbo* plants already have “specialized features,” such as elongated scalariform pits in the vessel walls (see their Figures 3 and 16).

Kosakai *et al.* then discussed possible trends of evolution within the monocot group. Some of the monocot families are herbs, as in the case of the grass family; and some are predominantly arborescent, like palms. Certain evolutionists hold that monocot herbs were the ancestors of the tree families, while other evolutionists assert with equal vigor that the arborescent forms produced the herbs.

It is clear, from the authors’ detailed treatment, that any or all of these “evolutionary” ideas could be defended (or rejected?) on the basis of existing fossil evidence, since the “earliest” layer that contains monocots has both the woody and herbaceous members present—e.g. palms and lilies. Because of this fact, Kosakai *et al.* stated:

We agree, consequently, with Delevoryas (1968) and Emberger (1968) in concluding that the fossil record has not yielded significant evidence concerning the origin of monocots.<sup>15</sup>

Takhtajan likewise mentioned the amazing explosion of angiosperm life that appears in the Cretaceous strata:

At the close of the Albanian, i.e. towards the middle of the Cretaceous period, one of the most sudden and fundamental transformations of terrestrial plant life occurred, and in the course of a few million years—a very short interval of geological time—the angiosperms came to be widely distributed throughout the world, quickly reaching the Arctic and Antarctic regions. They appear in great diversity of form and quickly become dominant. Most of these Cretaceous angiosperms belong to extant genera, and there are representatives both of more or less primitive forms (Magnoliaceae, Lauraceae and related families, the genus *Nelumbo*, etc.) and of highly evolved ones (Fagaceae, Moraceae, Euphorbiaceae, Salicaceae, Juglandaceae, etc.). It is obvious that the angiosperms had previously undergone a protracted period of development during which they had been able to differentiate into many distinct families.<sup>16</sup>

This last assertion of Takhtajan’s, of course, is not *obvious* to anyone except committed evolutionists, since the complexity and diversity of flowering plants in the Cretaceous fossils would otherwise fit better with the idea expressed in Genesis, that God created plants after their kinds, with the seeds inside.

There are no experimental data to show the origin of angiosperms from gymnosperms, or any other plant type, despite recent claims by Vesta Meyer<sup>17</sup> to the contrary. As a result of certain hybridization experiments involving cotton, plants resulted which produced ovules on the petal margins (“carpeloid petal” plants). Meyer maintained that such carpeloid petal forms are “. . . strikingly similar to fossil megasporophylls described by Mamy. . . .”<sup>18</sup>, and also asserted that “. . . their very existence in a living plant population demonstrates the possibility that something similar could have happened before.”<sup>19</sup> Thus she intimated that the carpeloid petal may have been the route by which angiosperms arose from ancestral gymnosperms.

In discussing the significance of carpeloid petal cotton, it should be pointed out that in addition to ovules borne on petals, the flower in question also had a typical ovary with enclosed ovules, as Meyer reported. Furthermore, she wrote, “Few of the abnormal flowers produce seed, and no exposed ovules have ever developed into seeds.”<sup>20</sup> Thus Meyer has simply shown that under intensive hybridization of cotton, various chimeras appear in which petals may produce sterile ovules. While this is informative and a significant finding in itself, it is surely no evidence favoring origin of angiosperms from gymnosperms.

No more phylogenetic significance should be attached to carpeloid petals than is given to any other chimeras, such as stem fasciation, sectoral chlorosis in plant organs, etc. Such reasoning on the part of Meyer is reminiscent of the logic by which zoological evolutionists rejoiced over the “tail,” which is evident infrequently on a human baby, but ignored at the same time possibly embracing phylogenetic significance of other birth abnormalities, such as cleft palates, hare lips, or flipper limbs.

### Conclusions

The Kosakai *et al.* paper is an excellent review. The authors have frankly stated "evolutionary" problems, and have supplied a comprehensive survey of the attendant literature—75 sources are mentioned. A catalogue of problems like this is of value to both evolutionists and creationists.

Apparently some creationists have also come to the place where they are willing to face controversial matters. In recent *C. R. S. Quarterlies*, for example, there have been fruitful exchanges regarding the nature of entropy before the Fall, and the problem of how the "races" and "varieties" may have arisen since the Flood.

There are still other problems that deserve critical discussion, such as (a) the supposed vapor canopy,

(b) possible role of continental drift in Biblical history, (c) limits of the actual plant and animal baramin, and (d) biogeographic problems, which have been largely untouched by those who hold the creationist view.

Viewed from the creationist context, Kosakai and coworkers have shown that all "evolutionary" attempts to explain the development of flower plants have thus far failed. Their presentation of data fits better with the position that God formed many "kinds" of monocot and dicot plants, distinct from each other, and yet with "parallel" patterns or systems as required for proper function. The Kosakai paper, although written undoubtedly for evolutionists as a critique of schemes of plant "evolution," will be of great value to any student of the subject who wants to get beyond superficial discussion.

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- <sup>12</sup>*Ibid.*, pp. 13-15.
- <sup>13</sup>*Ibid.*, p. 9.
- <sup>14</sup>Kosakai, Hatsume, M. F. Moseley, Jr., and V. I. Cheadle 1970. Morphological studies of the Nymphaeaceae. V. Does *Nelumbo* have vessels?, *American Journal of Botany*, 57 (5):487-494. (See p. 487.)
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- <sup>16</sup>Takhtajan, Armen. *Op. cit.*, p. 128.
- <sup>17</sup>Meyer, Vesta 1970. A facultative gymnosperm from an interspecific cotton hybrid, *Science*, 169 (3948):886-888.
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- <sup>20</sup>*Ibid.*, p. 886.

## WHAT CAN AND CANNOT BE DESCRIBED

Most people who have taken a course in physics or general science will recall Young's experiment. Two narrow parallel slits, a short distance apart, are made in an opaque screen. Light is directed through the slits, and onto a suitable surface. On the surface are seen alternate bright and dark regions; for at the dark regions the light from one slit is "interfering" with that from the other. For a long time this interference was considered to be conclusive evidence that light consists of waves in something.

About the turn of the century Planck and others introduced the notion of "photons." Instead of a sequence of waves, one might think of a stream of photons. But then there are difficulties. How can a photon which came through one slit interfere with one which came through the other? Worse still, if the light should be so weak that only one photon at a

time is involved, how can the photon interfere with itself?

Authors of many treatises admit frankly that such questions should not be asked; rather men should give up trying to say what happens between the source of light and the surface on which it eventually falls.

Sometimes, when creation is discussed, the objection is made that no one can say in great detail what happened during the actual Creation, because it was unique and not repeatable, by scientists. But if it is acceptable—and, in fact, good science—to forego trying to describe what happens to light at the slits of Young's experiment (which one would expect, at first thought, to be a part of regular nature, and hence a fit subject for science), how much more is it legitimate to forego trying to get a detailed description of Creation (which is outside the regular course of nature)!

—Contributed by Harold Armstrong