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The General Classification of Higher Plants

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THE GENERAL CLASSIFICATION OF HIGHER PLANTS.

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A large part of our thinking about living things is bound up with some system of classification. This system is at once the product of the best thought, and a guide to further thinking. The function of classification as a guide is peculiarly important to beginners.. It is therefore extremely desirable that classification should represent correctly the most approved conclusions of the science in question. At the present time current usage in botanical classification is not in harmony with the most approved conclusions. The following tabulation and discussion is an attempt to express recent morphological thought in its bearing on the broader lines of taxonomy. According to this view, the Vegetable Kingdom may be outlined thus:

- Thallophyta
- Embryophyta (Archegoniatæ)
  - Atracheata (Bryophyta)
  - Tracheata (Vasculares)
    - Lycopsida (Lycopodiales and Equisetales)
    - Pteropsida
      - Aspermae (Filices)
      - Gymnospermæ
      - Angiospermæ

In defense of this scheme, the best of authority can be cited, and it appears to the writer that the evidence is overwhelmingly favorable. That the Thallophyta is a miscellaneous group, united only by negative characters, is freely admitted. The term has, however, proven so useful as to deserve permanent acceptance. It serves to gather up all those elementary forms of plant life which are clearly lower than the fairly coherent archegoniate or embryophytic series. This twofold arrangement, Thallophyta and higher plants, has long been familiar in the taxonomic portion of the Strasburger text-book.

By including all of the mosses, ferns and flowering plants in the single group Embryophyta, we call attention to the embryo as the feature of their life history which has doubtless been of prime importance in bringing about the very obvious supremacy of this group on the face of the earth. The careful sheltering of an embryo plant within parental tissues is a distinct advantage to the new generation. It is precisely parallelled in the development of the higher animals. It is well worth while, therefore, to point out this characteristic as basic in the evolution of land plants.

In the lectures of Professor E. C. Jeffrey at Harvard University—I am not aware of any publication of the point—the Embryophyta are next divided into those without tracheary or vascular tissue (Mosses) and those with such tissues. This again is a distinction of the highest biological significance. It is the absence of water conducting apparatus that keeps the mosses of small stature. It was the development of effective water conducting tissues which made it possible for land plants to attain to sizes exceeding those of the humble mosses. These tissues were also necessary for a plant which should continue to vegetate and reach upward in a dry atmosphere, provided only its roots have access to a water supply. Since, therefore, the size, habit and habitat of the principal vegetation of the earth are dependent on the possession of tracheary tissues, it is well to name the higher plant group Tracheata. Owing to these same biclogical conditions, the evolution of these plants has been largely recorded in the structure of their vascular parts. Progress has been made possible by means of ever increasing perfection and specialization of the water and food conducting organs. Finally, in fossil plants the water conducting cells and vessels have retained their characteristics better than any other tissues, and therefore these cells and vessels offer the fullest chronological record of the changes in plant structure throughout geological time.

The Tracheata were recognized by Jeffrey in 1897 as constituting two well marked groups which he named at that time Lycopsida and Pteropsida, on account of their resemblances in certain important features to the lycopods and ferns respectively. Although we may agree with Bower that Lycopodium is the most suggestive plant to consider as ancestral to the entire tracheate phylum, all the facts point to the conclusion that the fern series is much larger, that it includes the seed plants, and that it was separated from the lycopsidan stock in early or mid Palaeozoic times.

The fundamental anatomical difference between the lycopods and equiseta on the one hand, and the pteropsida on the other is this. In Lycopsida the leaf trace is small, and the water conducting cells of the leaf trace, coming into the stem from the leaf, end abruptly in contact with the water cells and vessels of the stem. The leaf gets only what water these trace cells can catch from the side of the cells of the stem. There is no direct water passage from stem to leaf. Correlated with this we find that in all Lycopsidans—Lycopodium, Selaginella, Psilotum, Equisetum, Lepidodendron, etc.—the leaf is small and individually of little consequence. Such leaves may be numerous, or may be greatly reduced. In the first case—Lycopodiales—the number makes up for size. In the latter—Psilotum, Equisetum—the stem takes over the function of photosynthesis. These small leaves when fertile, are further limited to one or a few sporangia. And the sporangia are axillary or nearly so, and associated with the upper side of the leaf.

Now in the Pteropsida there are for every leaf few or several water conducting cells or vessels which bend out bodily from the stem into the leaf, carrying an uninterrupted flow of water directly out into every veinlet of the foliar structure. This at once removes the limitation of size in leaves. The giant leaves of tree ferns, palms, bananas and the like now become possible. On such a leaf also, with its great assimilating capacity, spore formation may go on *ad libitum,* as actually occurs in ferns. In stems whose primary vascular tissues take a tubular form, the vessels which curve out into the leaf leave an actual break or gap in the continuity of vascular tissues in the stem. Above every leaf trace there is an area where medullary cells come more or less directly into contact with cortical cells. Such a break in the cylindrical stele Jeffrey calls a leaf gap. And he calls such stems phyllosiphonic. The Pteropsida are therefore primarily phyllosiphonic and megaphyllous. In Lycopsida gaps in the stem stele occur only in relation to branches. This group is therefore called cladosiphonic and microphyllous.[1] It cannot be doubted that this distinction marks the profoundest biological and evolutionary cleavage in the vascular plants.

Among Pteropsidans, recent studies of fossil plants have shown remarkably close affinities. The fern alliance merges insensibly into the gymnosperms, and these, anatomically at least, grade off very strikingly into the angiosperms. In fact, the gap above the gymnosperms is as yet more serious and difficult to bridge than that between the gymnosperms and ferns. One cannot tell at present whether a given fossil stem or leaf is fern or gymno-

[1] Cf. Jeffrey: Anatomy of Woody Plants, 1917.

sperm unless the manner of its fructification can be established in considerable detail. The Pteropsida therefore represents a highly unified, natural series. The series is divided wholly on the question of seeds. Since, then, there is at present no term to designate the fern section of this great phylum, I have proposed for this lower seedless group the name Aspermæ, suggested by my colleague Miss M. L. Sawyer. The term corresponds aptly with the accepted names of the two higher groups, Gymnospermæ and Angiospermæ,

Up to the last step this classification has the advantage of dichotomy. This is an assurance of simplicity. It follows strictly those great biological characters which have influenced the trend of evolution, and which have themselves appeared in response to world-phenomena of cosmic origin. Its general acceptance would certainly help the student to tabulate our present thought regarding plants, and to think correctly in pursuit of further knowledge.

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