

All these features lead to a logical conclusion that the plants bearing these fruits grew in warm, humid climate and marshy habitat.

PATRICIA CHOW*. Department of Biology, Univ. of Waterloo, Waterloo, Ontario, Canada N2L 3G1. - Phytoplankton response to fertilization in a small Quebec Shield lake.

The role of nutrients as a limiting factor in pelagic primary production was investigated in Baie Phillippe Lake Matamek, Quebec, a very dystrophic Shield lake. Fertilization in the form of weekly additions of monoammonium phosphate, approximating six times the ambient P loading was carried out for two consecutive field seasons (1978 & 1979) in the treatment basin, Lower Baie Phillippe (LBP), while a contiguous basin, Upper Baie Phillippe (UBP) served as a control. Phytoplankton biomass and chlorophyll *a* increased 3 to 4 fold in both years, coinciding with a marked rise in P profile of the treatment basin. The species composition of the two basins clearly indicate that the growth of the two most responsive species, *Tabellaria fenestrata* and *Cryptomonas erosa* was not at the expense of the less competitive species, since trends in species succession and community structure were not altered. Recent laboratory studies on nutrient kinetics lend support to the hypothesis that increase in *Tabellaria* was probably due, not so much to the increase of the P concentration, but to a decrease in the Si:P ratio. It has been documented that *Asterionella* prefers a high Si:P ratio and is quickly selected out when this ratio is decreased. Our field observations allow speculation that the lowering of the Si:P ratio upon P addition has probably caused the decline in prominence of *Asterionella*, while it selected out *Tabellaria*, which probably has a much lower optimum ratio.

STEVEN P. CHURCHILL. Department of Botany, University of Kansas, Lawrence, Kansas 66045. - The phylogenetic systematics of *Jaffueliobryum* (Grimmiaceae: Musci).

Methods of phylogenetic systematics were used in a revision and evolutionary analysis of the genus *Jaffueliobryum* and this analysis has led to a reconsideration of the classification of the Grimmiaceae. It is hypothesized that this genus is a monophyletic group with several autapomorphic (uniquely derived) characters: autoicous sexual condition, a unistratose leaf thickness, and a broad-concave leaf. *Coscinodon* is the sister group to *Jaffueliobryum* with synapomorphies (shared derived characters) that include a calyptra that is plicate and completely covers the capsule, and an intermediate peristome type. Among the four species of the genus, *J. raii* is hypothesized as the most plesiomorphic (primitive) taxon, while *J. arsenei*, with several unique features, is the most apomorphic (derived) taxon. *Jaffueliobryum* is hypothesized as having originated in southwestern North America. The distributional origin of *J. latifolium*, now extant in Siberia, is considered to have arisen through a vicariance event from an ancestor shared with *J. wrightii*. In determining the systematic position of *Jaffueliobryum*, a preliminary generic classification was determined for the Grimmiaceae. This classification is based on the transformation series involving reduction of a complete peristome to one that is deeply divided. Concurrent with the transformation is a reduction in the thickness of the outer peristome layer. Use of phylogenetic systematics in this study clearly indicates a method that is both testable and thorough for moss taxonomy.

STEVEN P. CHURCHILL* and E. O. WILEY. Division of Biological Sciences, University of Kansas, Lawrence, Kansas 66045. - A comparison of Wagner's and Hennig's methods of phylogenetic analysis.

Wagner and Hennig independently developed methods of reconstructing phylogenetic relationships. We suggest that the basic principles used by both workers are essentially the same. Both stressed grouping by synapomorphy and determination of relative apomorphy by outgroup comparison. Both held that such criteria as "common = primitive" or "unique = derived" could only be critically assessed by outgroup comparison. Twenty-odd papers using the Wagner ground-plan/divergence method were examined. The determination of derived characters were applied only sporadically. The case of outgroup comparison was not extensively used. Instead, a criterion of "common = primitive" or dicta of various types were frequently employed. Occasionally no justification was given. While it is true that primitive characters are frequently more common and widely distributed than their derived homologues, it is also true that this "criterion" is violated frequently enough to negate it as a critical criterion. Dicta also fail as critical criteria because even if they are true they can only apply at a single level of analysis (i.e. Bessey's dicta may apply at the level of Angiospermae, but not at lower levels within Angiospermae). Hennig's major strength on the methodological level lay in his extensive discussion of criteria for determining relative apomorphy. When these are applied, either method will yield the same results.

DAVID P. CHYNOWETH

Institute of Gas Technology, 3424 S. State Street, Chicago, IL 60616. Microbial Conversion of Biomass Substitute Natural Gas: Kelp and Other Plants. Laboratory studies at the Institute of Gas Technology (IGT) have investigated the biomethanation of a variety of feedstocks including sea kelp, water hyacinth, terrestrial herbaceous and woody plants, sewage sludge, municipal solid waste, and biomass-organic waste blends. The results of these and other studies will be used to illustrate key factors which influence methane production rates and yields, including feed organic composition, nutrients, inoculum, temperature, retention time, feed concentration, particle size, and mixing. A new process recently developed at IGT which combines biological and thermal operations for conversion of biomass to substitute natural gas will be presented. Current and future applications and research needs for improvement of bioconversion processes will be discussed.

CURTIS CLARK, WILLIAM C. THOMPSON*, and DONALD W. KYHOS. Department of Botany, University of California, Davis CA 95616. - Comparative morphology of the leaf trichomes of *Encelia* (Compositae: Heliantheae).

We have studied with light and scanning electron microscopy the leaf trichomes of 11 of the 15 species of *Encelia*, and of 10 interspecific hybrids. There are three classes of trichomes in the genus, the large hair, the small hair, and the gland. All are multicellular. All three may be present in a species, or one or more may be lacking; the large hair is present in all. Length and density of large hairs accounts for most of the observed macroscopic differences in pubescence among the species. In

F₁ hybrids, trichomes appear intermediate between those of the parent species, except that if one parent lacks small hairs or glands, the hybrid inherits those from the other parent.