

LEMANEA (RHODOPHYTA, FLORIDEOPHYCEAE) IN INDIANA

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ABSTRACT: A species apparently endemic to Indiana, *Lemanea* (Subg. *Paralemanea*) *deamii*, is described from sites in Harrison and Crawford Counties. Systematic problems resulting from the fact that many species descriptions in this genus are based on collections made on a single day are discussed. The desirability of making repeated collections from the respective collection sites is stressed.

INTRODUCTION

Lemanea, one of the freshwater red algae, is a widespread, sometimes abundant, and biologically important inhabitant of streams in southern Indiana, where it appears to be better represented than in any other State. The naming of the Indiana species of *Lemanea* has been a problem ever since the extensive work of C. Mervin Palmer (1933, 1940, 1941), who wrote his doctoral thesis on *Lemanea* in Indiana and devoted much of his life to building an extensive collection of these plants. He avoided applying specific names to the Indiana material, and the relation of the Indiana forms to other species known from North America has remained an open question.

Vis and Sheath (1992) have grouped North American representatives of Subgenus *Paralemanea* under three species. The present paper adds a species to the North American flora, but this should not be construed as enlarging the flora as this flora is conceived by Vis and Sheath.

The work described here has extended over a period of seven years and has involved repeated visits to and collections from the sites where this plant is known to grow. Most of these sites were studied by Palmer in the 1930's. Hopefully, a better understanding of the variability of this plant will be obtained by such repeated visits at different seasons.

The genus is subdivided into Subgenus *Lemanea*, which is scarcely if at all represented in Indiana, and Subgenus *Paralemanea*. The members of the latter subgenus at least in North America are generally larger plants, and the conspicuous generation, the gametophyte, is more complex than the gametophyte of Subgenus *Lemanea*. The gametophyte, which grows attached by rhizoids to rocky substrata, alternates in the life-history with a small, similarly attached, filamentous plant, the "chantransia." The "chantransia" gives rise to the much larger gametophyte axes in late winter and spring. The gametophyte has a stipelike base which enlarges distally into a cylindrical or compressed-cylindrical axis which is nodose in a more or less regular way; i.e., swollen "nodes" alternate with more slender areas, "internodes," sometimes with as many as 100 or more of each. The male sexual apparatus is formed in the nodal areas; the female and the consequent spores (in the Subgenus *Paralemanea*) are internodal. This body plan is essentially the same for all species in the Subgenus *Paralemanea*, but it can be modified in a number of ways. For example, strikingly large nodes or strikingly long internodes may occur regularly in the same collection. The same body plan may recur from year to year at a single collection site. Some of these variations are probably genetically determined, and

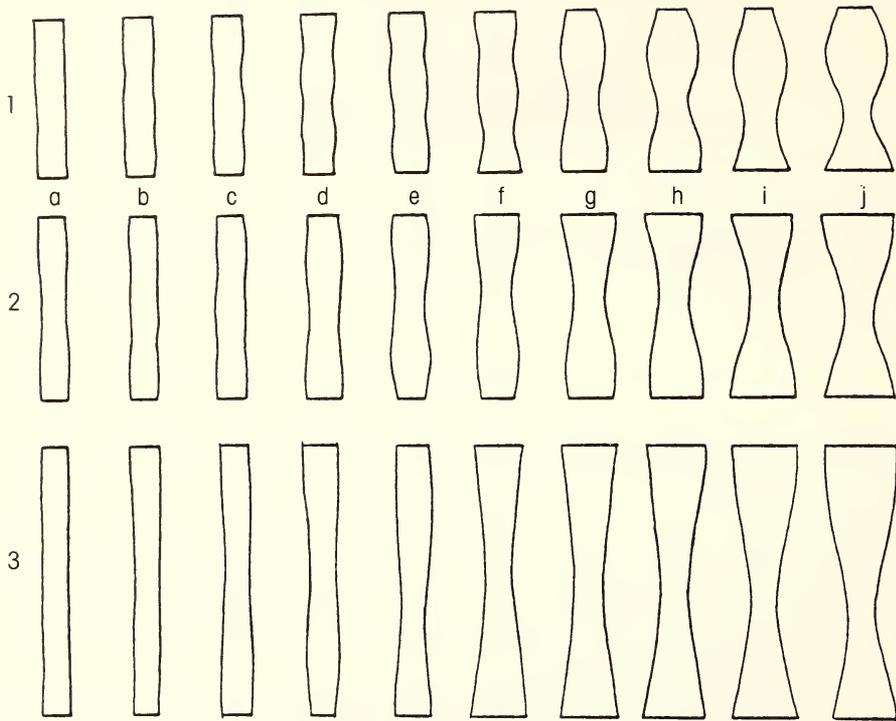


Figure 1. Schematic representation of increasing (L to R) degrees of nodosity of the sexual axis of *Lemanea* (Subg. *Paralemanea*) species and increasing (top to bottom) internodal length.

some method of recording them is needed. A means of recording this variation is shown in Figure 1; it illustrates diagrammatically the range in nodosity and in internode length found in North American and in European *Lemanea* collections. Most summer (i.e., mature) collections exhibit variability such that of 100 axes, several will be found to correspond with two to three usually adjacent diagrams in Figure 1. A specimen recorded as consisting of 2e, 2f, and 3f axes would therefore have moderate nodosity and internodes varying from about $3\frac{1}{2}x$ longer than their diameter to about $6x$ longer.

MATERIALS AND METHODS

Plants, including the "chantransia" stage, were studied primarily from specimens in the collections of the Philadelphia Academy of Natural Sciences (PH) and Butler University (BUT). Additional specimens were examined from the herbaria of Cornell University (CU), the Field Museum, Chicago (F), the Farlow Herbarium of Harvard University (FH), the University of Michigan (MICH), the University of Minnesota (MIN), the University of California, Berkeley (UC), and the United States National Herbarium (US);

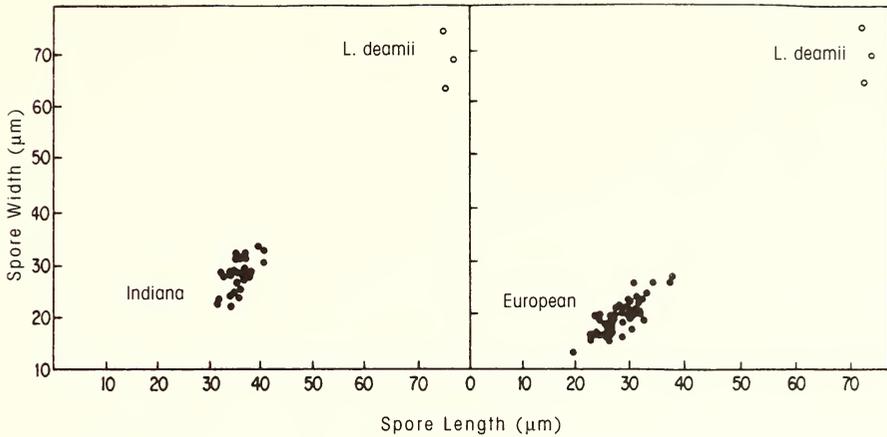


Figure 2. Length vs. width of the mature spores of three collections of *Lemanea deamii* and 31 collections of other specimens of *Lemanea* from Indiana streams (left). Length vs. width of the mature spores of three collections of *Lemanea deamii* and 54 collections of *Lemanea* (Subgenus *Paralemanea*) from western European streams (right).

specimens were also examined from the British Museum (BM), Jardin National de Belgique, Meise (BR), Laboratoire d'Algologie fondamentale et appliquée, Caen (CN), University of Florence, Italy (FI), Conservatoire et Jardin Botanique de la Ville de Genève, Switzerland (G), Rijksherbarium, Netherlands (L), Ecole Nationale Supérieure Agronomique, Botanique, Montpellier, France (MPA), and the Muséum National d'Histoire Naturelle, Laboratoire de Cryptogamie, Paris (PC). These specimens were hydrated, stained in dilute rose bengal solution, and ultimately mounted in dilute sugar (*Karo*) solution. Fresh plants were gathered *in situ* at many American sites identified on specimen labels in the above collections and were similarly treated. Mature spores, defined as carpospores with a clearly visible wall and separated from all other spores, were removed by sectioning or crushing fertile portions of the sexual axis. From each collection, 15 randomly chosen spores were measured for length and width, and the mean diameter and length determined.

RESULTS

A *Lemanea* with distinctive, very large spores, which occurs in southern Indiana, is here given the name *Lemanea deamii* after C.C. Deam, one of the original collectors of this entity. The species has apparently escaped notice due to the general lack of attention which freshwater phycologists have shown to *Lemanea* spores. Yet, this diagnosis is not difficult to make. Nearly- to full-sized spores are likely to be present in the maturing axis from late June on and need only to be squeezed out and examined microscopically. Due to their uniquely large size, the identification can even be made with a hand lens. Figure 2 shows mature spore length plotted against mature spore width for a sampling of specimens of *Lemanea* from Indiana; the same parameters are shown for *L. deamii* and for specimens of *Lemanea* from Europe, whose spores were studied. The European data are obviously an extremely small sample to be taken as representing the rest of the world, but

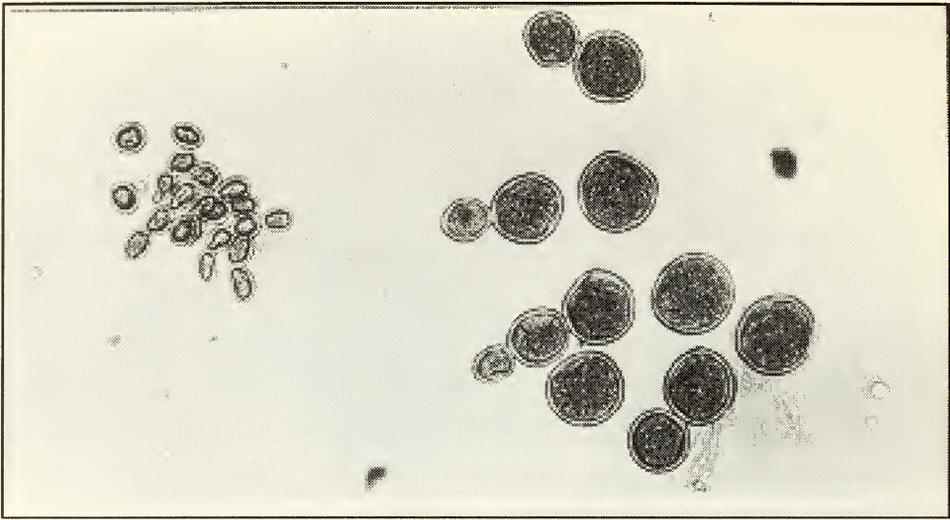


Figure 3. Cystocarp portions of *Lemanea deamii* (right) and of another Indiana *Lemanea* from McCormick's Creek State Park (left) to show the striking difference in spore size (x100).

available European and North American collections are numerous, while those from other continents are not. In addition, most dried collections, wherever they were made, do not have mature spores. Thus, grounds exist for supposing that *L. deamii* is an Indiana endemic and that it has larger spores than any other known *Lemanea*. Figure 3 illustrates a portion of the spore mass or cystocarp of *L. deamii* in comparison with that of another species (collected in McCormick's Creek State Park by Fay K. and W.A. Daily #1783 (BUT)) which is typical (for spore size) of other *Lemanea* collections from Indiana. *Lemanea deamii* has a robust "chantransia" stage (Figure 4) not obviously different from other Indiana material. Filament diameter (at the crosswalls) measures 17-20 μm near the base to 17-30 μm in the upper part. The sexual axis, described in terms of Figure 1, is recorded in midsummer as 1d-1e.

This alga has been collected at least five times. The Deam collection (#63578) was made in the Indian River near Corydon in Harrison County on 25 August 1945 (BUT). Other collections were made in Whiskey Run near Marengo in Crawford County by C.M. Palmer in 1930 and 1931 (BUT, CU) and by the author in 1989 and 1991. Although the Corydon site was searched on several different occasions, no specimens of *Lemanea deamii* were recovered where Deam had collected it.

***Lemanea deamii* (Subg. *Paralemanea*) Blum, sp. nov. (Figures 3 and 4)**

Type: U.S.A., Indiana. Crawford Co.: Whiskey Run, near Marengo, Sec. 6, T2S, R2E, 18 August 1989. J.L. Blum #4971 (Holotype: F).

"Chantransia" usque ad 2.7 mm longa; 17-24 μm diametro ad septa, aliquando angustata ad basem sed inconstanter et atypice; filamenta aliquando ramosa e base aut super basem, aliter paulum ramosa. Axis sexualis 0.8-1.6 mm diametro ad nodos, usque ad 13 cm longus, internodis ca. 45 (-58), aliquando in stipitem basalem abrupte angustatus. Carposporae subsphaericae, maxime, 66-68 μm diametro maturitate.

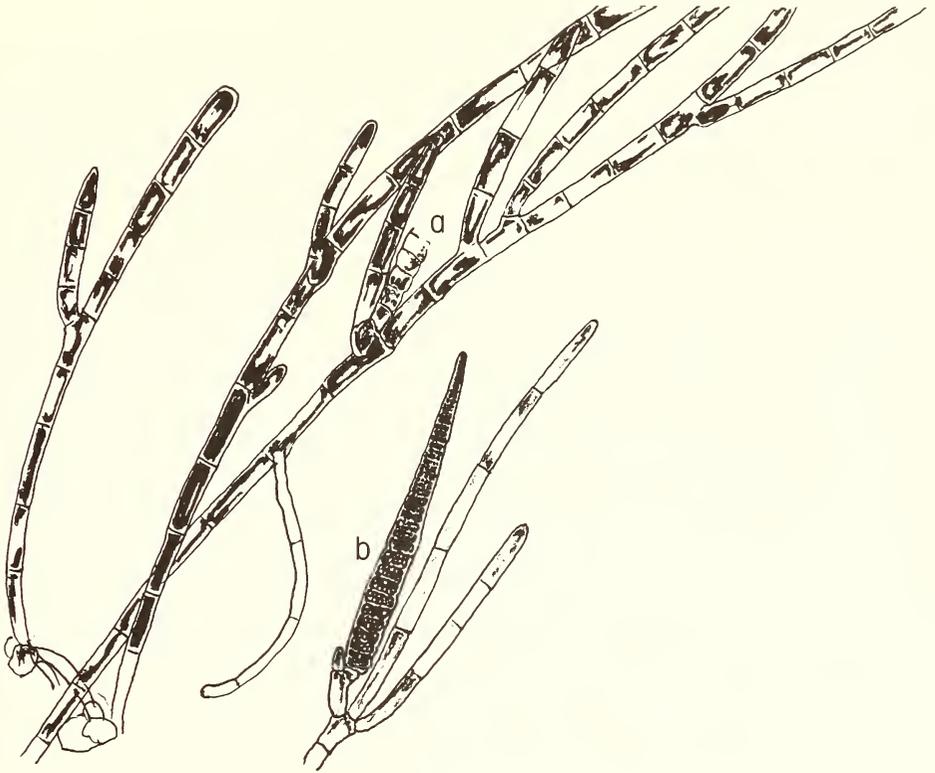


Figure 4. "Chantransia" stage of *Lemanea deamii* (x100). Juvenile gametophyte axes are shown at a (broken) and b (intact).

"Chantransia" to 2.7 mm in length, 17-24 μm in diameter at the crosswalls, sometimes narrowed toward the base, but not typically so; sometimes branching from the base or just above the base, not much branched above; sexual axis 0.8-1.6 mm in diameter at the nodes, to 13 cm overall length, with ca. 45 (-58) internodes, sometimes abruptly narrowed to a basal stipe; carpospores subspheric, very large, 66-68 μm in diameter at maturity.

DISCUSSION

The various manuals for the identification of fresh water algae (e.g., Pascher and Schiller, 1925; Starmach, 1977; Compère 1991) have to date utilized structural characteristics of both the sexual plant (Figure 1) and the "chantransia." Although distinguishing characteristics may appear convincing in print and especially in illustrations, the European forms on which most species of subgenus *Paralemanea* are based are in fact difficult to separate, and the author suspects that many or most applications of species names are made with either an overt or an intended question mark.

If the several European species names are subject to misinterpretation and misapplication, it is not surprising that the 3 or 4 American species names in this group are sometimes loosely applied. Part of this problem is due to the fact that each collection in the

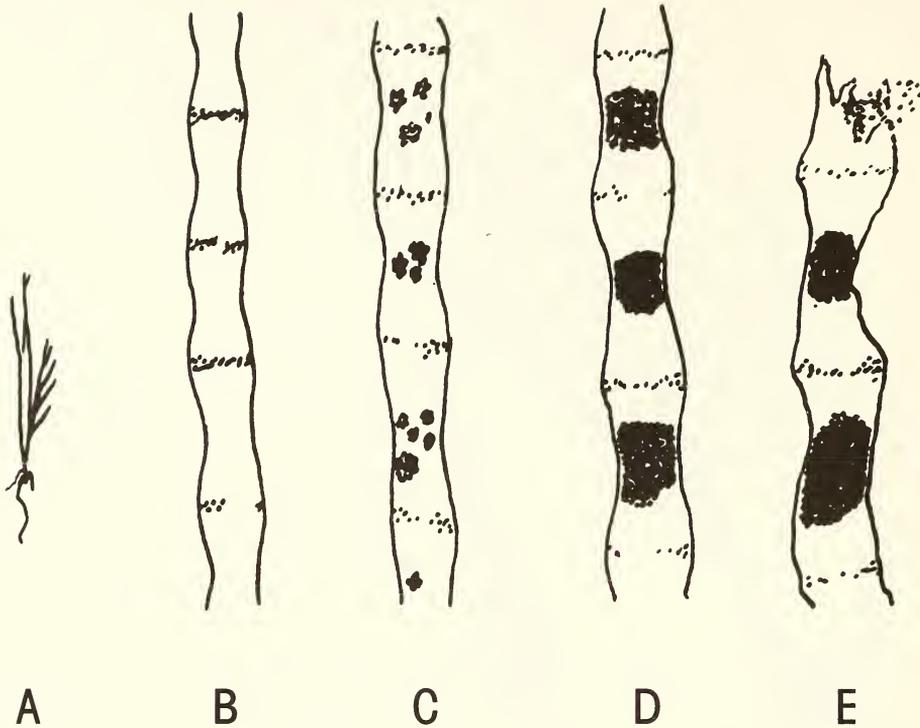


Figure 5. Diagrams to represent successive stages in the growth and development of *Paralemanea* species. A represents the "chantransia" stage (x10). B-E represent successive stages in the growth and development of the sexual axis (x100).

large herbaria was made on a single date, and few follow-ups can be found, so possible variations due to the stage in life at which the plant was collected cannot be properly assessed. Figure 5 represents some changes which can be expected in the course of the growing season in an Indiana colony. One can postulate at least five stages in the life history which are potential points of taxonomic distinction (Figure 5): the "chantransia" (A), which is to be sought in winter and early spring; the young sexual axis (B); the older sexual axis (C) with developing and discrete cystocarps (gonimoblasts); the still older axis (D) with cystocarps more or less fused into a single mass of maturing spores; and the senescent plant (E), externally eroding and distributing its mature spores. In herbarium collections, stages C and D appear to be preponderant.

Ngan and Price (1979) measured spores of several tropical marine Rhodophyceae and concluded that spore diameters (in Florideophyceae) were not taxonomically significant at the species level. The species of the various genera they studied exhibited considerable overlap in spore dimensions, however, and their conclusion does not seem warranted for a freshwater taxon so clearly set apart by spore dimensions from species potentially related to it.

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