Bull. Southern California Acad. Sci.
77(1), 1978, pp. 28–35

Phycological Notes VIII.
Two Brown Algae (Phaeophyta) New to California

George J. Hollenberg

Abstract.—Two brown algae, *Cutleria cylindrica* Okamura and *Myriactula rivulariae* (Suhr in Areschoug) J. Feldmann from Santa Catalina Island are reported as new to California. Neither genus has been previously reported from the eastern north Pacific Ocean. Comparisons with related taxa are not wholly conclusive because of anomalous features shown by the California plants.

Department of Biology, University of Redlands, Redlands, California 92373.

Two species of brown algae, collected on Santa Catalina Island off southern California by Nancy L. Nicholson (recently of the Allan Hancock Foundation, University of Southern California) and given to me for identification and study are both new to the eastern north Pacific Ocean. These collections, deposited in the Herbarium of the Allan Hancock Foundation, University of Southern California, Los Angeles, form the basis for the following note.

Cutleria cylindrica Okamura

Material.—Nicholson No. 1003, from rocks at a depth of approximately 3 m, Pebbly Beach, Avalon, Santa Catalina Island, 4 May 1973 (largest specimen shown in Fig. 1A).

Description.—California specimens erect from discoid holdfast; branches dichotomously branched with slender apices, 120–200 μm in diameter; growth in length trichothallic, involving meristematic activity at uniseriate base of numerous terminal, simple, colored filaments (Figs. 1B–D, 2C); filaments cylindrical, up to 1 mm long and 12–18–(20) μm in diameter, quickly becoming multiseriate by longitudinal divisions of cells (these filaments are soon shed); cells cut off from base of assimilatory filaments (branchlets) directly forming pseudoparenchymatous branch apex with cells more or less cuboidal, in distinct longitudinal rows (Fig. 2A); older branches with medullary cells cuboidal to slightly elongate (branches soon becoming fistulose); cells around small central cavity elongated parallel with cavity and relatively loosely associated; cortical cells progressively smaller outward; deciduous assimilatory branchlets soon partially replaced by numerous protuberant soral tufts of unbranched fertile filaments (Figs. 1A, 2B); sori not confluent, occurring from near base of plant to within 5–6 cm from branch apices; fertile filaments (Fig. 2D) 0.8–1.2 mm long, about 8 μm in diameter near base of unbranched fertile part, 12–15 μm in diameter in widest parts and attenuate to about 6 μm at rounded apex; cells of fertile filaments basically uniseriate (but some cells are divided longitudinally, and infrequently they are multiseriate throughout the sterile terminal part), mostly about one-half as long as diameter in sterile pigmented portion, but longer in less pigmented fertile region near base; fertile filaments bearing one to six plurangia (plurilocular reproductive structures) per filament (Fig. 2D); plurangia multiseriate, 98–120 μm long and 15–24 μm in diameter, cylindrical to slightly fusiform with about four longitudinal rows of

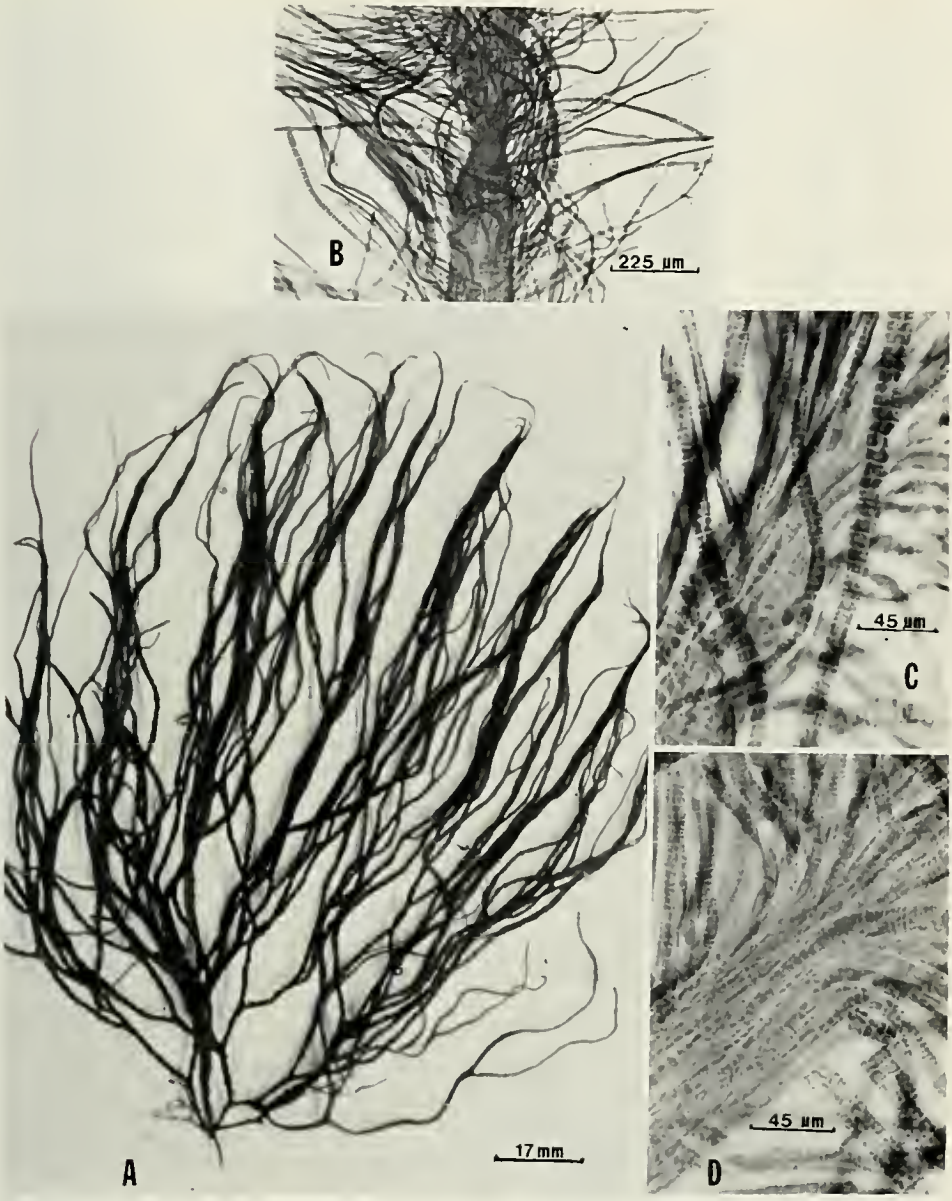


Fig. 1. *Cutleria cylindrica* Okamura from Santa Catalina Island: A. Photograph of large specimen taken underwater showing dichotomous branching and soral tufts (by Nancy L. Nicholson); B–D. Photomicrographs of branch apices showing central terminal assimilatory filaments in the meristematic region.

locules; plurangia borne on one to five-celled pedicels; unangia unknown; phaeophycean hairs absent.

Discussion.—The identity of the Santa Catalina specimens was much in doubt until Michael Wynne of the Department of Botany of the University of Michigan, suggested that they probably should be identified with *Cutleria cylindrica*. This

species, illustrated and later originally described by Okamura (1900, pl. 28; 1936), has been reported from several localities in Japan but not elsewhere. Through the kindness of Professor M. Kurogi of Hokkaido University, I was able to examine in detail a specimen of *C. cylindrica* collected at Sagami Bay, Japan, by Yukio Yamada in May 1932. The Japanese specimen corresponded closely in most respects with the California algae, namely: 1) cylindrical branches with dichotomous branching, 2) apical growth by intercalary cell division at the base of a terminal tuft of initially uniseriate unbranched filaments, 3) the deciduous nature of the laterally oriented filaments, 4) the multiseriate mature parts of the assimilatory filaments, 5) plurangia developed on fertile filaments in surface tufts, and 6) the multiseriate nature of the plurangia, one to several arising at the base of the fertile filaments.

Okamura (1936) described the cells of the assimilatory filaments as being only "here and there divided by longitudinal walls," whereas all cells of the mature parts of the assimilatory filaments are longitudinally divided in the California alga. Okamura does not mention longitudinal divisions of the cells of the fertile filaments that are frequently present in the California alga. Also, judging by Okamura's (1900, pl. 28) figure, the fertile filaments of the Japanese alga are shorter than those of the California specimens. Despite these slight differences, I believe that the California alga should be identified with the Japanese species. However, certain features of this taxon raise questions concerning its placement in the Cutleriales.

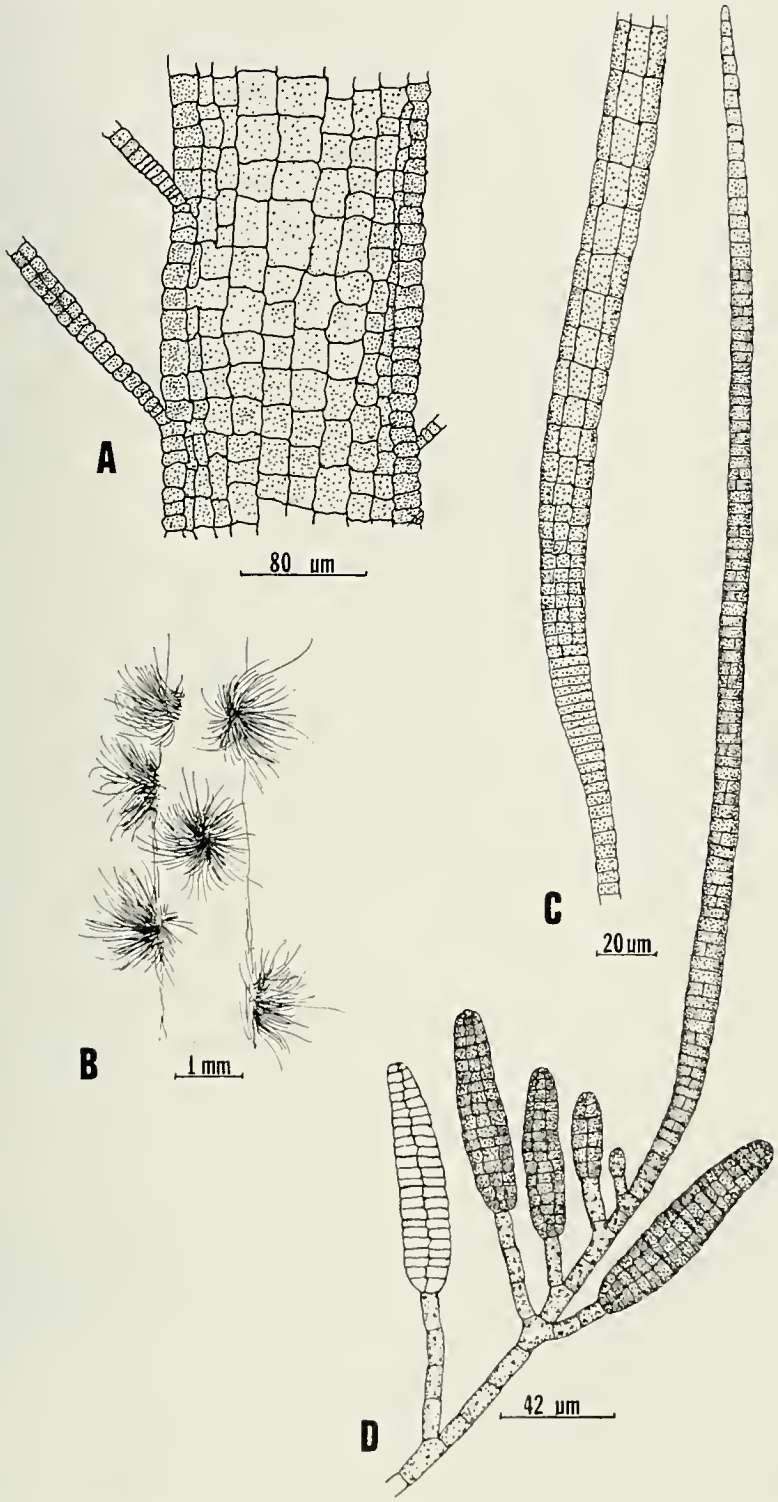
The chief features justifying placing *C. cylindrica* in the Cutleriales seem to be as follows: (1) trichothallic growth by cell division at the base of unbranched colored filaments; (2) soral grouping of the fertile filaments and (3) multiseriate plurangia borne at the base of the fertile filaments. However all of these features are found in one or more genera in the Chordariales.

Features which seem to exclude *C. cylindrica* from the Cutleriales are: (1) the cylindrical nature of the branches; (2) the multiseriate assimilatory filaments and (3) the promptly deciduous nature of the assimilatory filaments. According to Fritsch (1945), the marginal assimilatory filaments of *Cutleria* are in two superimposed series; there is no suggestion of this feature in *C. cylindrica*.

Since the central axis of this alga is formed as a result of trichothallic growth near the uniseriate base of numerous terminal and subterminal assimilatory branchlets, it seems logical to consider the possibility that it is a member of the order Chordariales as characterized by Kylin (1940). The grouping of the fertile filaments in soral tufts is similar to that found in several genera of the Spermatochnaceae. However, in that family, phaeophycean hairs are present, and growth in length occurs by means of apical cells of the central filaments, whereas neither of these features are characteristic of the California alga. In the Chordaria-Group of the Chordariaceae (as delimited by Kylin, 1940), the central axis arises from

→

Fig. 2. *Cutleria cylindrica*: (fig. 2A) near median longitudinal section close to branch apex, showing longitudinal rows of cell derivatives of central assimilatory filaments; (Fig. 2B) sketch of portion of branch with soral tufts; (Fig. 2C) basal portion of an assimilatory filament, showing the uniseriate meristematic base and polysiphonous mature portion; (Fig. 2D) fertile filament with Durangia.



intercalary growth at the base of unbranched central filaments, but phaeophycean hairs are present, and the assimilatory filaments are relatively short and uniseriate. Furthermore, in the Chordaria-Group, plurangia, as far as is known, arise by transformation of cells of the assimilatory filaments.

The Splachnidiaceae are represented by a single genus, *Splachnidium*, which is very different from the California alga: (1) although growth in *Splachnidium* occurs at the base of a group of apical filaments, the filaments are very short, uniseriate and branched, and end in numerous short clavate assimilators; (2) the cortex of *Splachnidium* is likewise very specialized, becoming uniquely cavernous and traversed by numerous branched hyphae; (3) unangia of *Splachnidium* arise in pitlike sori or conceptacles accompanied by numerous phaeophycean hairs. None of these features are characteristic of the California alga.

The California alga seems closer to the Myriogloia-Group of the Chordariaceae, as described by Kylin (1940). In that group, growth in length involves intercalary cell divisions near the base of numerous monopodial monosiphonous central filaments; descending rhizoidal filaments are not present in the cortex, and phaeophycean hairs are lacking (although the latter are present in other groups within the family). *Levringia* seems to be the only genus in the Myriogloia-Group that has multiseriate plurangia borne near the base of fertile filaments, similar to those of the California alga. (Levring, 1939, fig. 1d.)

The California alga differs from *Levringia* in the soral grouping of the fertile filaments of the former (Figs. 1A, 2B), and in certain features of these filaments, including the presence of frequent longitudinal divisions of the cells (Fig. 2D). Furthermore, the multiseriate nature of the main parts of the assimilatory filaments (Figs. 1C, D, 2C) is a very distinctive feature, unlike that of any previously described genus in the order Chordariales. Finally, rhizoidal filaments, present in *Levringia*, are lacking in the outer cortical layers of the California alga.

If placed in the Chordariales, the California alga appears to be most similar to *Myriogloia* as described by Kuckuck (1929) and Levring (1939). However, it differs from *Myriogloia* in a number of important respects: (1) the central filaments are unbranched and multiseriate in the California alga, whereas in *Myriogloia* they are branched and uniseriate; (2) in the California alga the central filaments appear fused below the meristematic zone (forming a pseudo-parenchyma [Fig. 2A] as described by Parke, 1933, for *Myriogloia* species), and are not readily separated by pressure as they are in the more gelatinous *Myriogloia* species; (3) assimilatory filaments (branchlets) are soon shed in the California alga, whereas in *Myriogloia* they form a more or less permanent covering over the branches; (4) unlike *Myriogloia*, plurangia arise in sori in the California alga; (5) rhizoidal filaments are absent in the outer cortex of the California alga, whereas numerous such filaments occur in the outer cortex of species of *Myriogloia*.

The chief, and perhaps the only feature which seems to exclude *C. cylindrica* from the Chordariales (as delimited by Kylin, 1940) is the multiseriate nature of mature parts of the assimilatory filaments. Other characteristic features of this alga are represented in one or more genera of the order as treated by Kylin. This raises a question concerning the statement by Kylin (1940) that true parenchyma never occurs in the Chordariales. Obviously, this is an area of study in which clarification is needed to better understand this poorly defined order. Culture studies of *Cutleria cylindrica* would probably help in determining the true relationship of this remarkable alga.

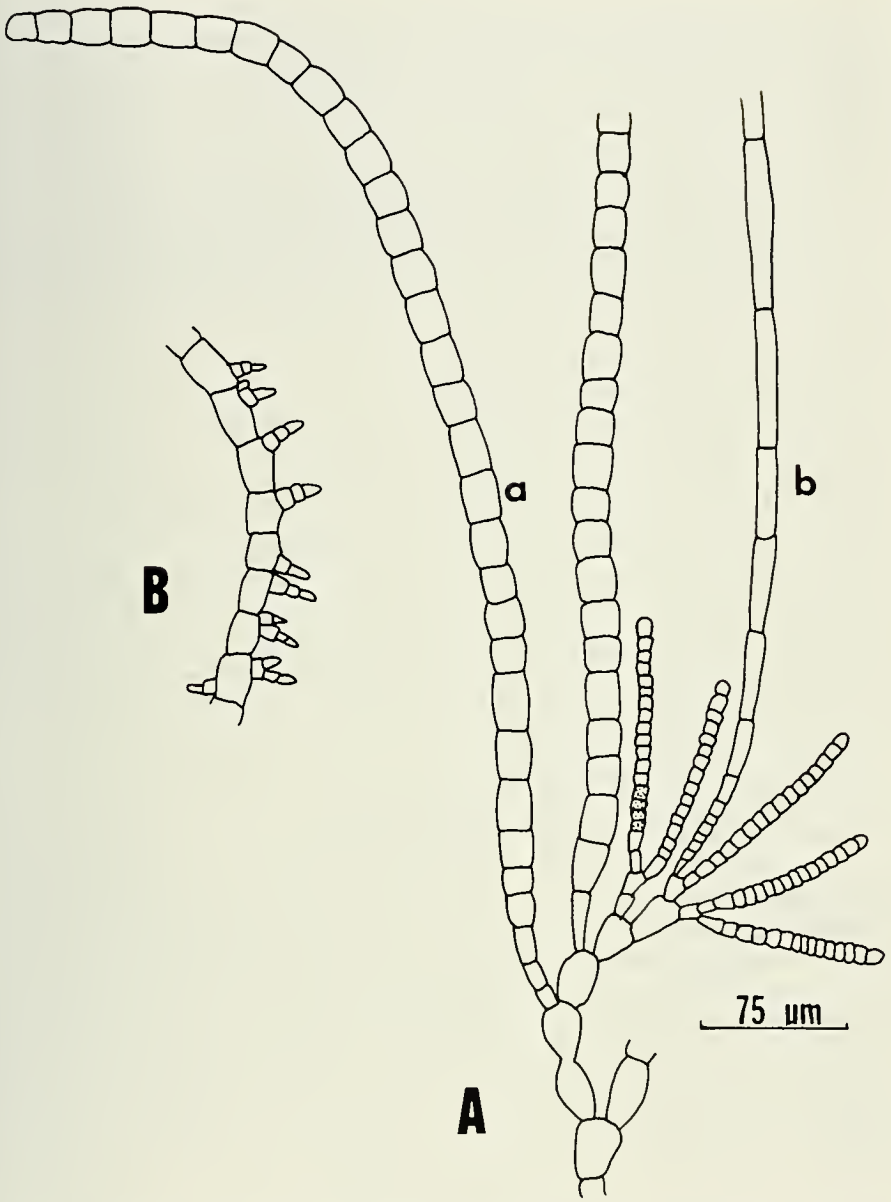


Fig. 3. *Myriactula rivulariae* (Suhr in Areschoug) J. Feldmann (?) from Santa Catalina Island: A. Assimilatory filaments and associated plurangia (a = assimilatory filament, b = colorless hair, presumed "paraphyses" not shown); B. Presumed plurangia borne laterally on apical portion of frequent assimilatory filaments.

Myriactula rivulariae (Suhr in Areschoug) J. Feldmann

Material.—Nicholson No. 900, a single collection of numerous thalli growing on *Sargassum palmeri* Grunow at Big Fisherman Cove, Santa Catalina Island, 5 April 1973.

Description.—This alga is a pulvinate partial endophyte, with basal cushion of irregular colorless cells penetrating host and bearing numerous free radiating assimilatory filaments (Fig. 3A,a), to 960 μm long and composed of up to 52 cells (mostly less than 40); filaments straight or somewhat curved, with abruptly narrowed base of relatively colorless cells, above which cells are pigmented; assimilatory filaments 14–18 μm in diameter, with cells about as long as diameter or slightly longer; filaments taper slightly toward rounded apex; similar but shorter and more slender pigmented filaments (which some authors designate as "paraphyses," not shown in Fig. 3) often present; colorless hairs (b) usually present; hairs considerably longer than assimilatory filaments, about 8 μm in diameter, composed of cells 3–6 times as long as wide; hairs may arise in place of plurangial branches or among pigmented filaments.

Plurangia uniseriate, very numerous, mostly 60–90 μm long, and composed of 10–15–(24) locules; plurangia arising in fasciculate clusters on short branching stalks from basal cushion; much shorter plurangia (?) (Fig. 3B) frequently arise separately as laterals on upper portions of assimilatory filaments (such structures are known for several species of *Myriactula*); unangia not observed.

At least 25 species of *Myriactula* have been described as epiphytes or endophytes, mostly on larger species of brown algae. A number of these are very poorly distinguished. The southern California specimens are tentatively identified with *M. rivulariae*. The southern California specimens differ from *M. rivulariae* in a number of respects, having longer assimilatory filaments, with mostly longer cells and relatively little upward tapering. Comparison with figures of *M. rivulariae* provided by Hamel (1935, fig. 31) indicate such differences.

Discussion.—*Myriactula johnstonii* and *M. marchantae* were described as *Gonodia johnstonii* and *G. marchantae*, respectively (Setchell and Gardner, 1924) from material collected in the Gulf of California. A portion of the type material of *M. johnstonii* was examined. The assimilatory filaments are much shorter than those of the California specimens. They are mostly less than 200 μm long and either clavate or distinctly tapering above the center. Plurangia are composed of usually less than 12 locules. As stated by Setchell and Gardner (1924), the apparent lack of hairs in these two algae raises a question as to their identity. In any case, they do not appear to be closely related to the southern California specimens.

More extensive study of the genus *Myriactula* is needed before the tentative assignment of the southern California specimens to *M. rivulariae* can be confirmed.

Acknowledgments

I am grateful to Isabella A. Abbott of Stanford University and Peter S. Dixon of the University of California at Irvine for valuable comments and suggestions concerning the manuscript and for loan of pertinent reference material. The assistance of Susan Manchester in preparation of the line drawings is also gratefully acknowledged. Photomicrographs were prepared with the assistance of Charles D. Howell of the University of Redlands.

Literature Cited

Fritsch, F. E. 1945. The Structure and Reproduction of the algae. Cambridge, Vol. 2, xiv + 939 pp.

Hamel, G. 1935. Phéophycées de France. Fasc. 2:81–176.
Kuckuck, P. 1929. Fragmente einer Monographie der Phaeosporeen. Wissensch. Meeresunters. N.F. 17(2):6–93.
Kylin, H. 1940. Die Phaeophyceenordnung Chordariales. Lunds Univ. Årsskr. N. F. Avd. 2. Bd 36(9):1–67.
Levring, T. 1939. Über die Phaeophyceengattungen *Myriogloia* und *Haplogloia* nov. gen. Bot. Notiser 1939:40–52.
Okamura, K. 1900. Illustrations of the marine algae of Japan. Keigroshi, Tokyo. No. VI. Pl. XXVIII.
———. 1936. Nippon Kaiso-shi. Tokyo (Published by the author).
Parke, M. 1933. A contribution to knowledge of the Mesogloiaceae and associated families. Publ. Hartley Bot. Laboratories, 9:1–43.
Setchell, W. A., and N. L. Gardner. 1924. New marine algae from the Gulf of California. Proc. Calif. Acad. Sci. Ser. 4. 12:695–949.

Accepted for Publication December 1, 1977.

ANNOUNCEMENT

The Joint Science Department of the Claremont Colleges has many incomplete sets of the *Pomona Journal of Zoology and Entomology*, including volumes 7, 8, 11, 13, 15, 29. These volumes include much work in the 1940's and earlier on marine and fresh water invertebrates and insects. These sets are being given away for the cost of mailing. Contact Professor Daniel A. Guthrie, Joint Science Department, Joint Science Building, 11th and Dartmouth Avenues, Claremont, Ca. 91711.