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Bryophytes from Arno Atoll, Marshall Islands

by

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# BRYOPHYTES FROM ARNO ATOLL, MARSHALL ISLANDS<sup>1</sup>

by Harvey Alfred Miller<sup>2</sup> and Maxwell S. Doty<sup>3</sup>

There appears to have been but a single previous record of a bryophyte from the Marshalls. This is Calymperes tenerum, a widely distributed species in Oceania, collected by W. R. Taylor (12) in the northern Marshall Islands in 1946. Glassman (7), and others (2,3,8,9,10,11), have reported on the bryophytes from the nearby Caroline Islands. Dixon (4) published a list of mosses from the Gilbert Islands, south of the Marshalls. There is little or no reference to the bryophyta in Catala's "Report on the Gilbert Islands" prepared for the South Pacific Commission, or in the vegetational and other reports on the Pacific Science Board's atoll studies.

During the summer of 1951, Leonard Horwitz collected several species of mosses and liverworts on Arno Atoll in the southern Marshall Islands in connection with the Coral Atoll Project of the Pacific Science Board. Horwitz's collections were turned over to the authors at the University of Hawaii for determination. It is these collections which form the basis for this report. The senior author made the determinations, produced the first draft of the report manuscript and drew up the specific conclusions in reference to the bryophyta. The junior author contributed the original illustrations, the key and the labor involved in finishing the work in this form.

The authors are greatly indebted to E. B. Bartram who made many of the original determinations of the mosses. The specimens cited herein are deposited in the U. S. National Museum, Washington, D. C., and in the herbarium of the B. P. Bishop Museum, Honolulu, with duplicates, wherever possible, in the Chicago Museum of Natural History and the herbaria of E. B. Bartram and the authors. The senior author wishes to thank Prof. Harold St. John, of the University of Hawaii, for provision of the assistantship and space in the Department of Botany which have enabled him to continue his studies of Central Pacific bryophytes. The authors are grateful for the material assistance given this project by Mr. Harold J. Coolidge, Mrs. Lenore Smith, and Miss Ernestine Akers, of the Pacific Science Board.

For the convenience of future atoll workers at Arno who are not bryologists, the following key is included. A set of figures made from camera lucida sketches of leaves has been included. This has been done because the

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leaves are so distinctive that they may be used to distinguish rather positively between the few known Arno mosses. With the description of each figure there appears the number of the collection from which the drawing was made and certain remarks of aid in distinguishing the species. Illustrations have not been included for the liverworts as they are much more rare and their taxonomy is as yet most incomplete in many respects.

The characteristics to which this key refers are those visible in fresh, water-soaked or wet, mature specimens. The leaves of all mosses should be compared with the figures as to size and other characteristics, for juvenile forms, in particular, may not "key out" in this key. It is our hope that these devices will facilitate greater familiarity with the mosses in the field and promote a study of their role in the atolls.

#### KEY TO THE BRYOPHYTA KNOWN FROM ARNO ATOLL

- A. Axis with leaves borne in 3 planes and in such a manner that the moist fronds are not bilateral; leaves elliptical to linear lanceolate; branches usually all erect from the substratum (mosses):
  - B. Leaf bases, stems and occasionally some leaves red when stems not densely clothed with leaves; growing on the ground: Bryum nitens.
  - B. Leaf bases, stems and leaves never red (though often brown); growing on wood or rocks or occasionally on the ground:
    - C. Growing on tree trunks or vegetable debris; tufts often over 1 cm. thick, dark brown inside or pale whitish-green throughout:
      - D. Tufts pale whitish green throughout: Leucophanes glauculum.
      - D. Tufts yellow at surface, dark brown internally: Calymperes mollucense.
    - C. Growing on various other substrata or yellow green to green throughout, or if in dense tufts then yellow-green to green:
      - E. Leaves with an area of large cells conspicuous near leaf base (Figs. 3, 4, 5); midribs extending to apex in leaves, percurrent; often extending into macroscopically visible propagulae (terminal lumps which are asexual reproductive bodies); no capsules known for the Arno material:
        - F. Prostrate moss with green stems and often widely spaced green leaves; leaf tips denticulate: Calymperes hyophyllaceum.

F. Erect moss with closely placed brownish green leaves; leaf tips not denticulate:

Calymperes tenerum.

E. Leaves without an area of large cells near the base (Figs. 2, 6); midribs lacking or not extending completely to the apex; leaf tips not bearing propagulae; capsules often present in abundance:

G. Leaves tapering quickly to a long point, often sickle shaped; midrib absent or extremely short; capsules often abundant:

Ectropothecium monumentorum.

G. Leaves strap-shaped, broadly rounded at apex, almost symmetrical; midrib extending nearly to leaf apex; capsules not known in Arno material:

Splachobryum indicum.

A. Axis with leaves borne in two planes and in such a manner that flat or hemispherical branches result; leaves either overlapping and ovoid or like the flattened axis in structure; usually all branches (except in Ptychocoleus) prostrate on the substratum (liverworts).

H. Leaves and axis alike in appearance, flat; frond prostrate:

Riccardia multifida.

H. Leaves bladelike and axis terete; frond free or prostrate:

I. Leaves strongly overlapping so as to form a frond which is hemispherical in cross section when damp and more or less cylindrical when dry; fronds becoming free from the substratum, forming a moss-like coating on tree bases up to one centimeter thick:

Ptychocoleus sp.

I. Leaves not strongly overlapping, if at all; frond usually flattened against the substratum:

J. Fronds green, about or over 1.5 mm. broad:

Lejeunea sp.

J. Fronds pale if green at all, about or less than 0.5 mm. broad:

Microlejeunea sp.

MOSSES (MUSCI)

Leucophanes glauculum C. Müll. in Micholitz, M. Philippines 163.

(SEE: Figure 1.)

Eastern end of Ine Island, Horwitz 9669, 9670B, August 19, 1951.

Distribution: Malaysia, Caroline Islands.

This plant was collected on decaying wood and coconut, Cocos nucifera, husks. It formed dense tufts where found. E. B. Bartram (correspondence) reports that F. R. Fosberg has collected this species in abundance on strand coconuts in the Carolines.

Calymperes hyophyllaceum C. Müll. in Besch., Essai Calymp. Ann. Sci. Nat. 287. 1895.

(SEE: Figure 3.)

Malel Island, Horwitz 9425B.

Distribution: Sumatra, Java, Philippines (1).

Mixed with Riccardia multifida growing in the shade and on the under side of damp outer and inner coconut husks. This record is based on a few scattered plants, but the species is so distinct that there is little question of its identity.

At the apex the leaves of this genus may bear propagulae in varying stages of development. To the naked eye the asexual reproductive lumps of cells appear as little balls on the leaf tips. In figures 3, 4, and 5 the variation in shape of the apex may be due to the degree of maturity, largely in reference to the stage of propagulum development. This genus of mosses is the only one from the Marshalls that produces such structures. The presence of these propagulae is a good field character, the presence of which on a moss from Arno can be taken as indicating this genus, Calymperes.

Calymperes mollucense Schwaegr., Suppl. II, II, p. 99, t. 127. 1824.

(SEE: Figure 5.)

Malel Island, Horwitz 9422, 9426A, 9429B, August 4, 1951.

Distribution: Moluccas, Fiji, Philippines (1).

Horwitz collected a large tuft (#9422) of this species from the base of one coconut tree but gave no indication of its abundance or whether it occurs on more than one island in the atoll. A few isolated plants (#9429B) were scattered with the Ptychocoleus (#9429A) reported here, also from a coconut trunk.

Calymperes tenerum C. Müll., Linnaea 37: 174. 1871-73.

(SEE: Figure 4.)

Ine Village, Ine Island, Horwitz 9310A, August 3, 1951.

Distribution: India, Malaysia, Philippines, and Pacific Islands to Hawaii.

This is a widely distributed species and the only one reported by Taylor (12) from the northern Marshalls. It is interesting to note that Taylor found it abundant on Rongerik, Rongelap, Bikini and Eniwetok. The collection from Arno consisted of scattered plants among lichens scraped from the trunk of a breadfruit Artocarpus sp. tree.

The collector noted the propagulae to be particularly conspicuous on this moss when collected.

Splachnobryum indicum C. Müll., Linnaea 37: 174. 1871-73.

(SEE: Figure 2.)

Ine Village, Ine Island, Horwitz 9437B.

Distribution: India, Java (1).

Scattered plants among Ectropothecium monumentorum growing "on top, sides, and even some on bottom of shady moist stones near a cistern."

The Philippines have not been included in the distribution of this species because there is considerable doubt that the plant which Bartram cites (1: 126) is S. indicum. If the Philippine plant is a distinct species, then this record leaves a larger gap in distribution than any of the other species cited herein.

Bryum nitens Hook, in Wall., Cat. n. 7592 et Icon. pl. rar. t. 20, fig. 6. 1837.

(SEE: Figure 7.)

On vertical layer of soil lining main path across Jilang Island in open coconut grove. Horwitz 9105, July 17, 1951.

Main roadway of Ine Village, Ine Island. Horwitz 9312, August 3, 1951.

Distribution: Nepal, Ceylon, Java, Bali (8), Fiji.

The extension of range indicated by this collection may not be as great as shown here since there is considerable question whether this species and Bryum ambiguum Duby (known from the Philippines) are distinct from one another. E. B. Bartram (correspondence) suspects that Fleischer's (5) remark about B. nitens, "Diese Art zeigt so geringe Unterscheide von voriger, dass ich sie nur als Abart auffassen kann. Sie is sicher nur eine kleinere Varietät von Br. ambiguum, von dem sie sich mehr durch eine Summe kleiner Merkmale, als wie specifisch unterscheidet" was well justified.

Ectopothecium monumentorum (Duby) Jaeg., Adumbr. 2 (1877-1878) 523.

(SEE: Figure 6.)

On ground in a coconut grove, Jilang Island, Horwitz 9103, July 17, 1951. On damp stump and on outer husk of coconut, Malel Island, Horwitz 9426B, 9427, 9424, August 4, 1951.

On shady moist stones near a cistern, Ine Village, Ine Island, Horwitz 9437A, August 9, 1951.

On decaying wood at eastern end of Ine Island, Horwitz 9670A, August 19, 1951.

Distribution: Sumatra, Java, Timor, Philippines, Carolines (1), Gilberts (4).

This moss appears to be common in the southern Marshalls from the number of collections Horwitz made. It was fruiting abundantly and was found in a variety of habitats. This was the only species of moss in the whole collection with sporophytes (capsules).

#### LIVERWORTS (HEPATICAE)

Riccardia multifida (L.) S. F. Gray, Nat. Arr. Brit. Pl. 1: 683, 1821.

Growing over damp coconut husks and occasionally also on inner husks. These were growing in the shade and on under surfaces. Malel Island, Horwitz 9425A, August 4, 1951.

Distribution: Worldwide (6).

Although cosmopolitan, this is the first record of the species from eastern Micronesia. See also next species.

Riccardia sp.

Found growing on a piece of outer coconut husk by Horwitz, 9426C, at Malel Island, August 4, 1951.

While the literature is not presently available for a definite determination, the material seems to be placeable close to the widely distributed Riccardia sinuata (Dicks.) Trev. The thalli of this material and this species (6) have no unicellular margin more than one cell broad. R. multifida has a 2- to 3-celled unistratose margin along with additional differences in the sporophyte. The more dependable sporophyte characters were not available in our sterile material.

Microlejeunea sp.

On an old inner coconut husk found lying in a damp situation, Malel Island, Horwitz 9426D, 9428, August 4, 1951.

This is a large and widespread tropical genus, the previous nearest report being from Ponape by Glassman (7).

Lejeunea sp.

Growing on the trunk of Cocos nucifera, Jilang Island, with various other bryophytes and lichens, Horwitz 9102B, July 17, 1951.

In abundance but only on dampest parts of the same breadfruit tree trunk which bore the Calymperes tenerum collection, 9310, Ine Village, Horwitz 9316, August 3, 1951.

The closest locality known for this genus is Yap, from which Stephani (10) reported two species.

Ptychocoleus sp.

Growing on upfacing side of a slanting coconut tree from the ground level up to about the 4 or 6 ft. level where it thinned out, Malel Island, Horwitz 9429A, August 4, 1951. On the same island and date on a coconut husk, Horwitz 9426E.

This may prove to be a species distinct from all so far described; as a search of the available literature has revealed nothing close to it. However, here as with the previously cited lejeuneoid species, the limited library sources immediately available have necessitated a temporary reservation of judgment concerning the specific identity.

DISCUSSION

The only bryophytes known to be common to both the Gilbert and the Marshall Islands are Calymperes tenerum and Ectropothecium monumentorum. These two are species of wide Indomalaysian distribution.

It is particularly interesting to note that although a goodly number of investigators have reported on moss collections from the Carolines, most of the species found on Arno Atoll have not been reported from there. Perhaps the reason that these species have not been reported from the Carolines lies in the fact that the greatest interest in these islands has been centered on the rain forests of the higher islands and the moss strand vegetation, which is similar to that of an atoll, has been grossly neglected.

There are several good reasons for believing that the Carolines are the route of migration for the Marshallese species. Nearly all of the mosses cited here are found in the Philippines. The strong storm winds of the fall and winter months are widely experienced coming from the west and southwest and it seems reasonable to assume that these winds might at some time or other carry spores as far as the Marshalls. There is a possibility, too, that the early inhabitants of these islands unwittingly carried spores or propagulae with them during their migrations.



There is a possibility of comparatively recent introduction by traders and copra boats, but if this is so then one is led to wonder why these mosses are not found in the Gilberts which are isolated by the winds and currents from the Marshalls. It seems logical that some boats would visit both groups.

Until more is known of the distribution of bryophytes in the Pacific one can propose only such broad hypotheses, to be later substantiated, modified or rejected on the basis of more complete information.

A search was made for literature reporting ethnic uses of bryophytes in Micronesia. None was found. It is hoped that future workers at Arno will inquire into the ethnobotany of the different bryophytes and that such work will be facilitated by the treatment which has been presented here.

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## EXPLANATION OF FIGURES

Figure 1) Leucophanes glauculum (9669).

The pale color, hardly green at all, and the leaf size distinguish this species from other Arno species.

Figure 2) Splachnobryum indicum (9437B).

Note that the midrib does not quite reach the leaf tip, there often being a group of specialized cells between the leaf apex and the tip of the midrib.

Figure 3) Calymperes hyophyllaceum (9425B).

The leaf tip shapes are variable and of relatively little taxonomic value. The leaf bases with their conspicuous areas of large cells, called cancellineae, and the nature of the leaf margins are much more dependable taxonomic characters. In this particular species, opposite the cancellineae and again near the apex, the margin of the leaf tends to have a little tooth opposite each marginal cell (denticulations).

Figure 4) Calymperes tenerum (9310A).

See notes under figure 3 and in text under the other species of Calymperes. The margins of the leaves in this species are nowhere denticulate. Note the difference in shape of the cancellineae.

Figure 5) Calymperes mollucensis (9422).

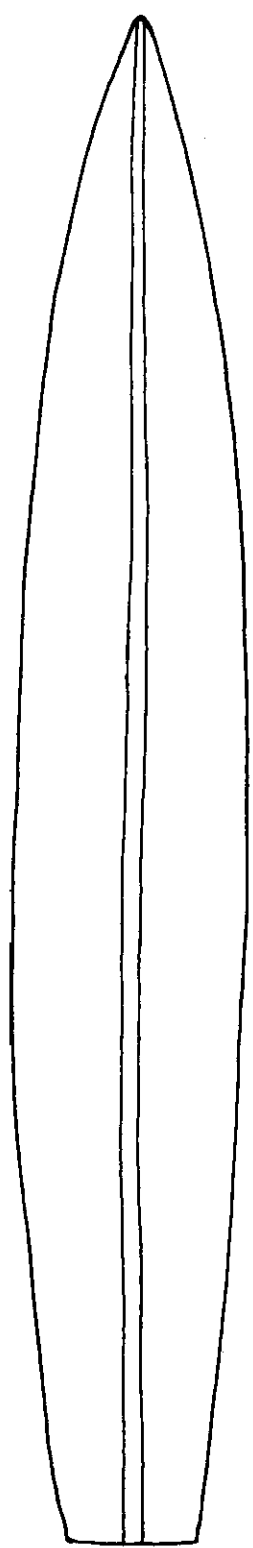
See notes under figure 3 and in text under the other species of Calymperes. The dotted lines just within the leaf margin indicate the extent of a thickened strip. This is absent in the other two Arno species.

Figure 6) Ectropothecium monumentorum (9103).

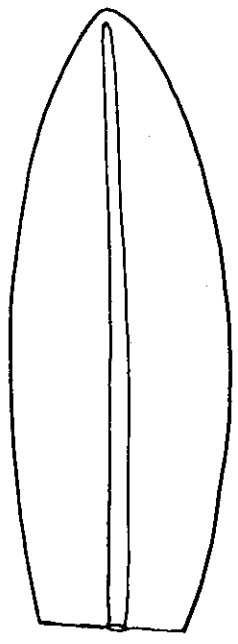
Most of the leaves of this species are sickle-shaped. There are only very small traces of midrib thickenings near the base of the leaves.

Figure 7) Bryum nitens (9312).

The midrib extends right to the apex of these usually strongly concave, boat-shaped, green leaves.



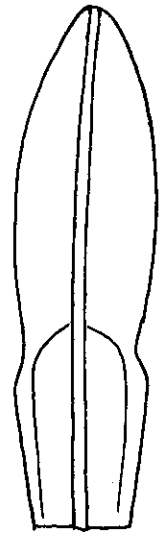
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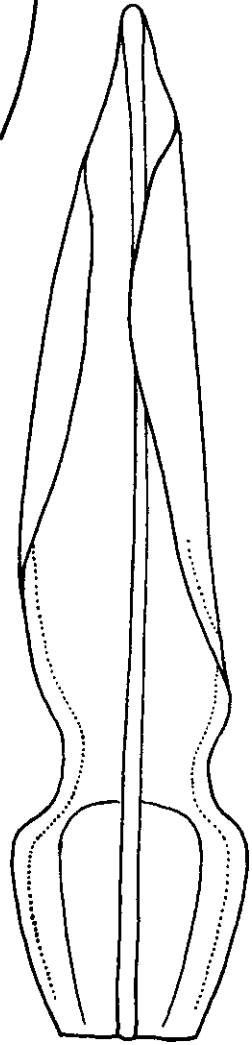
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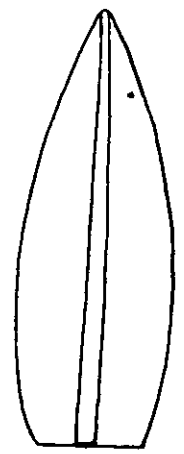
4



5



6



7



1 mm