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the figure rather suggests a small or starved *C. curta* than *helvola*.

C. helvola seems to have been first gathered in 1826 by Holmgren (2), and by Blytt in 1833 (2), but not published until 1849.

One difficulty is, *C. lagopina* is not known on Ben Lawers.

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ECOLOGICAL TERMINOLOGY AS APPLIED TO MARINE ALGÆ.

By N. MILLER JOHNSON, B.Sc., F.L.S.

The works of Warming and Borgesen are eloquently suggestive of what research methods *should* be in ecological botany.

That of the former is magnificently comprehensive, covering as it does the whole field, while the latter is no less comprehensive, from, however, a more restricted standpoint.

Algæ are *included* in Warming's work, while they occupy the entire theme of Borgesen's "Faeroese Algæ."

No doubt the general concepts of formation and association possess similar values in the mind of each writer, but

as regards Algæ the terminology clearly shows that the concepts are different.

It would appear that formation as used by Borgesen, implies association as used by Warming.

According to the former, the word formation is used to denote a group of different species belonging, as in the Fucaceæ formation of a sheltered coast, to the same family; whereas, if one correctly interprets the latter, the word formation is used to designate the entire group of Algæ (limno- or halo-nereid formation according to the fresh- or salt-water habitat).

Borgesen's association appears to be a formational unit consisting of one species only, while Warming's association seems to imply a group of plants of one, two, or more species all growing together under the same or similar conditions; or, in his own words, which must be taken to refer to terrestrial vegetation only, "an association is a community of definite floristic composition within a formation" (p. 145).

Thus it will be seen that while under certain circumstances the idea of association as used by both writers is the same, yet in the majority of cases formation, as used by Borgesen, means association as used by Warming, and the association of the former is the plant society of Moss (p. 48, 1910).

The suggestion which the present paper wishes to embody is, that as ecological terminology is now fairly definite, and accepted as such at least in Great Britain, an effort should be made to use the same terms, if not to the entire range of cryptogamic botany, at any rate to marine Algæ.

Just as a terrestrial formation may be divided into two or more sub-formations, the nereid formation (of Algæ) is divided by Warming into two sub-formations:

(a) Fresh-water (limno-nereid).

(b) Marine (halo-nereid) (p. 169).

It is customary to distinguish in the latter sub-formation two regions:

(a) the littoral; (b) the sub-littoral.

These regions could then be again divided into associations and plant societies, according to groups, single species, or in many cases successive storeys, but it will be seen that the sub-littoral habitat would be a great drawback in actual delineation of group boundaries.

Borgesen's methods of nomenclature will be seen from the following (p. 711):—

Of the formations of exposed coasts (littoral region), he recognises among others a *Hildenbrantia* formation consisting of *Hildenbrantia rosea*, *Ralfsia verrucosa*, and blue-green Algæ; a chlorophyceæ formation consisting of *Prasiola crista*, *Enteromorpha intestinalis*, and *Rhizoclonium riparium*; and a porphyra association found under the chlorophyceæ formation, and consisting of *Porphyra umbilicalis*.

It will be recognised that, according to the preceding matter and suggestions, the terminology would be as under:—

The littoral region of exposed coasts being part of the general halo-nereid sub-formation, consists of, among others, a *Hildenbrantia* association composed of small or large plant societies of *Hildenbrantia rosea*, *Ralfsia verrucosa*, and blue-green Algæ; a chlorophyceæ association consisting of plant societies of *Prasiola crista*, *Enteromorpha intestinalis*, and *Rhizoclonium riparium*; and, existing beneath the chlorophyceæ association as a lower storey, a plant society of *Porphyra umbilicalis*.

The following summarised notes may illustrate further the suggested method of treatment.

These brief notes are from observations made by the writer on the marine Algæ of the Kirkcaldy district of Fife (littoral region).

Nereid formation of Algæ; marine (halo-nereid) sub-formation; littoral region.

District I.—Ravensraig to Craig Endle; rocks and sandy beach; creeks and isolated rocks.

ALGÆ.—(1) Fucaceæ association, with *Fucus vesiculosus* (minus bladders) dominant between H. and L.W.M.

(2) Plant societies of—

(a) *Callithamnion scopulorum*.—Extensive, existing beneath *F. vesiculosus* as a lower storey.

(b) *Enteromorpha compressa*.—Not plentiful, on rocks both at H. and L.W.M.

(c) *Porphyra laciniata*.—Fairly plentiful at L.W.M.

District II.—Craig Endle to Dysart harbour; A, a series of creeks; B, a bay with rock areas.

A. (1) Fucaceæ association; *F. vesiculosus* (with bladders where on creek sides) dominant.

(2) Plant societies of—

(a) *F. serratus*.—Common.

(b) *F. spiralis*.—Near H.W.M.; scarce.

(c) *Pelvetia canaliculata*.—In honeycombed rocks near H.W.M.; scarce.

(d) *Enteromorpha compressa*.—Abundant; due to sewage.

(e) *Laminaria digitata*, *L. Saccharina*, and *Chondrus crispus* in tidal pools.

(f) *Ceramium rubrum* (pale brown), and *Enteromorpha compressa* (colourless), in, and due to high stagnant pools.

B. (1) Fucaceæ association; *F. vesiculosus* and *F. serratus* dominant.

(2) Plant societies of—

(a) *Ascophyllum nodosum*.

(b) *Callithamnion scopulorum* and *Gigartina mamillosa*.—Abundant as a lower storey on sea-wall between H.W.M. and half-tide mark.

(c) *Chylocladia articulata* and *Gigartina mamillosa*.—Abundant as lower storey on sea-wall between half-tide mark and L.W.M.

(d) *F. spiralis*.—Near H.W.M.; scarce.

Indubitably supporters of the view that this terminology, as applied to marine Algæ, is capable of improvement, will not be lacking.

The writer, however, ventures (with all due modesty) to suggest that the value of the suggestion lies in the fact that, if acted upon, the study of Algæ from the present standpoint will be brought into unity and conformity with existing methods of phytogeographical terminology.

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