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ON THE HABITATS AND FREQUENCIES OF SOME MADEIRA BRYOPHYTES

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These notes on the habitats and frequencies of some Madeira bryophytes apply only to the southern side of the island up to 4500 ft (circa 1390 m.). The data were obtained from January to March, 1909.

GEOGRAPHY AND GEOLOGY

Madeira, one of the Atlantic Islands, lies 320 miles (circa 530 km.) off the coast of Africa; Funchal, on the south, is situated in lat. $32^{\circ} 37' N.$, and long. $17^{\circ} W.$ The island is about thirty miles long and twelve broad (50×20 km.), and is the top of a huge volcanic mountain rising from the bed of the ocean which here attains a depth of 13,000 ft (3,900 m.). The gradient is extremely steep everywhere, the island rising as one mountain block, culminating in a number of peaks from 5000 to 6000 ft (circa 1540-1840 m.) high at a distance of only six miles from the sea.

The island is chiefly composed of a dark coloured basalt. Where the rock decomposes, forming the mountain soil, it is called "cascalha." The rock sections on the lofty sea-cliffs, some of them reaching 1900 ft sheer out of the sea, are well seen from the small steamers plying from one port to another. A much contorted arrangement of volcanic rocks is shown, coloured red, yellow, brown and purple. The rocks are seamed throughout with narrow vertical dykes of grey igneous material. The soil on the lower slopes of the island and on the volcanic hills near the coast is a very fertile tufa, called "Pedra molle." It is red, yellow, or deep crimson in colour and is particularly suitable for vine culture.

CLIMATIC AND EDAPHIC FACTORS.

The mountain sides are seamed with precipitous ravines. The mean annual rainfall is 30 inches (circa 75 cm.), most of it falls in the winter months; and owing to the steepness, much of the disintegrating rock and soil is yearly washed into the sea. After a few hours of heavy rain the sea is coloured red for some distance out from Funchal roadstead.

The mean winter temperature is $60^{\circ} F.$ (circa $16^{\circ} C.$).

The north and south sides of the island differ considerably in climate. Clouds laden with moisture roll up from the sea on the north and condense on the mountain tops, producing much rain on the north side. Here the population is scanty, and the vegetation is more in the primeval condition which obtained throughout the uninhabited island when it was discovered by Portuguese navigators in 1419. They named it "Madeira," Portuguese for "wood," from its forest-clad aspect. In the steep northern ravines some of the ancient indigenous forest remains, Hollies, Junipers and several trees of the Laurel type. On the south the Portuguese colonists cleared and burnt it, replanting with Oak and Sweet Chestnut. Almost all these trees have been cut down for fuel and timber work, and now on every available mountain slope the quick-growing maritime Pine (*Pinus pinaster*) is planted to supply the needs of the thickly populated south side.

During winter the rain-clouds and mists constantly roll down from the mountain tops (where snow lies for a couple of months) on to the south side, veiling the summits above 4000 ft and rendering impossible the investigation of the northern side, as the passes are very high.

BRYOPHYTE COMMUNITIES.

The distribution of the Bryophyta will be considered under the following zonal divisions:

I. *Sea-level to 1500 ft (460 m.).* There are very few bryophytes in this zone; owing to the dryness of the soil and the elaborate cultivation, every yard of land that can be is terraced and cropped with food plants; but shady walls carry a few species.

II. *1500-3000 ft (460-920 m.).* Here we have wayside and woodland species along the paths and tracks leading up to the higher region and in the afforested areas.

III. *The Ravines (Ribeiras), 1000 to 4000 ft (310-1230 m.).* Here are found some of the most interesting rock and stream-bed species, but owing to the extremely precipitous character of the sides of the ravines, the absence of tracks, and the difficulty of climbing about in them, much of these narrow gorges is inaccessible.

IV. *Open mountains, 2000-4500 ft (620-1390 m.).* The turf and rock-growing species of open drier country are met with here, also epiphytes on trees and shrubs.

In studying the following lists it will be observed that a very large proportion both of the mosses and of the liverworts are found in the fruiting condition in Madeira, this is indicated by "c. fr." after the name in mosses and "c. per." in hepaticas. The usual frequency symbols are used: a--abundant, f.=frequent, o.=occasional, r.=rare, v.r.=very rare. An asterisk preceding the name of a moss or hepatic at its first mention indicates that it had not been recorded for Madeira previously.

I. Sea-level to 1500 feet.

(a). On damp walls, generally in shade, and on wall tops.

Mosses:

Funaria hygrometrica c. fr., f.*Tortula muralis* c. fr., o.**Dieranella heteromalla* r.¹**Weisia calcarea* r.

Hepatics:

Corsinia marchantioides c. per., f.*Plagiochasma rupestre* c. per., f.*Lunularia cruciata* c. per., f.*Marchantia polymorpha* o.

(b) On damp earth by road-sides.

Mosses:

Anomobryum juliforme o.*Bryum atropurpureum* c. fr., o.**Dieranella canariensis* r.

II. 1500 to 3000 feet.

(a). On shady mountain ground, mostly under oak and pine trees.

Mosses:

Campylopus polytrichoides c. fr.², f.*Fissidens taxifolius* f.*Pogonatum aloides* c. fr., f.*Homalothecium sericeum* f.*Brachythecium illecebrense* c. fr., f.*B. purum* f.*Hypnum cupressiforme* f.*Campylopus fragilis* c. fr., o.*Fissidens serrulatus* c. fr., o.*Bryum Donianum* o.

Hepatics:

Corsinia marchantioides c. per., f.*Lunularia cruciata* c. per., f.*Gongylanthes erectorum* f.*Saccogyna viticulosa* f.*Calypogeia fissa* f.**Aneura sinuata* c. per., o.*Fossombronia angulosa* c. per., o.*F. pusilla* c. per., o.*Plagiochila spinulosa* o.*Lophocolea bidentata* o.¹ A form bearing peculiar red translucent bulbils, figured in (2).² This variety is also found on the curious deposit of blown sand, known as the Fossil beds, near Caniçal.³ This very interesting member of the Bryaceae has hitherto been met with in only two other localities, Madagascar and Usambara in Central Africa; it is known from two stations in Madeira,⁴ Fruit extremely rare, previously only known from Portugal.**Weisia calcarea* v. *mutica* c. fr., r.³**Bryum erythrocarpum* c. fr., r.*B. murale* r.**Fossombronia pusilla* c. per., o.**Frullania dilatata* o.**Riccia glauca* r.**R. glauca* var. *ciliata* r.

(b). In damp places by the Levadas (concreted aqueducts, bringing water for irrigation from high mountain springs).

Mosses:

Philonotis rigida c. fr., f.*Brachythecium illecebrense* f.*B. purum* f.*Bryum pseudo-triquetrum* o.*Bryum geminiparum* o.*Polytrichum commune* o.*Brachythecium rivulare* o.**Barbula cylindrica* c. fr., r.

(c). On open ground and bare earth and banks.

Mosses:

Trichostomum mutabile c. fr., f.*Webera Tozeri* c. fr., f.*Pogonatum aloides* c. fr., f.*Weisia viridula* c. fr., o.*Bryum argenteum* o.*B. alpinum* v. *meridionale* o.*Pogonatum nanum* c. fr., o.*Pogonatum piliferum* c. fr., o.**Pleuridium subulatum* c. fr., r.*Ceratodon purpureus* r.**Weisia crispata* c. fr., r.*Trichostomum crispulum* c. fr., r.**T. mutabile* v. *littorale* r.*Entosthodon Templetoni* c. fr., r.**Bryum capillare* c. fr., v. r.

Hepatics:

Gongylanthes erectorum f.*Plagiochasma rupestre* o.*Lunularia cruciata* o.*Fossombronia angulosa* c. per., o.*F. pusilla* c. per., o.*Aplozia crenulata* c. per., o.*Diplophyllum albicans* c. per., o.*Anthoceros dichotomus* c. per., o.*Cephalozia bicuspidata* r.

III. Ravines (1000-4000 feet).

(a). On the drier rocks.

Mosses:

Ptychomitrium nigricans c. fr., a.*Bartramia stricta* c. fr., a.*Philonotis rigida* c. fr., a.*Ptychomitrium polyphyllum* c. fr., f.*Anomobryum juliforme* c. fr., f.*Bryum platyloma* c. fr., f.*Anacetangium compactum* o.*Amphoridium curvipes* c. fr., o.*Webera Tozeri* c. fr., o.*Bryum canariense* o.*Pleuropus sericeus* o.*Hypnum cupressiforme* v. *filiforme* o.*Hedwigia ciliata* c. fr., r.*Timmella barbula* c. fr., r.*Trichostomum mutabile* v. *littorale* r.**T. flavovirens* r.*Leucodon Treleasei* v. *latifolium* c. fr., r.**Eurhynchium circinatum* r.

Hepatics:

Targionia hypophylla c. per., a.*Plagiochasma rupestre* c. per., f.*Frullania polysticta* f.*Corsinia marchantioides* c. per., o.*Reboulia hemisphaerica* o.*Frullania dilatata* o.*Radula Lindbergii* r.**R. Bornmulleri* r.

(b). On the wetter rocks and on stones in the streams.

Mosses:

Fissidens taxifolius f.*Eucladium verticillatum* v. *angustifolium* o.*Webera Tozeri* c. fr., o.*Bryum canariense* c. fr., o.*B. geminiparum* o.**Hypnum cuspidatum* o.*Haplodontium Notarisii* c. fr., r.*Philonotis marchica* r.*Hypnum riparium* v. *longifolium* c. fr., r.

Hepaticas:

- Fosombroniella angulosa* e. per., f.
Anthoceros dichotomus e. per., f.
 **Reboulia hemisphaerica* o.

- Conocephalum conicum* o.
Marchantia polymorpha o.

IV. Open mountains (2000-1500 feet).

(a). On the open turf stretches.

Mosses:

- Rhacomitrium heterostichum* e. fr., a.
Brachythecium illecebrense e. fr., f.
Hypnum cypresiforme f.
Polytrichum juniperinum e. fr., o.
P. commune o.

- Homalothecium sericeum* o.
Brachythecium purum o.
Eurhynchium Stokesii o.
Hypnum cypresiforme v. *ericetorum* r.
H. canariense r.

(b). On mountain rocks and bare open ground.

Mosses:

- Rhacomitrium heterostichum* e. fr., a.
Grimmia trichophylla o.
 **G. azorica* o.
Bryum alpinum v. *meridionale* o.

- Rhacomitrium aciculare* e. fr., o.
Hypnum cypresiforme v. *filiforme* r.
Rhacomitrium canescens v. *ericoides* r.
**Grimmia trichophylla* v. *meridionalis* v. r.

Hepaticas:

- Aplozia crenulata* e. per., o.
Diplophyllum albicans e. per., o.

- Madotheca Thuja* r.

(c). Epiphytes.

Mosses; on Laurus Canariensis:

- Ptychomitrium polyphyllum* e. fr., o.
Ulota calvescens e. fr., o.

- **Orthotrichum Lyellii* r.
Homalothecium sericeum v. *Mandoni* r.

On bushes of *Vaccinium maderense* 3-4 feet high.

- Antitrichia curtipendula* f.
Ulota calvescens e. fr., r.

Hepaticas; on Quercus pedunculata, Radula Lindbergii r; on *Vaccinium maderense, Frullania germana* v. r.; this rare species is known only from the British Isles and the Faroe Islands. In (1) this plant was named *F. Teneriffae*.

Many of the species and most of the genera here enumerated are also found in Britain, several of them representing the southern element of our flora as found in the south-western districts of Ireland and England, and in the Channel Islands.

So far as I can ascertain, 171 species and varieties of mosses, and 76 of hepaticas, are recorded altogether from Madeira. Mr H. N. Dixon pointed out to me the interesting fact that while about 80 per cent. of the mosses are also British, the remaining 20 per cent. are mostly of quite a different range. The following notes, kindly contributed by Mr Dixon for the mosses and by Mr Macvicar for the hepaticas, indicate the distribution of the non-British forms in my collection from Madeira. M, Madeira, C, Canaries, A, Azores.

Dixon
 Mosses: only known in M., *Amphoridium curvipes*, *Haplodontium Notarisii*, *Homalothecium sericeum* v. *Mandoni*, *Leucodon Treleasei* v. *latifolium* (species found in M., C., A.). *Dicranella canariensis* M., C. *Fissidens atlanticus* M., A. *Grimmia azorica* M., C., A. *Hypnum canariense* M., C., A., Newfoundland, possibly Ireland. *Fissidens pallidicaulis* M., C., N. Italy. *Ptychomitrium nigricans* M., C., A., S. Portugal. *Brachythecium Phlomotula* M., Usambara, Madagascar. *Bryum platycloma* M., C., A., Algeria. *B. alpinum* v. *meridionale* M., C., A., Portugal (Cornwall). *B. canariense* M., C., A., Portugal, Corsica. *Eucladium verticillatum* v. *angustifolium* M., C., S. Spain (species very widely distributed). *Grimmia trichophylla* v. *meridionale* M., Norway, Caucasus, Tunis, Algeria, California. *Timmia Barbula* M., C., S. Europe, Asia Minor, Persia, Abyssinia. *Philonotis murchica* M., Mid Europe, Japan, Caucasus, Algeria, N. America. *Ulothrix calvescens*, known from the British and Atlantic Islands, has lately been found in Portugal.

National
 HEPATICS: *Corsinia marchantioides* M., C., Algiers, France, Spain, Portugal, Switzerland, Italy, Corsica, Sardinia, Louisiana, Japan. *Plagiochasma rupestre* M., C., A., Spain, Portugal, Italy, Sicily, Dalmatia, Greece, Abyssinia. *Gongylanthus ericetorum* M., C., Algiers, Spain, Portugal, France, Corsica, Italy, Dalmatia. *Madotheca canariensis* M., C., Portugal. *Radula Boroniifolia* M., C. *Frullania polysticta* M., C., A.

The thick-tissued frondose hepatic genera, *Corsinia*, *Targionia*, *Plagiochasma*, *Reboulia*, and dry, tufted mosses such as *Grimmiae*, *Rhacomitria*, *Ptychomitria* and some *Trichostoma*, are the dwellers on arid rock; on the open uplands the grey cushions of *Rhacomitrium heterostichum* are very striking from the excessive development of the long white hair-point of the leaves, useful in checking transpiration; *Haplodontium* and several *Brya* are found on the moist shaded rocks in ravines; *Bartramia stricta* and *Targionia hypophylla* were found on dry basaltic rocks in close proximity, just as in this country they grow together (in Radnorshire for instance) in like conditions; the epiphytic species are noteworthy on the infrequent arboreal and fruticose vegetation of the higher mountain slopes; while the distribution of the other forms of mosses and of the foliose and some frondose hepaticas closely follows that with which we are familiar here, in woodland and wayside habitats.

LITERATURE.

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