The Cryptogamic Flora of the Awarua Plains

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Abstract

THE peat bogs of the Awarua Plains, in Southland, formerly very extensive, are fast disappearing as a result of drainage and cultivation. The plant cover contained many plants which elsewhere were always restricted to subalpine areas. These included both the flowering plants and the cryptogams, of which only the former have previously been catalogued. The present paper serves to complete a record of a unique plant formation before its final replacement and disappearance.

PRIOR to the European settlement of Southland and, indeed, for the first two decades of the present century, the Awarua Plains, extending from Invercargill to Bluff Harbour and for some miles to the north, was largely occupied by an extensive series of swamps and bogs covering some thousands of acres. Botanically the area held a special interest from the presence of a vegetation markedly sub-alpine in character though occurring almost at sea level. Smaller areas of a similar nature occurred as far north as Owaka, near Makarewa, and again in Stewart Island, but none were so extensive, or populated by such varied florula, even though subalpine species at sea level are still more numerous in the south of Stewart Island.

In 1927 a very comprehensive catalogue of the pteridophytes and flowering plants of the Awarua Plains was compiled by J. Crosby Smith and published in Vol. 58 of the *Transactions of the New Zealand Institute*; but no account of the even larger cryptogamic flora has hitherto been made, notwithstanding the rapid replacement of these bogs by arable land consequent on drainage and cultivation. In a few years the opportunity will have vanished.

L. Cockayne in "*The Vegetation of New Zealand*" (2nd edition, p. 202) attributes the existence of extensive areas of bog in the west and south of the South Island to "an abundant rainfall, a comparatively low summer temperature, and frequent cloudy skies", and in the case of the Awarua Plains we might add to poor drainage owing to their low elevation above sea-level.

These Awarua Plains were occupied by a number of distinct plant associations, one of the most extensive of which had as its dominant species *Donatia novae-zealandiae*, a species elsewhere restricted to subalpine bogs. In this association the subalpine element was strongly represented both in the phanerogamic and in the cryptogamic sections of the vegetation. The occurrence here in quantity of *Herpolirion novae zealandiae, Oreostylidium subulatum, Oreobolus pectinatus, Carpha alpina,* and many other species elsewhere montane and subalpine gave these bogs a unique character, as did the presence of *Siphula medioxima* and of *Cladonia sullivani* in the associated lichens. Besides the species elsewhere restricted to subalpine areas, there were numerous others which were commonest in such localities though sometimes found at lower levels.

Over much of the area, the peat, six to eight feet deep, overlies a layer of white gravel, but the depth thins out almost to vanishing point in some localities. Drainage channels have been cut and as a consequence the peat has partially dried out and greatly shrunk, leaving the *Donatia* cushions considerably elevated above the lowered surface. As a consequence, these have slowly died, and today scarcely a cushion remains in areas where they formerly existed in hundreds. Many of the associated

species are also fast disappearing, and on these dried-out soils manuka (*Leptospermum scoparium*) is now commonly present to complete the destruction of the former cover. Extensive fires have recently swept much of the area.

As already indicated by Crosby-Smith, the distribution of the various associations is consequent very largely on the water content and degree of aeration of the peat. Much of the area south of the railway line to Bluff is occupied by fresh water and saline swamps and marsh rather than by bogs, and here *Phormium* and Carices are abundant but replaced by *Leptocarpus simplex* in the saline marshes. The only cryptograms noted in the swampy areas were *Sphagnum falcatulum* and *S. australe* and an occasional patch of *Polytrichum commune*.

To the north of the railway and road *Donatia* bog was formerly extensive, with the drier, more elevated areas occupied by tussocks of *Danthonia rigida* var. *rubra* or by *Leptospermum*. However, large areas were dominated by *Gleichenia circinata* and by *Hypolaena lateriflora*. On the driest ridges bracken (*Pteridium esculentum*) was quite common.

On the margins of the peat area the *Danthonia* tussocks were more massive, and the ground between them often sheltered epacrids and heaths, as well as the three species of *Cladonia* constituting the sub-genus *Clathrina*.

The Cryptogamic Florulae of the Individual Plant Associations

1. Coastal Swamps.

The saline marshes south of the railway line are occupied mainly by *Leptocarpus simplex*, and in these areas cryptogams are absent. The fresh water swamps further inland are populated variously by *Phormium tenax*, *Leptospermum scoparium*, or Carices, *Carex geminata* being the principal species. Here the only cryptogamic plants observed were the fern *Blechnum procerum* and three mosses, the slender *Sphagnum falcatulum*, the more robust *S. australe*, and occasionally *Polytrichum commune*. Hepatics, fungi and lichens were not observed.

2. Donatia Bog.

This occurs on the wettest peat soils, but two sub-associations are present. *Donatia novae-zealandiae* which occupied the samewhat drier, slightly elevated portions, was the dominant species in an association which included *Carpha alpina*, *Celmisia gracilenta*, *Gentiana lineata*, *Gunnera monoica*, *Gunnera prorepens*, *Oreostylidium subulatum*, *Oreobolus pectinatus*, and *Thelymitra* spp. In the wetter hollows *Drosera binata*, *D. spathulata*, *Montia fontana*, and *Utricularia monanthos* were the commoner species. The cryptogams were commoner on the drier areas, but as the two sub-associations occupied the same territory no distinction was observed and they are listed together. The Pteridophytes were the ferns *Schizaea fistulosa* and *Lindsaya linearis*, and the endemic lycopod (*Lycopodium ramulosum*). *Sphagnum falcatulum* and *S. australe* were abundant in the hollows and *Campylopus torquatus*, *C. introflexus*, the rare *C. Kirkii*, and *Dicranoloma billardieri* on the more elevated mounds. *S. falcatulum* is almost confined to stagnant pools or to ditches.

The liverwort *Marchantia berteroana* formed occasional patches, but fungi were few and lichens were absent with the exception of occasional clumps of *Cladonia Boryi* on raised mounds left by decayed *Donatia* cushions. A hepatic (*Riccardia* sp.) occurs sparingly.

3. Bogs Dominated either by *Hypolaena lateriflora* or by *Gleichenia* spp.

Hypolaena and *Gleichenia* usually occupied separate areas, but occasionally were intermingled on peat soils rather drier, especially in summer and autumn, than the *Donatia* bogs; and, as the cryptogamic plants are the same for each, they are considered together. Both *Gleichenia circinata* and *G. microphylla* are present. Where

their growth is dense other cryptogams are absent save for *Sphagnum australe.* Where the growth is short or more open, and especially on bare patches of peat the following cryptogams were collected:—Ferns: *Schizaea fistulosa* and *Lindsaya linearis.* Lycopods: *Lycopodium ramulosum.* Mosses: *Polytrichum juniperinum, Campylopus torquatus, C. introflexus, Campylopodium euphorocladum* and *Dicranoloma billiardieri.* Hepatics: *Cephaloziella exiliflora, Chiloscyphus coalitus, Chiloscyphus normalis, Lophocolea heterophylloides, L. insularis,* and on the sides of a large drain *Marchantia berteroana* and *Riccardia* sp. Fungi were not uncommon, all being agarics, but lichens were few. These were the three *Cladoniae* of the sub-genus *Clathrina*—viz., *Cladonia aggregata, C. retipora,* and *C. sullivani,* together with *C. cornutoradiata* and *C. verticillata* var. *evoluta.*

4. BOGS WITH "RED TUSSOCK" AS THE DOMINANT SPECIES.

The grass *Danthonia rigida* var. *rubra,* generally known as the Red Tussock, occurs throughout eastern and southern Southland on open hillsides, by stream courses, in swamps, and on peat bogs, but only on such peaty areas as are not continuously water-logged. In swamps it may attain an overall height of four feet or more, but normally it is less than three feet tall. In swampy areas cryptogams are few, but on drier peaty soils the three species of the sub-genus *Clathrina* are common associates on the ground, with several red fruited *Cladonias,* and the brown-fruited *C. cornutoradiata, C. carassensis, C. pityrea* and *C. verticillata* common on the mounds left by dead tussocks or less commonly on the lower "trunks" of the largest tussocks and even on the peat itself, where *C. aggregata* in several forms is the commonest lichen. Two agarics, one yellow with decurrent gills and the other dull red, and both fairly small, were common. *Campylopus introflexus* and *C. torquatus* cover patches of some extent, the latter almost always sterile, and with the same two *Sphagna* noted elsewhere comprise the moss flora. *Marchantia berteroana* is present but rare.

5. "MANUKA" SWAMP-BOG.

This is the driest type of bog, and in summer the surface may be quite dry. After rain the area is really swamp rather than bog, though the soil is peat several feet deep. As areas are drained, manuka (*Leptospermum scoparium*) speedily spreads to areas formerly occupied by *Hypolaena, Phormium* or *Danthonia,* and rapidly overtops and kills these by exclusion of the light. On these soils it is on the shady side of the manuka groves or for a yard or so within the margin that the cryptogamic flora is most abundant. Many groves are separated from neighbouring groves by open spaces only a few yards wide. These areas often have epacrids and heaths or perhaps *Hypolaena* forming an open shrubbery in which cryptogamic plants are exceedingly numerous.

Where the manuka groves reach up to ten to fifteen feet in height the interior is commonly open and diffused light penetrates freely. In such stations the ferns *Blechnum procerum, B. penna-marina, Histiopteris incisa,* and more rarely *Polystichum vestitum* may be found, or even the scrambling *Lycopodium volubile,* seen but once by the writer. In other areas the presence in the manuka groves of dead *Danthonia* tussocks and decaying "flax" bushes is evidence of aggression by the manuka following the drying of the soil consequent on drainage operations. Where the manuka is under ten feet tall the penetration of light is difficult and no crytogams are encountered save for a distance of two or three feet within the margin of the grove. This is a very common location for *Cladonia retipora*—the Coral Lichen, and for *C. leptoclada* and *C. alpestris*; less commonly *C. crispata, C. Boryi,* and *C. cornutoradiata* occur in this station. *C. aggregata* in two principal forms is also found here but is commoner in areas just clear of the manuka.

In the shade of the manuka in particular, but also on bare peat of the open spaces the following *Cladonia* species occur in great quantity, especially in areas bordering the road to Awarua Bay for a mile from the Bay itself. Commonest of all are *Cladonia deformis* var. *cyathiformis*, a red-fruited species with tall trumpet-shaped podetia, and *C. aggregata.* Other species of section *Coccifera* include *C. didyma, C. macilenta, C. Floerkeana, C. vulcanica* (?) and more rarely *C. digitata* var. *monstrosa.* The representatives of section *Chasmaria* are *C. carassensis, C. crispata, C. scabriuscula. C. Boryi* and an undetermined *Cladonia* are locally common on bare peat.

Of the section *Thallostelides* the usual species are *C. chlorophaea, C. fimbriata* and *C. pyxidata* with trumpet-shaped podetia, *C. pityrea, C. cornutoradiata* in several forms, *C. cervicornis, C. gracilis* (two forms), and *C. verticillata* var. *evoluta.* All three species of the subgenus *Clathrina* are abundant. *C. sullivani* is here a short grey-green plant growing in compact tufts quite unlike the usual brown or brown and black forms that are commonest in subalpine habitats. Furthermore the black lining of the central canal may be absent, and some plants approximate closely to forms of *C. aggregata. C. sullivani,* however, is the only species which develops divaricatic acid. This very distinct form occurs widely in Southland.

The other *Cladonia* sections are represented by (1) Unciales—*C. Boryi* and an undetermined species; (2) Foliaceae—*C. foliaceae* var. *alcicornis*; (3) Podostelides—*C. cariosa*; (4) Ochroleucae—*C. carneola,* a subalpine species obtained near Fortrose by J. Scott Thomson, but not observed by the writer.

Other epigean lichens from this zone include *Baeomyces heteromorphus, Sticta crocata* (more usually a lithophyte or epiphyte) and the only known collection of *Thelidea corrugata* from the New Zealand mainland. At the bases of manuka on wet soil *Peltigera polydactyla* var. *polydactyloides* is quite common.

On the bases and stems of the manuka the mosses *Sematophyllum contiguum* and *Lembophyllum clandestinum* were observed, and on the ground amongst *Cassinia, Hypnum cupressiforme* and *Thuidium furfurosum* were abundant. *Ceratodon purpureus* is common on dry peat soils, and the small *Lycopodium ramulosum* is plentiful on the wetter areas, sometimes prostrate but more often semi-erect and fruiting freely.

Fungi are not uncommon on the peat, especially a bright yellow *Clavaria* (?) a small yellow agaric (*Omphalia* ?), and a tufted species with stout stems but very small pilei, the whole dingy brown in colour. Two *Caloceras* and *Crucibulum vulgare* are present on rotting stems of manuka.

Hepatics were identical with those listed for the *Hypolaena* bogs.

CLASSIFIED LIST OF CRYPTOGAMIC SPECIES

Filices

Blechnum banksii Mett. Recorded by Crosby Smith; not seen by the writer.
— *penna-marina* Kuhn.
— *procerum* (Forst. f.) Labill
Gleichenia circinata (Sw.) C. Christen. var.
— *microphylla* (R. Br.) C. Christen.
Histiopteris incisa J. Smith.
Lindsaya linearis Swartz.
Ophioglossum pedunculosum Desv. Recorded by Crosby Smith; not seen by the writer.
Pteridium esculentum (Forst.) Diels.
Polystichum vestitum Presl.
Schizaea fistulosa

LYCOPODIACEAE

Lycopodium ramulosum T. Kirk.
— *volubile* Forst. f.

MUSCINAE

Bryum sp.
— *truncorum* Brid.
Campylopus introflexus (Hedw.) Mitt.
— *kirkii* Mitt. apud Beckett.
— *torquatus* (Mitt.) Jaeg.
Campylopodium euphorocladum (C.M.) Besch.
Dicranoloma billardieri (Schwaegr.) Par.
Hypnum cupressiforme Hedw.
Lembophyllum clandestinum (H. f. & W.) Lindb.
Leptobryum pyriforme (Hedw.) Schimp.
Polytrichum commune Hedw.
— *juniperinum* Willd.
Sematophyllum contiguum (H. f. & W.) Mitt.
Sphagnum australe Mitt.
— *falcatulum* Besch.
Tayloria purpurascens (H. f. & W.) Broth.
Thuidium furfurosum (H. f. & W.) Jaeg.

HEPATICAE

Cephaloziella exiliflora (Tayl.) Spreng.
Chiloscyphus coalitus (Hook.) Nees.
— *normalis* Hodgs.
Lepidozia compacta St.
— *calcarata* St. (?)
— *kirkii* St. var.
Lophocolea insularis St.
— *heterophylloides* Syn. Hep.
Marchantia berteroana Lehm. et Lindenb.
Riccardia sp.

LICHENAE

Cladoniaceae.

A. Genus *Cladonia* Hill. Subgenus *Eucladonia* Mattick.

SECTION 1. *Cocciferae.*

Cladonia deformis (Hoffm.) f. *cyathiformis* Sandst.
— *didyma* (Fèe) Vainio.
— *digitata* Schaer. f. *monstrosa* (Ach.) Vain.
— *floerkeana* (Fr.) Sommerf. f. *carcata* (Ach.) Vain.
— — f. *intermedia* Hepp.
— *macilenta* (Hoffm.) Nyl.
— *pleurota* (Flk.) Schaer.
— *vulcanica* Zoll. et Mor (?).

SECTION 2. *Foliosae.*

Cladonia foliacea (Huds.) Schaer. var. *alcicornis* (Light f.) Schaer.

SECTION 3. *Ochroleucae.*

Cladonia carneola Fr. Obtained near Fortrose by J. Scott Thomson.

SECTION 4. *Podostelides.*

Cladonia cariosa (Ach.) Spreng.
— sp. (undetermined).

SECTION 5. *Thallostelides*

Cladonia borbonica (Del.) Nyl.
— *cervicornis* Schaer.
— *chlorophaea* (Flk.) Spreng.
— *cornuta* (L.) Schaer.
— *cornutoradiata* (Coem.) Sandst. f. *subulata* (L.) Sandst.
— — f. *furcellata* Sandst.
— — f. *radiata* (Schreb.) Sandst.
— — f. *repititoprolifera* Sandst.
— *degenerans* (Flk.) Spreng. f. *euphorea* (Ach.) Flot.
— *fimbriata* (L.) Fr.
— *gracilis* (L.) Willd. var. *chordalis* (Flk.) Schaer.
— — var. *dilatata* (Hoffm.) Vain. f. *dilacerata* (Flk.) Vain.
— *pityrea* (Flk.) Vain. f. *phyllophora* (Mudd.) Vain.
— — f. (?)
— — f. *subacuta* Vain.
— *pyxidata* (L.) Fr.
— *verticillata* (Hoffm.) Schaer. var. *evoluta* Th. Fr.
— — — f. *apoticta* (Ach.) Vain.
— — — f. *phyllocephala* Flk.

SECTION 6. *Chasmariae.*

Cladonia carassensis Vain.
— *crispata* (Ach.) Flot.
— sp. nov. (?)
— *scabriuscula* (Del.) Leight.

SECTION 7. *Unciales.*

Cladonia boryi Tuck. f. *lacunosa* Tuck (?).

SECTION 8. *Cladinae.*

Cladonia alpestris (L.) Rabenh. (This may prove to be *Cl. alpestroides* Des. Abb.)
— *leptoclada* Des Abb.

SUBGENUS: *Clathrina.*

Cladonia aggregata (Sw.) Ach. (forms).
— *retipora* Flk.
— *sullivani* Müll. Arg. f. nov.

(B) OTHER GENERA.

Bacomyces heteromorphus (Bab.) Nyl.
Siphula medioxima Nyl. (?).
Stereocaulon corticatulum Nyl.

Peltigeraceae.

Peltigera polydactyla Hoff. var. *polydactyloides* Nyl. (?)

Stictaceae.

Sticta crocata Ach.

Pannariaceae.

Thelidea corrugata Hue. A subantarctic species, not hitherto observed on the mainland of New Zealand.

FUNGI

A parcel of fungi was forwarded for determination to a specialist, who had meanwhile left for England. The full list of a dozen or so species cannot therefore be listed; and, in any case, owing to the spasmodic fruiting of these plants, the collection was doubtless far from complete. It included, however, *Thelephora terrestris* from the upper margin of a deep drain cut through the peat; a small, unbranched, sulphur yellow *Clavaria,* 1–2 cm tall; two species of *Calocera* from dead manuka stems; *Crucibulum vulgare* from the same habitat; and a number of agarics.

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