THE MARINE ALGAE OF STRONSAY

By

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(With Map)

INTRODUCTION

DURING residence in Stronsay from 1939 to 1941 the author investigated the marine flora. A further visit was paid during August and September 1946.

The island, one of the Orkneys, lies in latitude 59° 5′–59° 10′ N., and in longitude 2° 32′–2° 42′ W. It is windswept and low-lying, the highest point being only about 150 feet above sea level. The soil is fertile, and the only large uncultivated area is the moor at Rothiesholm Head. Indented with bays, it is roughly star-shaped, and possesses approximately 40 miles of coast line, while its greatest length is only 6 miles. The bays provide shelter for certain marine algae, while the exposed headlands have their own characteristic species. The whole of the solid rocks of the parish belong to the Middle (or Orcadian) Old Red Sandstone, and may be divided into four groups in ascending order: (1) The Upper Caithness Flagstones, (2) The passage Beds, (3) The Lower John o' Groat's Beds, and (4) The Upper John o' Groat's Beds. The peculiar shape of Stronsay is largely the result of the irregular distribution of the faulted outliers of the sandstone series among the harder flagstones, modified by the ice-erosion and the boulder clay deposits of the Glacial Period. The sandstones are often soft and friable, and yield both to subaerial and to marine erosion more readily than the flagstones, with the result that the sandstones now occupy low-lying areas on the inner side of the bays.[17]

PREVIOUS WORK IN THE AREA

In 1890 Traill [18, 19, 20] published a paper, "The Marine Algae of the Orkney Islands," with two short supplements in 1892 and 1895. The total number of species not including varieties was then 253. Lyle[14] in 1928, in a paper, "Marine Algae of some German Warships in Scapa Flow and of the Neighbouring Shores," makes a further thirty-six additions, including species and varieties. However, of these, four have already been recorded by Traill, viz.—*Pelvetia canaliculata*, *Porphyra miniata* var. *abyssicola*, *Gigartina stellata* and *Lomentaria clavellosa*, so the number becomes thirty-two. Nicol[15] visited the lochs of Stenness and Harray in 1936. Her algal collections from there were identified by Dunn,[6] and the published list contains five more additions.

In July 1940 the author discovered in North Ronaldshay, the most northerly island of the group, eight algae new to Orkney, but not found in Stronsay. They are recorded here: *Spirulina major* Kütz., *Codiolum Petrocelides* Kuck., *Enteromorpha lingulata* J. G. Agardh, *E. clathrata* J. G. Agardh var. *Linkiana* Batt., *E. intestinalis* Link var. *tubulosa* Kütz., *Cladophora flexuosa* Harv., *Laminaria saccharina* Lamour var. *linearis* J. G. Agardh, and *Lithothamnium lichenoides* Foslie. He also discovered *Bostrychia scorpioides* Kütz. and *Fucus vesiculosus* Linn. var. *balticus* J. G. Agardh at the Bridge of

Waith, Loch of Stenness, in August 1936, both new to Orkney and absent from Stronsay. Incidentally it was at this spot where the first civilian was killed in Britain in 1939 by bombs from German aircraft. Dunn[7] records *Bostrychia* as new to Scotland, in Trans. Bot. Soc. Edin. Vol. xxxii, p. 498.

In the present survey of Stronsay, the author has obtained 225 species and varieties including fifty new records for Orkney. The majority of the fifty are microscopic epiphytes and parasites requiring careful searching and are easily overlooked. One of the macroscopic forms, *Colpomenia sinuosa*, is a newcomer, and given time ought to establish itself as it has done in recent years in other parts of Britain. Three other species not observed by Traill are *Mesogloia Griffithsiana*, *Pterosiphonia thuyoides* and *Polysiphonia spinulosa* var. *major*, the latter occurring in some quantity in October 1940. That the island, with its 225 algae out of a total of some 348 for the whole group, possesses a rich flora, is more evident when the extent of its coastline is compared with that of the whole area.

Some outstanding algal associations in relation to the nature of the coast

Space precludes a complete discussion of all the algal associations in question, and only the outstanding are briefly noted here. Details of habitat and fruiting notes are given in the section "The Systematic List."

The Supra-littoral

The term supra-littoral suggested by Lorenz to cover the area above the highest tide mark is used here for convenience in describing the vegetation in the spray zone on the exposed cliffs of Lamb Head and Burgh Head. In winter these cliffs are lashed with all the fury and surge of the waves, and foam is blown inland a considerable distance. Even in summer there are few days when the swell is altogether absent.

On the headlands the supra-littoral vegetation does not flourish to the same extent as in the Faeröes [2, 3], this being probably due to the presence of more sunshine and fewer blanketing mists. There is seldom any noticeable development of *Porphyra*, for instance, at any height above high water, while *Pelvetia*, too, never extends far above its usual limit. In August on bare slabs of rock on the top of the cliffs at Lamb Head, some 80 feet high, were sun-dried colonies of *Prasiola stipitata*. *Prasiola crispa* was also noted. Brackish, lukewarm pools contained *Enteromorpha intestinalis* and *Protococcus marinus*, while the following occurred on ledges of rock from water level to the top of the cliffs: *Enteromorpha minima*, *Gloeocystis adnata*, *Phormidium corium* and *Rhizoclonium riparium*. The latter was often found clinging close to soil in rock crevices. *Rhodochorton purpureum* was seen above high water especially in caves, but also in the drip of fresh water together with *Cladophora fracta* var. *marina*.

Vegetation at Low Water on Exposed Coasts

On flat sloping rocks near low water in Odin Bay were carpet-like associations of *Corallina officinalis*. The thallus of the latter, owing to the mechanical action of the surf, was very compact and provided anchorage

for various epiphytes such as *Ceramium acanthonotum*, *Chylocladia ovata* and *Polysiphonia urceolata*. *Leathesia difformis* was frequent especially in pools.

In very exposed places *Callithamnion arbuscula* grew on stones and mussels. Damage from the surf is lessened by its spongy thallus, while the closely interwoven filaments, retaining water in capillary fashion, safeguard it from drying on exposure. *Rhodymenia palmata* also formed associations on flat rocks near low water. *Fucus* vegetation suffered greatly from exposure and was often absent. *Fucus vesiculosus* var. *evesiculosus* was noted.

The *Himanthalia* association was common at low water mark of neap tides where it formed narrow belts. It merged into the *Alaria* association which occurred directly below it. The *Alaria* was well developed on the sloping rocks at Whale Geo and near Odness Point. *Cromastrum Alariae* now recorded from several stations in the British Isles, was noted as a dense tomentose red mass on the thallus.[1]

The Laminaria Cloustoni Association

This association forms extensive submarine forests in the sub-littoral region of both sheltered and exposed coasts and grows too deep to suffer much from surf. Great quantities are strewn on the beaches after storms, especially at Houseby and the Sands of the Crook. The haptera and stipes harbour an immense load of epiphytes which occur in succession down the stipes according to their individual light requirements.

After exceptionally low spring tides in February 1940 and March 1941, the author was able to examine this zone below Springwell, Holland Bay, and at Lamb Bay. There was a luxuriant growth of *Odonthalia dentata*, *Pantoneura angustissima*, *Delesseria sanguinea* and *Lomentaria clavellosa* both on the stipes and on the sea floor between them. On a single plant of *L. Cloustoni*, washed ashore at the Sands of the Crook, no less than fourteen species of algae were attached: *Acrosorium reptans*, *Callophyllis laciniata*, *Cruoria pellita*, *Delesseria sanguinea*, *Laminaria digitata*, two small plants, *Laminaria Cloustoni* itself, *L. saccharina*, *Membranoptera alata*, *Pantoneura angustissima*, *Phycodrys rubens*, *Polysiphonia urceolata*, *Ptilota plumosa*, *Rhodomela lycopodioides* and *Sacchorhiza bulbosa*.

Cave Vegetation

There is a large cave at Middle Banks which can only be entered by a boat in very calm weather. Its vault-like passages are wrapped in abyssmal gloom and the two electric torches used could only penetrate a few feet. It is safe to assume that no algal growth would be present in this total darkness, so if the best artificial lighting apparatus had been available it would have yielded a negative result.

Access to the mouth of the cave at Whale Geo is possible during spring tides. Here *Odonthalia dentata* was observed in a pool. The interior of the cave has a subterranean connection with the sea under the base of the cliff, and the surging of the waves on the floor of the cave might easily sweep the investigator into the depths.

The cave at Hell's Mouth is the most instructive, since its features can be observed without danger and inconvenience. At the entrance is a deep pool of water, but the interior slopes upwards and is dry. Algae accustomed to grow in full daylight are found at the entrance to the cave. Here was *Laminaria digitata* and *Callithamnion arbuscula* with a fringe of *Cladophora rupestris* high up on the walls. In the diminishing light at the bottom of the pool were several sub-littoral algae which here are served with the same light requirements as in their other habitats. The floor of the pool had a superb pink coating of *Lithothamnion polymorphum*, and was studded with bushy tufts of *Odonthalia dentata* and some *Dictyota dichotoma*, while fringes of *Plumaria elegans*, *Lomentaria articulata* and *Cryptopleura ramosum* adorned the sides. *Lithothamnion Lenormandi* and felted stretches of *Rhodochorton purpureum* extended across the walls to the interior, but in the darkness there was cessation of all growth.

Land-locked Bays

The Bay of Franks and its landward extension the Oyce of Huip are sheltered, and show some interesting features as well as possessing species not found on other parts of the island. At the extreme low water of spring tides a small patch of *Laminaria digitata* var. *cucullata* attracted attention by its curious mantle-like undivided lamina. (See systematic list.) Here, too, were found *Chaetopteris plumosa*, *Dasya arbuscula*, *Sphacelaria cirrhosa* var. *fusca*, *Lithothamnion colliculosum* and large sheets of *Acinetospora pusilla*.

Everywhere along the shore there was a great development of *Ascophyllum nodosum*. Generally the firm nature of the raised rocky boulders favoured it, while on small stones and flat rocks *Fucus vesiculosus* took precedence. In some places regular zone formation was broken when *Fucus spiralis*, *F. vesiculosus* and *Ascophyllum nodosum* all occurred together. The upper *Pelvetia* zone was narrow or absent if there was no suitable substratum. At one place a remarkable fact was revealed. Under a thick carpet of *Ascophyllum* which was bright yellow in its top layers and darker in the interior, a black and unhealthy growth of *Fucus vesiculosus* and *F. serratus* was seen. The latter two were probably the original colonists, but were now almost suffocated by the intrusion of the *Ascophyllum*.

A *Hildenbrandia–Lithothamnion Lenormandi* association with occasional *Chondrus crispus*, *Corallina officinalis* and *Cladophora rupestris* formed the bottom layer of vegetation. At other places under *Ascophyllum* and *Fucus serratus* were *Dilsea edulis*, *Cladophora rupestris*, *Ahnfeltia plicata*, *Rhodomela subfusca* and *Membranoptera alata*.

Nearer Whitehall Village in sandy patches at the edge of the *Fucus serratus* was a *Dictyosiphon–Chorda Filum* association with *Asperococcus fistulosus* as an epiphyte. These were covered with patches of *Anabaena torulosa* and *Anacystis parasitica*. Here, too, was a *Zostera marina* bed which proved disappointing as it lacked the epiphytes usually associated with this species. Further inland towards the Oyce of Huip *Spermatochnus paradoxus* occurred in loose patches on the sand.

In the narrow channel connecting the bay with the Oyce there was a healthy fringe of *Codium fragile*, while in the swiftly flowing water an equally

vigorous growth of *Cystoclonium purpureum* and *Halidrys siliquosa* lined the sides of the channel. At the junction of the channel and the bay *Dictyosiphon chordaria* was discovered.

The Oyce is much land-locked with a muddy sandy bottom, and little but its edges is bared at the lowest of tides. *Halidrys*, *Codium fragile* and *Chorda Filum* flourished here. Some loose plants of *Codium* were found proliferating in the mud.

THE SYSTEMATIC LIST

Explanation:

* denotes new Vice County record.

H.W.=High Water.

L.W.=Low Water.

Hf.T.=Half Tide.

Dates are given for all new records and for times of fruiting.

Myxophyceae

***Chroococcus turgidus** Naeg. Among threads of *Vaucheria sphaerospora* var. *synoica* on sand-covered rocks near H.W. Holland Bay, August 1940. St Cathrine's Bay.

Anacystis parasitica Kütz. Holland Bay. Bay of Franks.

Dermocarpa prasina Born. On *Polysiphonia fastigiata*. Point of Lenay.

***Entophysalis granulosa** Kütz. Forming encrusting layers on a patch of limestone. Vertical cliffs in the spray zone. Cliv, Odin Bay, February 1941.

***Phormidium corium** Gom. In the supra-littoral zone. Rocky top of sea cliffs, 80 feet above sea level. Whale Geo, Lamb Head, August 1946.

Calothrix confervicola C. A. Agardh. Common. On the smaller algae in shallow pools exposed to sunlight near H.W. St Cathrine's Bay. Holland Bay. Bay of Franks.

***Calhothrix crustacea** Thur. *On Stictyosiphon tortilis*. St Cathrine's Bay, August 1946.

Rivularia atra Roth. Very common on *Cladophora rupestris* in most of the sheltered bays.

***Microchaete grisea** Thur. On rocks at Hf.T. Grice Ness, August 1946.

***Anabaena torulosa** Lagerh. Gelatinous masses on other algae. Bay of Franks, August 1946.

Chlorophyceae

***Chlorochytrium inclusum** Kjellm. In the thallus of *Dilsea edulis*. Rare. Below Hescombe, August 1946. Best seen by scraping the surface layers of the host with a scalpel on to a slide.

***Chlorochytrium Cohnii** Wright. In the thallus of *Enteromorpha micrococca* var. *tortuosa*. Grice Ness, August 1946.

Protococcus marinus Kütz. In sun-exposed brackish pools in the supralittoral zone in summer. Rocks at the north side of the Vat of Kirbuster. Below Hescombe. Top of cliffs at Lamb Head, 80 feet above sea level.

Ulothrix flacca Thur. Near H.W. in winter and early spring. Widely distributed.

Ulothrix speciosa Kütz. Near H.W. in winter and early spring. Widely distributed.

***Gloeocystis adnata** Naeg. On cliffs and sides of caves in the spray zone. Hell's Mouth, March 1941.

Endoderma viride Lagerh. On *Myriogamme Bonnemaisoni* and other red algae. Holland Bay, August 1940.

***Endoderma leptochaete** Huber. In the cells of *Ectocarpus* and *Ceramium*. Odin Bay.

***Endoderma Flustrae** Batt. On *Sertularia*. Widely distributed round the coasts. August 1939.

***Endoderma Flustrae** Batt. var. **Phillipsii** Batt. The form occurring in the tissue of *Alcyonidium*. Holland Bay, November 1939.

***Pringsheimia scutata** Reinke. Rare. On *Rhizoclonium implexum*. Grice Ness, June 1940.

***Enteromorpha prolifera** J. G. Agardh var. **capillaris** Kütz.=[*E. prolifera* J. G. Agardh form B II. Carter in J. of Ecology 1933]. Det. V. J. Chapman. Shore side of the Sound, Odin Bay, June 1940. Sands of Odie towards Links Ness.

***Enteromorpha ramulosa** var. **robusta** Hauck. Attached to *Cladostephus spongiosus*. Flesh House Point, September 1939.

Enteromorpha compressa Grev. Common all round the coast.

***Enteromorpha compressa** Grev. f. **subsimplex** Ahln. Det. V. J. Chapman. Odness Point, May 1940.

Enteromorpha intestinalis Link. Common. Widely distributed. In pools at top of cliffs at Lamb Head, 80 feet above sea level.

Enteromorpha micrococca Kütz. var. **tortuosa** J. G. Agardh. Surf-exposed rocks and limpet shells near H.W. Bee Skerries. Links Ness. Burgh Head to Lamb Head. Grice Ness.

Enteromorpha minima Naeg. Top of sea cliffs at Whale Geo, Lamb Head, 80 feet above sea level.

***Monostroma crepidinum** Farlow. Rare. Bay of Bomasty, April 1940.

Monostroma Grevillei Wittr. var. **Cornucopiae** Batt. Best development in May, disappearing later. Holm of Odness.

Percursaria percursa Rosenv. Loose masses on sandy seashore. August. Bight of Stackaback, Papa Stronsay.

***Ulva lactuca** Linn. var. **rigida** Le Jol. Odin Bay, October 1939. Grice Ness. St Cathrine's Bay. Links Ness.

Ulva lactuca Linn. var. **latissima** DC. Odin Bay. Rothiesholm Head. Houseby. Mill Bay. Lamb Bay.

Prasiola stipitata Suhr. H.W. on rocks and boulders on exposed coasts. Showing a preference for places manured by sea birds. Odin Bay. Rothiesholm Head. Burgh Head. Top of cliffs at Lamb Head, 80 feet above sea level.

***Prasiola crispa** Menenghini. Rare. Top of cliffs at Lamb Head, 80 feet above sea level. September 1939.

Cladophora pellucida Kütz. Very rare. L.W. of stream tides in the *Laminaria Cloustoni* zone. Below Springwell, Holland Bay. South-east side of Papa Stronsay.

Cladophora rupestris Kütz. Very common round the shores in the littoral zone.

Cladophora refracta Aresch. Very rare. Slate Pencil Geo, Odin Bay.

Cladophora albida Kütz. Summer, in pools near H.W. Holm of Odness. Holland Bay.

Cladophora fracta Kütz. var. **marina** Hauck. At H.W. where fresh water drips from the cliffs. Vat of Kirbuster and above Middle Banks Cave, Odin Bay.

Cladophora fracta Kütz. var. **flavescens** Batt. Forming large tangled masses in a brackish pool on upper side of public road at seashore. Ayre of the Mires.

Cladophora arcta Kütz. Best development in spring. Bay of Franks. Links Ness. Sands of Odie. Rothiesholm Head.

Cladophora lanosa Kütz. On *Plocamium coccineum* at Bay of Bomasty. On *Polyides rotundus* at Mervar, Holland Bay.

Chaetomorpha tortuosa Kütz. Odin Bay. Point of Lenay. Rothiesholm Head. Lamb Bay.

Chaetomorpha litorea Cooke. Odin Bay.

Chaetomorpha linum Kütz. Rare. Oyce of Huip.

Chaetomorpha aerea Kütz. Holland Bay. Rothiesholm Head.

Chaetomorpha melagonium Kütz. All round the shores, but never in quantity.

***Rhizoclonium implexum** Batt. In pools at H.W. Mill Bay at Holm of Odness, June 1940. Bay of Franks.

Rhizoclonium riparium Harv. On sand-covered rocks near H.W. On soil on ledges of cliffs in the supra-littoral region. Mervar. Slate Pencil Geo. Rothiesholm Head. Below Hescombe. From sea level to top of cliffs at Whale Geo, Lamb Head.

***Rhizoclonium Kerneri** Stockm. var. **endozoica** Wille. In the tissues of *Halichondria panicea*. Widely distributed.

Gomontia polyrhiza Born. et Flah. In the old shells of *Solen* and other molluscs. Fairly common. Zoosporangia abundant. Holland Bay, August 1940.

Bryopsis plumosa. C. A. Agardh. Widely distributed but never in quantity.

Ostreobium Queketti Born. et Flah. In the shells of *Spirorbis* on *Laminaria digitata*. Mill Bay.

Vaucheria sphaerospora Nordst. var. **synoic** Nordst. Antheridia and oogonia present on the same branch. Antheridium with two horns. In excellent fruiting condition in August 1940 and 1946. St Cathrine's Bay. In Holland Bay below the Test House, Banks and the cemetery.

Codium fragile (Suringar) Hariot var. **typicum** Schmidt [13]=[*C. mucronatum* J. G. Agardh var. *atlanticum* Cotton]. Odin Bay. Bay of Franks. *Codium dichotomum* (Huds.) Setchell=[*C. tomentosum* (Huds.) Stack.] has not been seen in Orkney by the writer.

PHAEOPHYCEAE

***Ectocarpus simplex** Crouan. On *Codium fragile*. Rare, Unilocular spirangia present. June 1940. Grice Ness.

Ectocarpus terminalis Kütz. With terminal and lateral plurilocular sporangia and a few unilocular sporangia in Feb. 1941. On limpet shells near L.W. Rare. Grice Ness.

Ectocarpus confervoides Le Jol. Common. Bay of Franks. Bay of Bomasty.

Ectocarpus fasciculatus Harv. On *Fucus serratus*. St Cathrine's Bay, August 1946.

Ectocarpus tomentosus Lyngb. On *Fucus*. Bay of Franks. Holland Bay. Odin Bay.

Ectocarpus Hincksiae Harv. With abundant plurilocular sporangia. March 1941. Rare. On *Laminaria* at L.W. Lamb Bay.

Pylaiella littoralis Kjellm. Plurilocular and a few unilocular sporangia present, August 1946. On *Fucus serratus*, Holland Bay, and Bay of Houseby. With plurilocular sporangia on *Fucus serratus*, November 1939, at Langa Mae near Houseby. Common on *Ascophyllum nodosum*, April 1940, at Mill Bay and St Cathrine's Bay.

***Phaeostroma prostratum** Kuck. On *Chorda Filum*. Bay of Franks, October 1946.

Elachista fucicola Fries. Abundant on *Fuci*.

***Elachista flaccida** Aresch. On *Halidrys siliquosa*. Sterile. Below cemetery, Bay of Franks, May 1940.

Elachista scutulata Duby. On exposed coasts on *Himanthalia*. Abundant unilocular sporangia. September 1939 and September 1946. Lamb Bay. Odin Bay.

Sporochnus pedunculatus C. A. Agardh. Rare. With unilocular sporangia. Washed up in Holland Bay, October 1940.

***Petrospongium Berkeleyi** Naeg. Rare. With unilocular sporangia, September 1939 and September 1946. Hell's Mouth. This alga does not seem to be confined to southern coasts as mentioned in Newton's Handbook. The author has collected it from Barra, Durness in Sutherlandshire and North Ronaldshay in the extreme north of Orkney.

Leathesia difformis Aresch. All round the coast in rock pools in summer. Fruiting abundantly.

***Myriactis pulvinata** Kütz. Numerous plurilocular sporangia, September 1939. Forming minute tubercles on *Halidrys*. Below cemetery, Holland Bay. Odin Bay.

Chordaria flagelliformis C. A. Agardh. In rock pools at Hf.T. Common all round the coasts in summer.

Castagnea virescens Thur. Rare. Summer. Point of Lenay. Odin Bay.

Mesogloia vermiculata Le Jol. Common. Summer. Unilocular sporangia present. Holland Bay. St Cathrine's Bay. Mill Bay.

***Mesogloia Griffithsiana** Grev. Rare. Narrow channel with running water during low tide. Part of Bay of Franks leading to Oyce of Huip. August 1946.

Myrionema strangulans Grev. Epiphyte on *Ulva*, *Enteromorpha* and other algae. Odin Bay. Holland Bay. Bay of Franks.

Myrionema strangulans Grev. var. **punctatiforme** Holm. et Batt. Globose patches on *Enteromorpha*. St Cathrine's Bay. Odin Bay.

***Myrionema aecidioides** Sauv. Rare. On *Laminaria digitata* near L.W. Mervar, Holland Bay, April 1940.

Ralfsia verrucosa Aresch. Encrustations on rocks and stones. Fruiting in winter. Holland Bay. Odin Bay.

***Ulonema rhizophorum** Foslie. Hemispherical expansions on *Dumontia incrassata*. Rare. Point of Lenay. June 1940.

Spermatochnus paradoxus Kütz. Unilocular sporangia present, August 1946. Rare. On sand near L.W. Upper part of Bay of Franks towards Oyce of Huip.

Desmarestia viridis Lamour. Rare. Holland Bay.

Desmarestia aculeata Lamour. Common round the coasts in the deeper water. Often washed up after storms.

Desmarestia ligulata Lamour. Sub-littoral. Often washed up after storms. Lamb Bay.

Dictyosiphon foeniculaceus Grev. Bay of Franks. Holland Bay. Rothiesholm Head. Tor Ness.

Dictyosiphon hippuroides Kütz. St Cathrine's Bay. Holland Bay. Bay of Franks.

Dictyosiphon Chordaria Aresch. Rare. Upper part of Bay of Franks towards the Oyce of Huip, August 1946.

***Dictyosiphon Ekmani** Aresch. Rare. On *Scytosiphon lomentarius* at L.W. Holland Bay, below Fairhill, August 1946.

The genus *Dictyosiphon* is in need of revision. There is every gradation in form, branching, consistency and thickness of the filaments from the slender and usually unbranched thallus of *D. Ekmani* at the one end of the series, through the delicate, excessively branched *D. foeniculaceus* to the thick, coarsely branched and gelatinous *D. chordaria* at the other. So

difficult was it to draw a proper line of demarcation between *D. foeniculaceus* and *D. hippuroides* that the author is convinced that they are one and the same species. Coarser forms of *D. hippuroides* which may be labelled forma *fragilis* Kjellm. lead on to *D. chordaria*. Forma *fragilis* was recorded by Traill from St Peter's Point, South Ronaldshay. He also records *D. chordaria* forma *gelatinosa* Reinke from Ryasgeo and South Bay, S.E. of Howmae in North Ronaldshay, a form on which too much stress should not be laid. *D. mesogloia* Areach. with fronds supposedly thicker than any other British *Dictyosiphon* (and not recorded from Orkney) is only *D. chordaria* according to the investigations of G. Einar du Reitz.[9] This may well be the case.

Asperococcus fistulosus Hooker. Common round most of the shores in summer. In winter appearing as meagre individuals in shallow well-lit pools of the upper zone.

Myriotrichia filiformis Harv. Common. On various small algae in summer. St Cathrine's Bay.

Phyllitis Fascia Kütz. Exposed rocks. The Brough, Burgh Head. Odin Bay.

***Colpomenia sinuosa** Derb. et Sol. Very rare. Young specimens first observed at Holland Bay on *Dictyosiphon hippuroides*, in October 1940. Mature specimens with plurilocular sporangia seen at Grice Ness in August 1946.

The author collected *Colpomenia sinuosa* at Barra in July 1936. Dunn [8] records it as new for Scotland at St Andrews in May 1939.

Scytosiphon lomentarius J. G. Agardh. Common. Widely distributed. The same migratory habits of this species as observed by Knight and Parke [11] in the Isle of Man take place in Stronsay. In early summer the growth is most luxuriant about mid tide. As the summer advances the plant recedes to low water and towards the end of September small individuals without the characteristic constrictions make their appearance in large numbers in pools near high tide mark. These persist during the winter and beget a generation which will infect the mid tide pools the following season.

Stictyosiphon tortilis Reinke. Rare. St Cathrine's Bay.

Litosiphon pusillus Harv. On *Chorda Filum*. Not uncommon.

Litosiphon laminariae Harv. On *Alaria esculenta*. Odin Bay. Lamb Head.

Isthmoplea sphaerophora Kjellm. Rare. On *Cladophora rupestris*. Abundant unilocular sporangia in March 1941. Fraea Cliv, Odin Bay.

Punctaria plantaginea Grev. Rare. Plurilocular sporangia present, April 1941. Sand-covered rocks at extreme low water of spring tides. Below Mingro, Holland Bay.

Punctaria latifolia Grev. Sand-covered rocks at L.W. Plurilocular sporangia, May 1940. Below cemetery, Bay of Franks.

Punctaria tenuissima Grev. Rare. On *Cladophora rupestris* and other algae at L.W. June to October. Plurilocular sporangia. The Sound, Odin Bay. Below Mount Pleasant, Holland Bay.

Sphacelaria radicans Harv. Rare. On sand-covered rocks among *Fucus vesiculosus*. Sparingly in fruit. A few unilocular sporangia still remaining. Lamb Bay, March 1941,

Sphacelaria olivacea Pringsh. Rare. Forming small mats on the vertical sides of rocks at H.W. Unilocular sporangia scanty. March 1941. Hell's Mouth. Fraea Cliv, Odin Bay.

Sphacelaria cirrhosa C.A. Agardh var. **pennata** Hauck. Common. Widely distributed.

Sphacelaria cirrhosa C.A. Agardh var. **fusca** Holm. et Batt. Common. Loose strata on other algae in still water. Bay of Franks.

***Sphacelaria bipinnata** Sauv. Rare. On *Halidrys*. Grice Ness, August 1946.

Chaetopteris plumosa Kütz. Common. On muddy, sandy *Zostera* beds, May 1940. Fruiting, November 1940, with abundant plurilocular sporangia. South side of Bay of Franks. Traill records it from Linga Sound.

Cladostephus spongiosus J. G. Agardh. Common. Sand-covered rocks near L.W. Fruit in winter. St Cathrine's Bay. Holland Bay. Odin Bay. Sands of Odie.

Cladostephus verticillatus J. G. Agardh. Rare. Odin Bay.

Chorda Filum Lamour. Common all round the coast. Best growth in deep, still water.

Laminaria saccharina Lamour. Common in the deeper parts of the sheltered bays.

Laminaria saccharina Lamour var. **Phyllitis** Le Jol. Annual. Spring and summer. In the Sound—a narrow channel where there is a constant stream of salt water flowing with considerable velocity.

Laminaria digitata Lamour. Common all round the coasts.

Laminaria digitata Lamour var. **stenophylla** Harv. In the surf area on exposed headlands. Odness Point. Burgh Head. Lamb Head. Probably not a true variety but a physiological state due to the exposed habitat.

***Laminaria digitata** Lamour var. **cucullata** Le Jol. Magnificent specimens with plaited skirt-like laminae in the sheltered land-locked Bay of Franks, March 1941. Like the preceding form, an adaptation in response to habitat. Intermediates connect *digitata* with these two extreme forms, the degree of shelter or exposure being the controlling factor.

Laminaria Cloustoni Edmondst. Common all round the coast. Thousands of tons cast up annually in the bays.

Saccorhiza bulbosa De la Pyl. Common. Frequently washed ashore.

Alaria esculenta Grev. On exposed coasts at L.W. Fruit in winter. Lamb Head. Burgh Head.

Acinetospora pusilla Born. Epiphytic on other algae at L.W. in land-locked bay. Monospores abundant. Bay of Franks, August 1946.

Dictyota dichotoma Lamour. Rock pool in cave. Hell's Mouth. Odin Bay.

Dictyota dichotoma Lamour var. **implexa** J. G. Agardh. Dredged by trawl net at 40 fathoms. Ten miles east of Burgh Head.

Fucus spiralis Linn. Abundant all round the coast.

Fucus vesiculosus Linn. Abundant all round the coast.

***Fucus vesiculosus** Linn. var. **evesiculosus** Cotton. Common. Surf-exposed rocks between Odness House and the Point, September 1946.

Fucus serratus Linn. A conspicuous species in the marine vegetation except in exposed places.

Ascophyllum nodosum Le Jol. Common. Shows a preference for raised rock ridges and boulders rather than for a level substratum.

Pelvetia canaliculata Dcne. et Thur. Common. Occupies the highest zone of the *Fucoids*.

Himanthalia lorea Lyngb. On exposed coasts in the surf area. A magnificent colony in all states of development on Bee Skerries (Besker).

Halidrys siliquosa Lyngb. One of the dominant algae in the deeper pools at Hf.T.

***Halidrys siliquosa** Lyngb. var. **siliculosus** Newton's Handbook. Rare. Below Hescombe, August 1946.

Rhodophyceae

***Bangia fusco-purpurea** Lyngb. Common in winter and spring. Mill Bay, April 1940.

Porphyra umbilicalis J. G. Agardh. Common in sheltered and exposed places. Narrow growth forms in winter.

Erythrotrichia carnea J. G. Agardh. Rare. On *Polysiphonia nigrescens*. The Sound, Odin Bay.

Porphyropsis coccinea Rosenv. Two young specimens only, on *Desmarestia aculeata*, dredged by trawl net from 40 fathoms, ten miles east of Burgh Head.

***Acrochaetium endozoicum** (Darb.) Batters. In the tissues of *Alcyonidium*. Frequently washed up. Sands of the Crook, November 1939. Holland Bay.

Audouinella membranacea (Magnus) Papenfuss.
=[*Rhodochorton membranaceum* (Magnus) Hauck.] On *Bryozoa* with *Rhodochorton penicilliforme*. In the *Laminaria Cloustoni* zone. North side of Greenli Ness. On *Alcyonidium*, Point of Lenay.

Chromastrum virgulatum (Harv.) Papenfuss.
=[*Acrochaetium virgulatum* J. G. Agardh.] Common in summer on the smaller algae.

Chromastrum virgulatum (Harv.) Papenfuss forma **luxurians** Rosenv. On *Chaetomorpha melagonium*. Dritness, Odin Bay.

Chromastrum secundatum (Lyngb.) Papenfuss.
=[*Acrochaetium secundatum* (Lyngb.) Naeg.] Rare. Abundant tetraspores, May 1940. On *Cladophora rupestris* at side of a cave. Middle Banks.

***Chromastrum Alariae** (Jónss.) Papenfuss.
=[*Acrochaetium alariae* (Jónss.) Born.] The writer first found this species in Orkney at rocks south of Green Skerry, North Ronaldshay in July 1940. The Stronsay records are (1) Lamb Head, September 1940, and (2) between Odness House and the Point, September 1946. Batters[1] records it from Berwick-on-Tweed, 1904, and states that Harvey found at Miltown Malbay, some time before 1833, what he calls *Callithamnion secundatum* on *Alaria esculenta*; no doubt it was the present plant. Other records are from Clare Island (Cotton), Inis Meadhow in the Aran Islands (De Valera).

Chromastrum floridulum (Dillw.) Papenfuss.
=[*Rhodochorton floridulum* (Dillw.) Naeg.] On sand-covered rocks. Fruit in winter. St. Cathrine's Bay. Holland Bay. Sands of Odie.

***Rhodochorton penicilliforme** Rosenv. North side of Greenli Ness, March 1941.

Rhodochorton purpureum (Lightf.) Rosenv.
=[*R. Rothii* Naeg.] Common. In caves and in the supra-littoral. Also in a waterfall, thriving luxuriantly. Specimens referable to f. *globosa* Kjellm. similar to those Børgesen found in the Faeröes, were noted in exposed localities. The globular compact thallus is probably an adaptation to habitat. Fruit in winter. Rothiesholm Head. Burgh Head to Lamb Head. Odin Bay.

Helminthora divaricata J. G. Agardh. A single specimen washed up in Holland Bay.

Scinaia furcellata Bivona. Very rare. Two specimens washed up in Holland Bay.

Gelidium corneum Lamour. Common round the shores under sheltered rock ridges.

Dumontia incrassata Lamour. In all the bays. Best development in March, disappearing in summer.

Dilsea edulis Stackh. All round the coasts. Common under *Fucus* fronds.

Furcellaria fastigiata Lamour. Sandy pools in the sheltered bays, but not in exposed places. Fruit in winter.

Polyides rotundus Grev. Occurs with the former in similar localities.

Petrocelis cruenta J. G. Agardh. Mervar, Holland Bay. Fruit in winter. The green alga *Codiolum Petrocelidis* was found by the author in the thallus of this species in North Ronaldshay, but there was no trace of it in the Stronsay material.

***Cruoria pellita** Lyngb. On rocks at L.W. Common. Tetraspores and cystocarps plentiful in December at Kelsber, St Cathrine's Bay. A few tetraspores in May at Crook's Ness, Mill Bay. Sterile plants in October 1939 at Sands of the Crook.

Hildenbrandia prototypus Nardo. Reddish stains on stones and pebbles. H.W. to Hf.T. Fruiting in winter and spring. Widely distributed.

***Schmitziella endophloea** Born. et Batt. On *Cladophora pellucida*. Very rare. Below Springwell, February 1940. South-east side of Papa Stronsay.

Melobesia farinosa Lamour. On *Zostera marina* in a land-locked bay. Channel between Bay of Franks and Oyce of Huip.

Lithophyllum incrustans Foslie. Common in pools at Hf.T. Odin Bay. Holland Bay, Mill Bay.

Lithophyllum pustulatum Foslie. Epiphytic on *Gigartina*. Bay of Bomasty. Rothiesholm Head.

Lithophyllum pustulatum Foslie var. **Corallinae** (Crn.) Foslie. On *Corallina officinalis*. Rocks between Fairhill and the Lodge, Holland Bay, April 1940.

Lithophyllum pustulatum Foslie var. **Laminariae** (Crn.) Foslie. On the attachment organ of *Laminaria Cloustoni*. With two-celled sporangia. April 1940. Sands of Odie.

***Lithothamnion colliculosum** Foslie. Rare. At extreme low water of spring tides. Bay of Franks, March 1941.

Lithothamnion calcareum Aresch. On the rhizoids of *Laminaria saccharina*. Bay of Bomasty. A bed in deep water at St Cathrine's Bay.

Lithothamnion Lenormandi Foslie f. **typica** Foslie. Common in caves and sheltered rocks near H.W.

Lithothamnion membranaceum Foslie. On *Cladophora rupestris*. Mill Bay. Below Banks.

Lithothamnion polymorphum Foslie. Coating considerable areas of rocks with a magenta tint in the *Laminaria* zone. Very common all round the coast.

Corallina officinalis Linn. Very common in rock pools.

***Corallina officinalis** Linn. var. **compacta** Batt. Dense cushions in the surf area on exposed coasts. September 1940. Probably would revert to the type if grown in shelter.

Delesseria sanguinea Lamour. Common in the *Laminaria Cloustoni* zone. Fruit in winter.

Membranoptera alata Kylin. Common all round the shores in pools shaded by *Fucus* fronds.

Pantoneura angustissima Kylin. On the stipes of *Laminaria Cloustoni*. Often washed up. Sands of the Crook. Holland Bay. Mill Bay. Linga Sound (M'Bain).

Apoglossum ruscifolium Kylin. Rare. Washed up. Links Ness and Sands of Odie. Mill Bay.

Hypoglossum Woodwardii Kylin. Rare. With tetraspores, May 1940. Below cemetery, Bay of Franks.

Nitophyllum punctatum Grev. Rare. Occasionally washed up.

***Acrosorium reptans** Kylin. Rare. Creeping on the stipes and attachment organ of *Laminaria Cloustoni*. Washed up at Sands of the Crook, October 1939.

Phycodrys rubens Batt. In the sub-littoral zone. Holland Bay. Mill Bay. Lamb Bay.

Cryptopleura ramosum Kylin. In the sub-littoral and in caves. Tetrasporic plants, September 1939, in the caves at Hell's Mouth. Odin Bay. Bay of Bomasty.

Rhodomela subfusca C. A. Agardh. Common. Below Hescombe. Links Ness. Holland Bay. Bay of Houseby to Tor Ness.

Rhodomela lycopodioides C. A. Agardh. Usually on the stipes of *Laminaria Cloustoni*. Lamb Bay. Sands of the Crook.

Odonthalia dentata Lyngb. Common in the bays. Cystocarps and tetraspores observed in winter. Magnificent specimens in deep water.

Laurencia hybrida Lenorm. Rare. Bay of Franks. Rothiesholm Head.

Laurencia pinnatifida Lamour. Common in most of the bays with best development in exposed situations.

Polysiphonia urceolata Grev. On rocks and algae near L.W. Odin Bay. Houseby to Tor Ness.

Polysiphonia fastigiata Grev. Wherever *Ascophyllum* occurs.

Polysiphonia elongata Harv. Common in one small area. St Cathrine's Bay below Sandybank. Recorded by Traill from Linga Sound which is in the same area.

***Polysiphonia spinulosa** Grev. var. **major** J. G. Agardh. Sterile. On *Desmarestia aculeata*. Washed up in considerable quantity in October 1940. Odin Bay, October 1939. Tor Ness.

Polysiphonia Brodiaei Grev. Common. Tetraspores present, September 1946. Between Odness House and the Point.

Polysiphonia nigrescens Grev. Common in most of the bays.

Pterosiphonia parasitica Schmitz. Very rare. In deep pools at L.W. Bee Skerries. Below Hescombe.

***Pterosiphonia thuyoides** Schmitz. Rare. On the exposed top of rocks among *Corallina* at L.W. Greenli Ness.

Dasya arbuscula C. A. Agardh. Rare. Young tetrasporic stichidia present, November 1940. Sandy pools among *Zostera* beds. Bay of Franks.

Heterosiphonia plumosa Batt. Very rare. Washed up below cemetery, Holland Bay.

Trailliella intricata Batt. Sterile with the characteristic side cells. Rare. Bay of Franks, August 1946. Common and in fine condition in a pool near Odness Point, September 1946.

Griffithsia corallinoides Batt. Common. Washed up. Possessing a strong unpleasant smell and decomposing quickly. St Cathrine's Bay.

Griffithsia flosculosa Batt. Not uncommon. St Cathrine's Bay. Holland Bay. Links Ness.

Callithamnion Hookeri C. A. Agardh. Rare. Tetraspores, September 1939. Nebi Geo, Odin Bay.

Callithamnion arbuscula Lyngb. On exposed rocks at L.W. Odin Bay. Burgh Head to Lamb Head.

Callithamnion tetragonum C. A. Agardh. On *Laminaria digitata.* Occasionally washed up. Holland Bay.

Plumaria elegans Schmitz. In the *Laminaria Cloustoni* zone. On sides of rocks in caves. Fine specimens in cave at Hell's Mouth.

Ptilota plumosa C. A. Agardh. In deep water on *Laminaria Cloustini.*

Antithamnion plumula Thur. Rare. Washed up in Holland Bay. Cruciate tetraspores, October 1940.

Ceramium rubrum C. A. Agardh. Common round the shores. Tetraspores, March 1940.

Ceramium ciliatum Ducluz. Rare. Surf exposed rocks. Bee Skerries.

Ceramium acanthonotum Carm. Common. Surf exposed rocks. Bee Skerries. Hell's Mouth.

Chondrus crispus Lyngb. Common all round the shores. Fruit in winter and spring.

***Chondrus crispus** Lyngb. forma **corymbosa** (Ag.) M. Thomas. Common. Below Springwell, October 1940.

***Chondrus crispus** Lyngb. var. **aequalis** Turn. Widely distributed.

Gigartina stellata Batt. Common. Best development on exposed coasts.

Phyllophora Brodiaei C. A. Agardh. Common. Under ledges of rock at L.W. Bay of Bomasty. Holland Bay. Odin Bay. St Cathrine's Bay.

Phyllophora epiphylla Batt. Rare. In deep water. Odin Bay. Holland Bay.

Phyllophora membranifolia J. G. Agardh. Common. In pools near L.W. St Cathrine's Bay. Odin Bay. Holland Bay. Bay of Houseby. Mill Bay. Sands of Odie.

Gymnogongrus Griffithsiae Martius. Recorded by Traill from Odin Bay, but no trace has been seen by the author. Traill mentions no other Orkney locality.

Ahnfeltia plicata Fries. In sandy pools. Common.

Callophyllis laciniata Kütz. Commonly cast ashore from deep water. On the stipes of *Laminaria Cloustoni.* Sands of the Crook. Odin Bay. Lamb Bay.

Callocolax neglectus Schmitz. Parasitic on *Callophyllis laciniata.* Sands of the Crook. Lamb Bay.

Cystoclonium purpureum Batt. Common all round the shores. Gall-like growths, present on specimens from St Cathrine's Bay, are due to bacteria[10, 12]. See Kylin in Die Rhodophyceen der schwedischen Westküste 1944.

***Cystoclonium purpureum** Batt. var. **cirrhosa** J. G. Agardh. Pools at Hf.T. Point of Lenay, June 1940.

Catenella repens Batt. In caves and shady crevices of rocks near H.W. Odin Bay. Hell's Mouth.

Rhodophyllis bifida Kütz. Several plants washed ashore in Holland Bay. Cystocarps abundant, October 1940.

***Choreocolax Polysiphoniae** Reinsch. Rare. On *Polysiphonia fastigiata*. Point of Lenay, August 1940.

Sphaerococcus coronopifolius C. A. Agardh. Four plants washed up in Holland Bay. Good fruiting condition with abundant cystocarps.

Rhodymenia palmata Grev. Common on the stipes of *Laminaria Cloustoni*.

Rhodymenia palmata Grev. var. **marginifera** Harv. Old fronds develop proliferations. This is merely a state and does not deserve varietal rank.

Rhodymenia palmata Grev. var. **sobolifera** J. G. Agardh. Bay of Franks. Flesh House Point. A whole range of forms with divided thalli, having physiological rather than specific significance, was observed in still water.

Lomentaria articulata Lyngb. Rocks near L.W. Widely distributed.

Lomentaria clavellosa Gaill. Extreme L.W. of spring tides. Below Springwell. Below Hescombe.

Chylocladia kaliformis Hook. Common. In most of the bays.

Chylocladia ovata Batt. Rare. On surf exposed rocks. Bee Skerries.

Plocamium coccineum Lyngb. Very common. In deep water. Often cast ashore.

Character of the Flora and Comparison with other Areas

A comparison of the flora with that of the rest of Orkney is first essential, and is more significant after a knowledge of absentees. *Fucus ceranoides* is lacking due to the fact that no fresh water streams enter the sea at suitable places. The absence of salt marshes means that there will be no *Fucus vesiculosus* var. *balticus* or any other *Fuci* associated with salt marshes. For the same reason *Bostrychia scorpioides* and several *Myxophyceae* will not be found. It is hard, however, to explain why *Nemalion multifidum* was absent since ideal conditions existed for it and its presence was noted in other parts of Orkney.

The existence of a definite southern element in the Orkney marina flora resembling that of S. England and S.W. Ireland is well known from previous literature. That is well borne out in Stronsay by such species as *Cladophora pellucida*, *Codium fragile*, *Petrospongium Berkeleyi*, *Mesogloia Griffithsiana*, *Heterosiphonia plumosa*, *Trailliella intricata* and *Rhodophyllis bifida*, although many of the southern *Rhodophyceae* recorded by Traill as dredged up in Kirkwall harbour were looked for in vain. The direction of the gulf stream drift and the equable winter temperature of the sea are doubtless responsible for the presence of these from time to time. Southern English casuals may arrive frequently and flourish for a time in what is not quite their element, but they can never hope to compete with a hardier northern stock.

As is expected, there is much resemblance to the flora of Scotland and to that of the Faeröes. Although several species found in the latter were absent, yet the northern elements predominate since conditions of growth, light, exposure and duration of life are on the whole similar.

SUMMARY

1. Fifty species of algae new to Vice County No. 111 Orkney are recorded from Stronsay. These are mostly small epiphytes and parasites.
2. A further eight from North Ronaldshay and two from the Mainland of Orkney, also new to V.C. 111, are mentioned.
3. *Colpomenia sinuosa* has now extended its range to Stronsay where it was found in 1940.
4. A few of the chief associations in relation to the nature of the coast are discussed. The presence of a flora 80 feet above sea level on an exposed headland, comparable in lesser degree to a similar development in the Faeröes, was noted.
5. The flora is compared with the rest of Orkney and other areas.

In conclusion thanks must be expressed for help given, to Dr Blackler, University of St Andrews, and Miss Dickenson, Kew, and also to Professor Chapman, University College, Auckland, who determined the Enteromorpha species.

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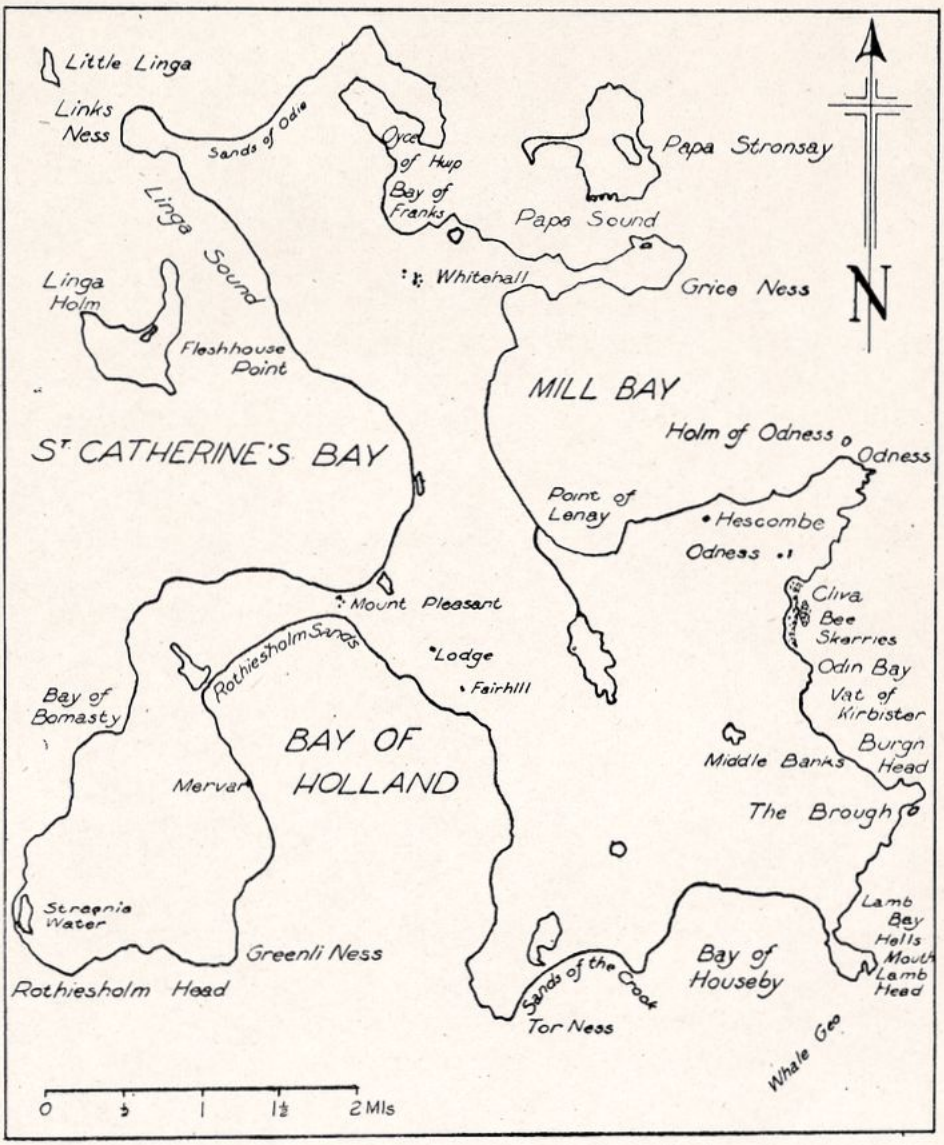

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