THE MARINE ALGÆ OF GUERNSEY.

By Lilian Lyle, F.L.S.

I. Introduction.

The little island of Guernsey is well known for its rich harvests of seaweed, which at stated times of the year are gathered for fuel, manure, etc. Such fertility among the coarser kinds extends to those of more delicate structure, for, though naturally not so profuse, there is a wide range of species of considerable interest to the marine botanist.

Having spent several months of the years 1911, 1912, and 1914 in collecting round these coasts, my efforts were rewarded by the discovery of various species, new either to Guernsey, to the Channel Islands, or to Britain. It is therefore hoped that a revised list of all the known species of Guernsey Marine Algæ will prove of interest to students. The gatherings were made between March and November of the respective years, along the shore, among the rocks at low tide, or from a boat by means of a dredge—some specimens were found floating.

The results of an attempt to study the growth and distribution of the seaweeds of Guernsey from an ecological point of view are also given. They are very inadequate and far from complete. In 1914, I had intended making measurements and careful observations throughout the year, but after four months' work my plans had to be changed, owing to the outbreak of the War.

My thanks are due to Dr. Rendle, at whose suggestion this account was undertaken, and to Miss Lorrain Smith and Mr. Gepp, all of the Department of Botany, British Museum (Nat. Hist.), for their valuable advice and suggestions; to Mr. E. M. Holmes, for help in naming Algæ; to Mr. Paulson, for naming lichens; to Mr. and Mrs. Lemesurier, of Guernsey, for their interest and assistance in the matter of dredging; and to Captain Cameron, N.Z.S.C., for information regarding winds and tides affecting the Channel Islands. I was also indebted to the late Mr. Best, of Guernsey, for hints on the economics of Algæ.

Previous Lists.

The rich and varied marine vegetation of the Channel Islands has attracted the attention of many botanists. Of these the late Mr. Marquand is well known; his *Flora of Guernsey* (1901) includes 236 species of seaweeds found mostly by himself, together with lists of such earlier collectors as Greville and Le Lièvre. In 1908 he published still further additions to the Marine Algæ of Guernsey, making a total of 257 species for the island. A new edition of Holmes and Batters's *Marine British Algæ* appeared in 1902, in which Mr. Marquand's lists up to date were included. Dr. Van Heurck collected in the Channel Islands, more especially in Jersey, which he worked most thoroughly. His *Prodrome de la Flore des Algues Marines des Iles Anglo-Normands* (1908) contains Mr. Marquand's list for Guernsey, as also does Chalon's *Liste des Algues Marines* (1905).

In view of these exhaustive gatherings, it seemed almost hopeless

that further search would yield any additional species. When it is remembered, however, that "some species are very uncertain in their appearance, occurring in abundance, perhaps, during one season and then disappearing for years," and when it is also borne in mind that currents and other agents frequently bring new species or their spores from long distances to establish themselves and even spread along our coasts—as, for example, *Colpomenia sinuosa*, *Bonnemaisonia asparagoides* v. *hamifera*, etc.,—one need never despair of making new discoveries. This was, indeed, my fortune, for I was able to find 46 species, 22 varieties, and 4 forms new to the Channel Islands; 46 species, 6 varieties, new to Guernsey; 3 species and 2 forms new to Britain; 1 species and 1 form new to science.

The total number of algæ for Guernsey, including those already listed by other workers is now 350 species, 78 varieties and forms.

Mr. Marquand throws some doubt on the existence of certain algæ mentioned in the lists of Miss Le Lièvre and Dr. Greville, or on their correct determination, as, after years of diligent search, he failed to find them. These are:—

Cystoseira barbata, *Fucus ceranoides*, *Sporochnus pedunculatus*, *Cutleria multifida*, *Sphacelaria Sertularia*, *Ectocarpus Mertensii*, *Daysa venusta*, *Nitophyllum Gmelini*, *Kallymenia Dubyi*, *Ceramium flabelligerum*, *Callithamnion arbuscula*, *Callithamnion roseum*, and *Cladophora repens*: also *Desmarestia viridis*, *Dictyosiphon fœniculaceus*, and *Rytiphlœa pinastroides* of Greville's list.

Cystoseira barbata is excluded from the British Flora by Batters as a waif. *Fucus ceranoides* is usually found in the estuaries of rivers. The absence of any large body of fresh water in Guernsey would tend to preclude the idea of its existence on these shores. *Cutleria multifida*, *Desmarestia viridis*, *Sporochnus pedunculatus*, *Tilopteris Mertensii* are all mentioned in Batters's *Marine Algæ* as growing in Guernsey, but they have not been found recently. *Callithamnion arbuscula* is an inhabitant of northern regions, and is replaced by *C. spongiosum* in the south: with the exception of localities where northern and southern floristic elements mingle—as, for instance, on the west coast of Ireland,—the two species never grow together. It is therefore hardly likely that *C. arbuscula* was collected in Guernsey, although *C. spongiosum* grows abundantly. *Nitophyllum Gmelini* and *Cladophora repens* are indicated by Marquand in his lists for Alderney, but they have not been found in Guernsey.

As regards the other missing species, Mr. Marquand suggests that they may have disappeared for a time to reappear later on. The fact that I was able to find five of them—*Schizymenia Dubyi*, *Ceramium flabelligerum*, and *Polysiphonia elongata* in 1911; *Halopithys pinastroides* in 1911, 1912, 1914; *Dictyosiphon fœniculaceus* in 1912; and *Sphacelaria Sertularia* in 1914—is in favour of his view. In no two years does it seem possible to find all the same Algæ.

I was able to find three of Mr. Marquand's four additions to the British Flora, viz:—*Streblonema Zanardinii*, *Liebmannia Leveillei*, and *Lithothamnion expansum*: but, though I searched diligently in

the locality given and elsewhere, I was unable to find the fourth—*Polysiphonia opaca*.

II. Systematic List.

The following list includes all the species hitherto recorded, as well as those of my own gathering. To facilitate quoting localities, the island is divided into six districts, each locality being numbered as shown in the table below. The figures and initials in the square brackets refer to Mr. Marquand's lists:—

EAST.

1. Paradis Hommet.
2. Bordeaux.
3. Vale Coast.
4. Spur Point.
5. Pike's Corner.
6. Belgrave Bay.
7. North Beach.
8. Castle Cornet.
9. Bathing-place.
10. Fermain Bay.
11. Bec-du-Nez.
12. St. Martin's Point.

SOUTH.

1. Jerbourg Point.
2. Petit Port.
3. Moulin Huet.
4. Saint's Bay.
5. Petit Bot.
6. Les Tielles.

NORTH-WEST.

1. L'Erée Bay.
2. Vazon.
3. Albecq.
4. Cobo.
5. Grandes Rocques.
6. Port Soif.
7. Port Grat.

WEST.

1. Pezèrie.
2. Les Portes.
3. La Varde.
4. Portelet.
5. Rocquaine Bay.
6. L'Erée.
7. Lihou Causeway.
8. Lihou Is.

NORTH.

1. Grande Havre.
2. L'Ancresse.

SOUTH-WEST.

Pleinmont.

The classification and nomenclature coincide, so far as possible, with Holmes and Batters' *Catalogue* of 1902. Here and there, as indicated in the notes, the work of more recent algologists has necessitated certain changes—*e. g.*, the older generic name *Chantransia* has replaced *Achrochætium*. With regard to the calcareous algæ, I have followed Dr. Lemoine's classification as given in Mr. A. D. Cotton's Clare Island Survey (Proc. R. Irish Acad. xxxi. part 15: 1912).

The following abbreviations have been adopted throughout:—

E.=East. S.=South. S.W.=South-West. W.=West. N.W.=North-West. N.=North. M.=Marquand. H. & B.=Holmes and Batters. C.I.=Channel Islands (new to). G.=Guernsey (new to). B.=Britain (new to). c.=common. f.c.=fairly common. a.=abundant. l.a.=locally abundant. r.=rare. v.r.=very rare.

MYXOPHYCEÆ.

Coccogoneæ.

C.I. APHANOCAPSA MARINA Hansg. N.W. 1. W. 4, 8. f.c.

C.I. ANACYSTIS PARASITICA Kütz. (*Polycystis pallida* H. & B. Rev. List). On *Calothrix* sp. and *Cladophora* sp. W. 8.

G. DERMOCARPA LEIBLEINIÆ Born. On *Calothrix crustacea*. r.

G. D. PRASINA Born. On various algæ. c.

G. Pleurocapsa fuliginosa Hauck. N.W. 7.
P. amethystea Rosenv. [On *Clad. rupestris.* S. 2.] N.W. 7.
Hyella cæspitosa Born. & Flah. Indicated by Batters.

Hormogoneæ.

G. Spirulina subsalsa Œrsted. (*S. tenuissima* Kütz.). S.W. On *Corallina officinalis.*
C.I. S. subsalsa var. oceanica Gom. (*S. oceanica* Crn.). r. Among *Oscillatoria margaritifera.* S.W.
C.I. Oscillatoria margaritifera Kütz. (*O. insignis* Thw.). f.c. N.W. 7. S.W.
O. nigroviridis Thw. S. 5. On wet rock.
O. corallinæ Gom. (*O. littoralis* Carm.). c. [E. 2.] S.W. on *Corallina officinalis.*
C.I. O. amphibia Ag. (*O. infectoria* Tassi). W. 5.
C.I. O. lætevirens Crn. S. 2.
O. limosa Kütz. c. Muddy rocks. S.W. W. 5.
C.I. Phormidium tenue Gom. Among *O. margaritifera.* S.W.
C.I. P. corium Gom. S. 5. On wet rock.
G. Lyngbya æstuarii Liebm. Muddy sand.
L. majuscula Harv. [N.W. 4.] W. 1. c. In rock-pools on other algæ.
G. L. semiplena J. Ag. N. On rocks.
Symploca hydnoides Kütz. (*Calothrix semiplena* Harv.). [E. 10. N.W. 4, 5. On Corallines], and on clay mud. W. 1, 5.
C.I. Microcoleus tenerrimus Gom. On stones mixed with *Isactis plana.*
Calothrix confervicola Ag. [c.] N.W. 4. On other algæ.
C. scopulorum Ag. [W. 8. N.W. 4. E. 11.] W. 5. S.W.
C. pulvinata Ag. (*C. hydnoides* Harv., *C. pannosa* Harv., and *C. cæspitula* Harv.). [S. 2. N.W. 4. E. 12, 10.] On muddy sand and on algæ.
G. C. parasitica Thur. On *Nemalion lubricum.*
C.I. C. æruginea Thur. On other algæ. W. 4, 7.
C. crustacea Thur. c. N.W. 4, 6, 7. W. 1, 2. S.W. On rocks.
Isactis plana Thur. (*R. plana* Harv.). [N.W. 2.] S.W. Common On stones.
Rivularia Biasolettiana Menegh. (*Schizosiphon Warreniæ* Casp.). [E. 10. S. 2.] Common on stones and on *Corallina* sp.
B. atra Roth. c. W. 2. S.W. On rocks, limpet-shells, etc.
B. nitida Ag. (*R. plicata* Carm.). [S. 2.] N.W. 6. W. 5. S.W. On earth.
B. bullata Berk. (*R. nitida* Desmaz.). c. N. 2. On rocks, *Lichina pygmæa*, etc.
Mastigocoleus testarum Lagerh. Indicated by Batters.
C.I. Nostoc entophytum Born. & Flah. (*N. tenuissimum* Born.). Among *Calothrix crustacea.*

c.i. N. Linckia Born. & Flah. (*Monormia intricata* Berk.). Among *O. margaritifera.*

Anabæna torulosa Lagerh. (*Sphærozyga Carmichælii* Harv.). [N.W. 4.] On *Cladophora*, etc.

CHLOROSPERMEÆ.

Protococcineæ.

c.i. Codiolum Petrocelidis Kuck. In *Petrocelis cruenta.*

Confervoideæ.

c.i. Gayella polyrhiza Rosenv. (*Schizogonium disciferum* H. & B.). Pulias pool.

g. Pringsheimia scutata Rke. On *Chætomorpha* sp. Pulias pool.

g. Enteromorpha clathrata J. Ag. [Pulias pool.] N.W. 3, 4, 7. E. 2. On *Rho. palmata*, etc.—var. *gracilis* (Le Jol.). [M.] Indicated by Batters.

The Guernsey specimens of *Enteromorpha* have been named on broad lines and in a general sense.

It is interesting to observe how the germinating sporelings of *E. clathrata* grow into flat expansions one cell in thickness, over the surface of stones, before sending up erect filaments. The latter begin as little pimple-like elevations which appear here and there over the procumbent portions. A circle of cells elongates and arches over at the top; they increase in size and divide, until a tube of indefinite length is formed—its base, as is characteristic of this genus, being additionally strengthened by the downward prolongations of the cells composing the lower part of the tube. This tendency to become procumbent in the initial stages, is common to various algæ; it has been referred to by Yendo (Proc. R. Dublin Soc. ii. 105) and in my notes on "Developmental Forms of Marine Algæ" (*New Phytologist*, xvii. 231).

E. torta Reinb. (*percursa* Harv.). [Pulias pool.]

g. E. prolifera J. Ag. (=*E. compressa* var. *prolifera* Grev.). Pulias pool.

E. ramulosa Hook. var. *robusta* Hauck. [E. 2.] Var. *tenuis* Hauck. N.W. 7. W. 7.

E. compressa Grev. c. On *Fucus serratus* and on stones.

E. intestinalis Link. c.

E. Linza J. Ag. c.

Ulva lactuca var. latissima DC. (*U. latissima* J. Ag.) v.c.

c.i. Phæophila dendroides Batt. (*Ochlochæte dendroides* Crn. and *Phæophila floridearum* Hauck.) On *Stilophora rhizoides* and *Cer. echinotum.*

g. Bolbocoleon piliferum Pringsh. On *Cer. echinotum.*

g. Endoderma viride Lagerh. In *Poly. macrocarpa* and *Callithamnion* spp.

Chætomorpha tortuosa Kütz. (*Conferva tortuosa* Dillw. and *Chætomorpha implexa* H. & B.). [S. 2. E. 11.] N. 2. W. 4, 7. On *Chorda filum*.

C. linum Kütz. (*Conferva sutoria* Berk.). Pulias pool.

C. crassa Kütz. (*Conferva linum* Harv. non alior.) [E. 11.] N.W. 4.

C. area Kütz. [Batt.]

Rhizoclonium Kochianum Kütz. (incl. *R. implexum* Kütz.). Pulias pool.

G. R. riparium Harv. E. 7.

R. implexum Batt. non Kütz. (*R. tortuosum* Kütz.). [S. 3, 5.] N. 2. N.W. 4.

C.I. Cladophora prolifera Kütz. E. 2. v.r.

C. pellucida Kütz. [N.W. 2, 4. S. 2.] W. 1. E. 6.

C. Hutchinsiæ Harv. S. 3. E. 7.—var. *divaricata* Harv. E. 6. r.—var. *distans* Kütz. (*C. diffusa* Harv.). E. 7. N. 2.

C. rectangularis Harv. E. 7. Thrown up.—(C.I.) var. *horrida* Kütz. (*Conferva Crouani* Chauv.). E. 7. v. 2.

According to Batters, *C. rectangularis* is very rare on the south coast of England; Mrs. Lane Clarke mentions having found it in Guernsey among *Zostera* beds. In 1911 and 1912, a few small pieces were thrown up, but in 1914 it occurred in greater abundance; in each case the specimens were taken from the *Zostera* beds north of the White Rock.

C. rupestris Kütz. c.

G. C. hirta Kütz. E. 3. One small specimen.

C. utriculosa Kütz. (*C. lætevirens* Harv. partim). E. 2, 6. W. 1.—var. *diffusa* Hauck. E. 6. On rocks at low tide.

C.I. C. gracilis Kütz. E. 2.

G. C. sericea Kütz. E. 7.

G. C. glaucescens Harv. E. 2.

C. flexuosa Harv. [E. 10. W. 5.] E. 2, 6. N. 2. N.W. 7.

C. albida Kütz. [E. 11.] E. 2, 10. W. 5.—var. *refracta* Thur. (*Conferva refracta* Wyatt, Alg. Danm. no. 228, *Clad. refracta* Harv. partim; *C. curvula* Kütz.). c. E. 2, 6.

C. fracta Kütz. [Pulias pool.]—var. *flavescens* Batt. (*C. flavescens* Harv. non Kütz.). [Pulias pool.]

C. repens Kütz. Indicated by Batters.

C.I. C. corynarthra Kütz. (var. *spinescens* Batt.). E. 7. Thrown up entangled among *Cl. rectangularis* and *Coral. rubens*.

C. arcta Kütz. [E. 11. N.W. 4.] S. 3.—(C.I.) var. *vaucheriæformis* Harv. S.W. 2.

G. C. lanosa Kütz. S.W.

G. Gomontia polyrhiza Born. & Flah. In shells. N.W. 7.

Siphoneæ Grev.

G. Ostreobium Quekettii Born. & Flah. In *Lith. polymorphum*.

Bryopsis hypnoides Lamour. [Round the coast.] W. 5. N. 1.

B. PLUMOSA Ag. [S. 3. E. 2, 4.] E. 2.—(C.I.) f. *nuda* Holmes. S. 3.

Bryopsis plumosa flourishes from spring to late autumn, even lasting till December. Mr. Holmes's specimen of the f. *nuda* was gathered in September. The rank of variety which is given to it in H. & B. is doubtless an oversight.

The plant is an annual, and the form *nuda* is very probably only an old stage in which most of the pinnæ have disappeared previous to the dying away of the plant itself. Three small pieces were gathered in Guernsey about August, which had every appearance of being the remnants of mature plants.

Mrs. Gatty has observed that *B. plumosa*, when kept in aquaria, degenerates into a denuded form which is probably identical with *Derbesia Lamourouxii* Solier (*B. Balbisiana* var. *Lamourouxii* J. Ag.), figured in Kutzing, vi. t. 74.

CODIUM ADHÆRENS Ag. [S. 4.] N. 2. r.

C. TOMENTOSUM Stackh. v.c.

C. BURSA Ag. [S. 2, 3. Dec. '05.]

FUCOIDEÆ.

PHŒOSPOREÆ.

DESMARESTIA VIRIDIS Lam. H. & B. '02.

D. ACULEATA Lam. c. Thrown up from deep water, and on bulbs of *Sacchoriza*. N.W. 2. N. 2.

D. LIGULATA Lam. c. Low tide, quantities thrown up. [N.W. 4. S. 5.] S. 3.

DICTYOSIPHON FŒNICULACEUS Grev. H. & B. N. 1. Rock-pools.

LITOSIPHON PUSILLUS Harv. c. [E. 2, 10, 6.] W. 4, 7. On *Asperococcus fistulosus* and *Chorda filum*.

G. PHLŒOSPORA BRACHIATA Born. (*Ectocarpus brachiatus* Harv., *Stictyosiphon Griffithsianus* H. & B.). r. On *Rhodymenia palmata*. N. 1, 2.

PUNCTARIA PLANTAGINEA Grev. [N.W. 4.]

P. LATIFOLIA Grev. [S. 5.]

C.I. PHYCOLAPATHUM CRISPATA Batt. One specimen thrown up. N. 1.

PHYLLITIS FASCIA Kütz. (*Laminaria* Harv., *P. cæspitosa* Le Jol.). [N. 1, 2.]

SCYTOSIPHON LOMENTARIUS J. Ag. (*Chorda lomentaria* Lyngb.). [r.] E. 6. On stones.

C.I. COLPOMENIA SINUOSA Derb. & Sol. Twice found thrown up. E. 6. N.W. 4.

This plant is a native of the Indian Ocean. Good specimens were found on rocks at low tide at St. Peter's Port and Cobo. The distribution of the species and its appearance and growth along the southern shores of England have been fully dealt with by Cotton in Kew Bull. 1908, 11.

ASPEROCOCCUS FISTULOSUS Hooker (*A. echinatus* Grev.). c. [E. 6.] W. 4. On stones.

A. BULLOSUS Lam. (*A. Turneri* Hook.). [W. 4.] N. 2. E. 10. On stones.

STREBLONEMA FASCICULATUM Thur. r. In thallus of *Castagnea virescens*. [E. 10.] N.W. 7.—(G.) var. *simplex* Batt. In thallus of *Stilophora rhizoides* and *Nemalion lubricum*. E. 2, 3. W. 7.

S. ZANARDINII (*Ect. Zanardinii* Crn.). In thallus of *Chy. kaliformis*. [E. 6, 10.] E. 9.

ECTOCARPUS VALIANTEI Born. In thallus of *Cystoseira ericoides*. Mrs. Humber. N.W. 4. 1900.

E. VELUTINUS Kütz. (*Elachista velutina* Phy. Br.). [N.W. 4.] S. 6. On *Himanthalia lorea*.

C.I. E. GLOBIFER Kütz. (*Ect. insignis* Crn.). On *Castagnea virescens*. E. 8, 10.

E. MITCHELLÆ Harv. (*Ect. virescens* Thur.). ["In several places between E. 10 and S. 1."] On *Zostera*.

G. E. CROUANII Thur. (*Ect. fenestratus* Berk.). r. N.W. 3. On *Poly. affinis*.

E. CONFERVOIDES Le Jol. c. W. 3. On other algæ.—var. *arctus* Kjellm. (*Ect. arctus* Kütz. et *Ect. pseudosiliculosus* Crn.). c. and on *Sacch. polyschides*.

E. SILICULOSUS Kütz. c. E. 2, 10, and on *Lam. Cloustoni* and other algæ.

E. FASCICULATUS Harv. [N.W. 4. E. 2, 10. S. 5.] W. 5. On *Lam. Cloustoni* and *Sacchoriza polyschides*.

E. TOMENTOSUS Lyngb. E. 10.

G. E. HINKSIÆ Harv. On *Sacch. polyschides*. r. W. 1, 2.

E. GRANULOSUS Ag. [S. 2.] S. 3. On *Rho. palmata*.—(C.I.) var. *refracta* Batt. On *Zostera*. Dredged off E. 11. r.

E. SECUNDUS Kütz. [N.W. 4.] W. 1. r.

PYLAIELLA LITTORALIS Kjellm. a. and on *Asco. nodosum*.—(C.I.) var. *varia* Kuck. (*P. varia* Kjellm.). r. On *Asco. nodosum* and *F. vesiculosus*. E. 6.

The var. *varia* is an intruder from the north; its habitats are Invergordon, Isles of Cumbræ and Bute, Saltcoats, and Cromarty Firth. I found several well-grown specimens parasitic on *Fucus vesiculosus* and *Ascophyllum nodosum*. According to Batters, "this rare Alga forms loose entangled mats of a dark olive-brown colour, lying free on the bottom or hanging on other algæ. The fronds are decompoundly branched, the branches spreading at a wide angle; the lower branches are clad short and patent. The short branches, consisting of 2–10 cells, are frequently terminated by a solitary sporangium. The unilocular sporangia are terminal, frequently solitary, but chains of 2–10 are sometimes found side by side with the solitary ones."

MYRIOTRICHIA FILIFORMIS Harv. c. S. 3, 5, 7. On *Castagnea virescens* and *Asperococcus fistulosus*.

M. CLAVÆFORMIS Harv. On *Asperococcus fistulosus* and *Castagnea virescens*. E. 2, 8.

MYRIACTIS PULVINATA Kütz. (*Elachista attenuata* Harv.). c. On *Cystoseira ericoides*. [E. 2, 10. W. 7.] N. 1. W. 5.

M. STELLULATA Batt. (*Elachista stellulata* Griff.). On *Dictyota*. [E. 10.] E. 11.

ELACHISTA FUCICOLA Fries. On small algæ and *Fuci*. N.W. 4. N. 2.

E. FLACCIDA Aresch. On *Cy. granulosa* and *Cy. fibrosa*. [N.W. 5. S. 2.]

E. SCUTULATA Duby. [E. 10, 2. N.W. 5.] S. 6. On *Himanthalia*.

SPHACELARIA RADICANS Harv. [N.W. 2.]

S. OLIVACEA Pringsh. H. & B. '02.

S. CIRRHOSA Ag.—var. *pennata* Hauck. c. On *Corallina officinalis*, etc.—(G.) var. *fusca* H. & B. (*S. fusca* Harv.). E. 2, 7, 11. a. On vertical rocks.—(C.I.) var. *patentissima* Grev. r. Entangled among *Enteromorpha clathrata* and on shell of spider-crab. W. 1, 4. N.W. 7.

I have followed Batters in placing the var. *patentissima* under *cirrhosa*. Sauvageau, however, questions this, and points out that since neither propagulas nor spores have been seen on the plant it might equally be allied to *S. plumula*. Specimens have also been found to possess transverse divisions in the secondary articulations—a fact which would connect those plants with *S. plumigera*. He therefore concludes that the var. *patentissima*, usually attributed to *cirrhosa*, is a form which several species take when certain unknown conditions have produced parallel modifications, such as that of sterility. My own specimens have so much the appearance of *S. plumula* that it is difficult to distinguish between them; the resemblance is much closer than to *Sphacelaria cirrhosa*.

C.I. S. PLUMULA Zan. (*S. pseudo-plumosa* Holm. Fac. no. 24). Dredged, entangled among small algæ and on *F. serratus*. E. 8, 11. W. 4.

The characters which separate this from *S. plumigera* and *Chætopteris* are the absence of transverse septa in the secondary articulations of the branches, and the scarcity of rhizoidal filaments; those that occur lie close to the axis of the plant, but do not form a cortex. It is an inhabitant of the temperate zone in Europe, extending from the Mediterranean as far north as the southern shores of England.

CLADOSTEPHUS SPONGIOSUS Ag. c. E. 2. W. 4. On stones in sand.

C. VERTICILLATUS Ag. c. E. 2. S. 6. W. 4. On stones in sand.

HALOPTERIS FILICINA Kütz. (*Sph. filicina* Ag.). At low tide all round the island, but scantily distributed. [S. 2, 3, 5. N.W. 2. N. 2.] E. 11. W. 1.—var. *Sertularia* (Bonnem.) (*H. filicina* Kütz., *B. patens* Harv.). v.r. Entangled among *Ent. clathrata*. W. 5. N.W. 7.

STYPOCAULON SCOPARIUM Kütz. (*Sphacelaria scoparia* Ag.). c. Among *Zostera*.—(C.I.) var. *scoparioides* H. & B. (*Sph. scoparioides* Ag.). r. Entangled among *Ent. clathrata*. N.W. 7.

Myrionema strangulans Grev. c.—var. *punctiforme* H. & B. (*M. punctiforme* Harv. and *M. intermedium* Fosl.). On *Cer. rubrum*. [E. 6. W. 4.]

M. reptans Fosl. (*Ascocylus reptans* Reinke; *Chilionema reptans* Sauv.; *Hecatonema reptans* Sauv.). r. On *Saccorh. polyschides*, *Rhodochorton* sp.

G. *Hecatonema maculans* Sauv. On *Corallina officinalis*. r. N.W. 5.

C.I. *H. speciosum* Cotton. v.r. W. 5. On stipes of *Saccorhiza* and on *Desmarestia aculeata*.

The specimen was kindly determined by Mr. Cotton as identifical with the species collected by him at Clare Island.

Chilionema Nathaliæ Sauv. (*Myrionema Lechlancherii* Harv. pro parte). c.

Ascocylus orbicularis Magn. H. & B. "on *Zostera*."

Ralfsia clavata Farlow. c. On limpets. [E. 2, 10. N.W. 2.]

R. verrucosa Aresch. [S. 3, 5. "With pleurilocular sporangia." N.W. 4, 5.] E. 11. S.W. Limpet-shells and small stones.

C.I. Spermatochnus paradoxus Kütz. (*Stilophora Lyngbyei* J. Ag.). r. N. 1. Floating and on *Cystoseira fibrosa*.

Stilophora rhizoides J. Ag. [N.W. 4, 5.] E. 10, 2. On *Cystoseira cricoides*.

Chordaria flagelliformis Ag. [N.W. 4. W. 7.] N. 1. W. 4.

Mesogloia vermiculata Le Jol. c. [S. 5. N.W. 4. E. 10, 2.] N. 1. On stones and other algæ.

M. Leveillei Menegh. (*Liebmannia Leveillei* J. Ag.). [E. 2.] N. 1. On stones.

C.I. M. lanosa Crn. One specimen. W. 7.

Castagnea virescens Thur. (*Mesogloia virescens* Carm.). c. [E. 3, 10. N.W. 4. W. 4.] S.W. E. 6. W. 5. N. 1.

C. Zosteræ Thur. (*M. virescens*, var. *zostericola* Harv.). N.W. 3. r.

C.I. C. contorta Thur. W. 1. r.

Petrospongium Berkeleyi Näg. (*Leathsia Berkeleyei* Harv.). c. N. 2. S. 2.

Leathsia difformis Aresch. (*Leathsia tuberiformis* S. F. Gray). a.

Sporochnus pedunculatus Ag. In H. & B. '02.

Chorda filum Stackh. c. Among *Zostera*.

Laminaria saccharina Lamour. c. On rocks.

L. digitata Lamour. c. On rocks.—(C.I.) var. *linearis* J. Ag. Pool form, half-tide. E. 6.

C.I. L. Cloustoni Edm. (*L. hypoborea* Fosl.). a.

This is a well-established inhabitant of the shores of the Channel Islands on the north and west coasts. As indicated by Cotton, the species "grows in about 15 fathoms of water, the stout and rigid stems being specially suited to the strong pull of the rollers in deep water."

The plants can be seen at extremely low spring tides, when

the rough erect stipes forms a conspicuous feature of the sublittoral.

A few stunted specimens were found in pools at low tide.

Sacchoriza polyschides Batt. (*S. bulbosa* De la Pyl.).

Alaria esculenta Grev. H. & B.

Zanardinia collaris Crn. (*Zonaria collaris* Ag.). [N.W. 2.] v.r.

Cutleria multifida Grev. [Lelièvre].

Aglaozonia reptans Crn. (*Zonaria parvula* Grev.). [N.W. 2.] W. 4. On *Lith. polymorphum.*

Fucineæ.

c.i. Fucus spiralis L. (*F. Areschougii* Kjellm.). c.—var. *platycarpus* Batt. (*F. platycarpus* Thur.). c.

A definite zone of these algæ grows round the whole of Guernsey, interrupted only here and there by a sea-wall or by the absence of rocks at a suitable level. It is incomprehensible how *F. spiralis* can have been overlooked, as it occurs all along the coast, broadening occasionally into var. *platycarpus* according to the degree of shelter experienced.

F. vesiculosus L. c.—(c.i.) var. *evesiculosus* Auct. a. S.W. W. 1. On exposed rocks.

This is another plant which has escaped notice on the island. It is a distinctive feature in the flora of exposed regions, where it takes the place of *F. vesiculosus* and *Ascophyllum nodosum* of other localities. The plants are short and stout, about 4 inches in length, with thick leathery stems, firm and devoid of air-vesicles, as the name indicates; the colour is very dark, almost black.

F. serratus L. c. On low rocks.

Ascophyllum nodosum Le Jol. a. W. 1, 7. N.W. E. 6.

Pelvetia canaliculata Dene. & Thur. (*F. canaliculatus* L.). a.

Bifurcaria tuberculata Stack. f. (*Pycnophycus tuberculatus* Kütz.).

Himanthalia lorea Lyngb. l.a.

Halidrys siliquosa Lyngb. l.a.

Cystoseira ericoides Ag. l.a. N.W. 4. S.W. On stones and in pools.

C. granulata Ag. [N.W. 4. N. 2.] E. 2. On stones and in pools.

C. fibrosa Ag. N.W. 4. On stones and in pools.

C. discors Ag. (*C. fœniculacea* Grev.). [E. 2, 10. W. 7, 5.] N.W. 4.

Tilopterideæ.

Tilopteris Mertensii Kütz. (*Ect. Mertensii* Harv.). H. & B. '02.

Achinetospora pusilla Born. (*Ect. pusillus* Harv.). [S. 2.] S. 5.—(c.i.) var. *crinita* Batt. (*Ect. crinitus* Carm.). On *U. latissima.* E. 6.

Dictyoteæ.

Dictyota dichotoma Lamour. c. W. 7.—var. *implexa* J. Ag. (var. *intricata* Ag.). [E. 2. S. 2, 3.] W. 1.

Padina Pavonia Gaillon. [W. 4. N.W. 3, 4.] N. 2. N.W. 2.

Dictyopteris membranacea Batt. (*Haliseris polypodioides* Ag.). [E. 10. N. 1.] S.W. and E. 11. Dredged and in deep rock-pools.

FLORIDEÆ.

Porphyreæ.

c.i. Goniotrichum elegans Le Jol. (*Bangia elegans* Chauv.) E. 6. v.r.

Erythrotrichia carnea J. Ag. (*Bangia ceramicola* Chauv.). E. 11. on *Cer. ciliatum*.] On *Rho. Rothii*.

g. E. reflexa Thur. (*Bangia reflexa* Crn.). W. 1. v.r.

E. Welwitschii Batt. v.r. H. & B.

Bangia fuscopurpurea Lyngb. Batters. r.

g. Porphyra leucosticta Thur. N. 2. E. 6. N.W. 3.

P. linearis Grev. (*P. vulgaris* Harv.). E. 6.

P. umbilicalis Kütz.—var. *laciniata* J. Ag. c.—var. *umbilicalis* J. Ag. c.

The markedly scanty distribution of this species along the exposed and moderately exposed coasts of Guernsey during the summer and autumn months may be accounted for by the fact that *Porphyra* is said to be a winter and spring plant in the South of England. On the other hand, luxuriant growths in very sheltered conditions persisted through the summer and still flourished in November. There were also quite appreciable quantities in even moderately sheltered districts.

P. umbilicalis hangs down from the rocks and boulders, giving place to *P. laciniata* where there is shelter, on low rocks often half buried in the sand. Intermediate stages between the two forms show the relationship distinctly. Along the thallus little holes or slits appear, which by their extension lengthwise, cause the splitting up into the laciniate form. These transitions would seem to indicate that var. *laciniata* is developed from *P. umbilicalis*, possibly as a result of mechanical agencies, such as sand-friction and wave-action.

Euflorideæ.

Chantransia Schm. (*Achrochætium* Näg.).

These generic names were used by Bornet to designate the sexual and asexual conditions. As further research has shown the presence of sexual organs in an increasing number of species, Rosenvinge has united them all under *Chantransia*.

g. Chantransia virgatula Thur. E. 2.—var. *luxurians* Näg. [E. 12.]. E. 6. On a limpet-shell.—(g.) var. *secundata* Rosenv. E. 7. On other algæ.

c.i. C. corymbifera Thur. (*Achrochætium corymbiferum* Batt.). E. 11. N.W. 3. On *Cer. rubrum* and other algæ.

C. Daviesii Thur. [S. 4, 5. E. 10, 11. W. 7.] S. 4, 6. W. 1. N. 2. E. 11. On other algæ.

C. Lorrain-Smithiæ Lyle, sp. n. On stipes of *Saccorhiza polyschides*. W. 2. (Fig. 1.)

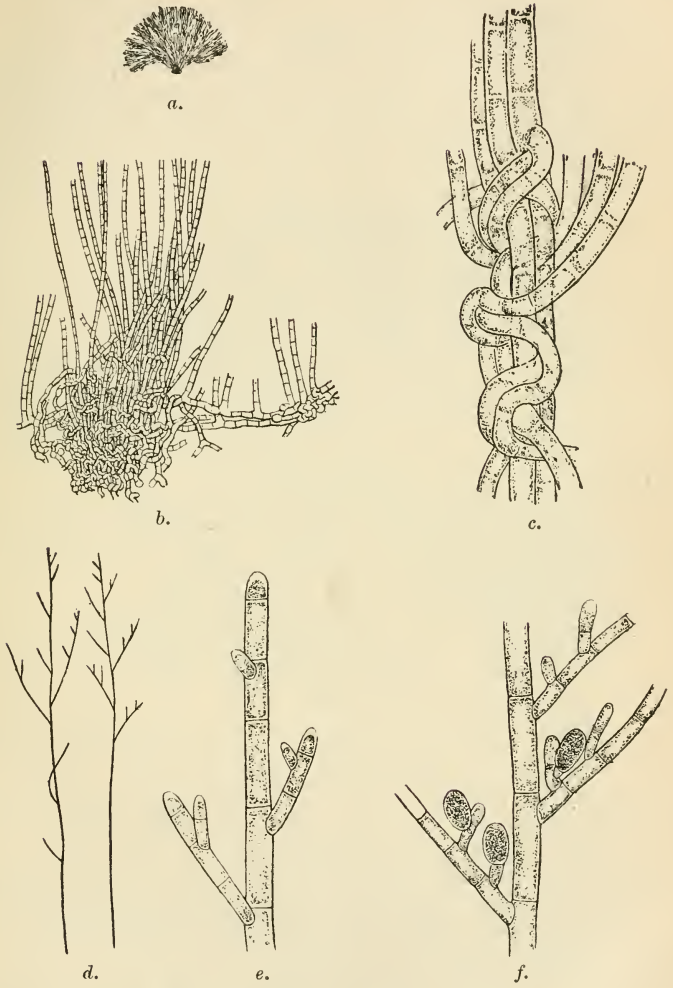

Fig 1.—*Chantransia Lorrain-Smithiæ.*

a. Tuft of plants, natural size.
b. Base of plants, showing rhizoidal filaments. × 80.
c. The same. × about 200.
d. Terminal branchlets. × 25.
e. The same. × about 200.
f. Monosporangia. × about 200.

Frondibus erectis, e strato pseudo-parenchymatico, decumbenti ascendentibus, copiosis, roseo-carnis vel pallide viri-

scentibus, 4–9 mm. long. Filiis sparse et vage ramosis, e articulis 45–60 μ long., 15–20 μ lat. compositis; ramis obtusis fastigiatis versus ad apices eorum ramos breves secundarios gerentibus; ramis secundariis 2–3 ramulos adaxiales pleurumque monosporangiferos 2–3 cell. longos emittentibus; monosporangies adaxialiter obvenientibus, ovatis, pedicellatis aut sessilibus, 30–35 $\mu \times$ 15–20 μ.

A luxuriant growth of this species was found on the stipes of *Sacchoriza polyschides* in October and November of 1912 and 1914, in an exposed region. The plant is assigned to the genus *Chantransia* on account of the monosporous reproduction and the basal disc of fusing rhizoidal filaments; it closely approaches *Daviesii*, but differs in the lax disposition of the sporangiferous branchlets which are situated towards the summits of the main branches, whereas in *C. Daviesii* the sporangiferous branches are longer, more numerous and crowded in or near the axils of the secondary branchlets on any part of the filament. The species is much more robust than *C. Daviesii* and possesses quite remarkably thick cell-walls. The absence of the terminal hairs is unimportant; Rosevinge points out that they are not of constant occurrence; some species never bear them and some only in their early stages.

G. Nemalion elminthoides Batt. N. 2. N.W. 2. E. 3. On exposed rocks.

This is found at L'Ancresse on bare rocks dashed over by the waves at low tide. Yendo refers to this genus as one flourishing best where aeration of the water is perfect, *i.e.* when surrounded by white foam.

Helminthocladia purpurea J. Ag. (*Nemalion purpureum* Chauv.). [S. 3, 5], and floating.

Helminthora divaricata J. Ag. (*Dudresnaya divaricata* Harv.). [S. 4, 5. E. 4.] N.W. 2, 3. N. 1. On other algæ.

Scinaia furcellata Bivona. (*Ginnania furcellata* Mont.). [N. 2. S. 2.].—(c.i.) f. *subcostata* J. Ag. Dredged off E. 11.

Choreocolax polysiphoniæ Reinsch. Mrs. Humber, 1902, on *Poly. fastigiata*; also N.W. 3, 4.

c.i. C. tumidus Reinsch. On *Cer. rubrum*. r. E. 6. N.W. 4.

Naccaria Wigghii Endl. [W. 4.] N.W. 2, 4. N. 1. Floating.

Pterocladia capillacea Born (*Gelidum corneum* vars. ϵ *capillaceum*, ζ *uniforme*, et γ *pinnatum* Grev.). [E. 4.] S. 5. W. 3, 4. E. 2, 6. On rocks.

G. Gelidum crinale J. Ag. (*G. corneum* var. *crinale* Auct.). E. 6.

G. G. pusillum Le Jol. (*G. corneum* var. *clavatum* Grev.), et var. *cæspitosum* J. Ag.). W. 1. On rocks.

c.i. G. aculeatum Batt. (*G. corneum* var. *aculeatum* Grev.). W. 1, 4. E. 5, 7. On rocks.—(c.i.) var. *abnorme* Batt. (*G. corneum* var. *abnorme* Grev.). E. 7.

G. PULCHELLUM Kütz.—var. *genuinum* Batt. (*G. corneum* var. *pulchellum* Grev.). E. 8. W. 3. N.W. 4. f.c. In shady pools.—var. *setaceum* Batt. (*G. corneum* var. *setaceum* Kütz.). [E. 10.] E. 2.—(C.I.) var. *clavifer* Batt. (*G. corneum* var. *clavifer* Grev.). S.W.

C.I. G. ATTENUATUM Thur. (*G. corneum* var. *attenuatum* Hook.). N.W. 4, 7. W. 1, 4, 5. S. 4.

G. CORNEUM Lamour. W. 1, 3. 5.

G. LATIFOLIUM Born. (*G. corneum* var. *latifolium* Grev.; var. *plumula* Kütz.). [E. 2.] N. 2. W. 1. On rocks.—var. *Hystrix* n. f. *condensata* Holmes. S.W. (Fig. 2.)

Fig. 2.—*Gelidium latifolium* var. *Hystrix* f. nov. *condensata* Holmes $\frac{2}{3}$ nat. size. *a*. Fruiting ramuli.

Ramuli simplices vel dichotome aut pinnatem divisi ad apices obtusi.

The form differs from the variety in the obtuse character of the short branchlets; a few fruiting ramuli are scattered over the surface. One specimen was found hanging from an overarching rock among huge boulders, and thus locally sheltered in an otherwise exposed position. It is curved in the upper part and measures $7\frac{1}{2}$ centimetres. The ultimate branchlets measure a little over 1 mm. in length.

G. TORULOSUM Kütz. W. 3. (Fig. 3.)

This is new to Britain; it was described by Kützing as a new species (Tab. Phyc. Bd. p. 18, pl. 57. f. 1) as follows:—

Plant 2–3 inches in height. Fronds lax, very narrow, flat, irregularly tripinnate, or breaking up above; pinnacles opposite, patent, with constricted articulations. Cystocarps are borne

on the terminal swollen branches. Native of Brazil; Chamisso.

De Toni has relegated this to a list of those species needing further investigation. The single specimen collected in Guernsey agrees fully with the above description.

Fig. 3.—*Gelidum tordosum* Kütz. Nat. size.

CHONDRUS CRISPUS Stach. Everywhere. Rocks, stones, and among *Zostera*.—(C.I.) var. *æqualis* (Turn. pro parte). W. 5. —var. *filiformis* Turn. W. 4.—var. *patens* Turn.—var. *Sarniensis* Turn.—var. *lacerus* Turn., H. & B.

GIGARTINA ACICULARIS Lamour. S. 5. On rocks and bottom of rock-pools.

G. PISTILLATA Stackh. [S. 5, 3, 2.] W. 3. N.W. 2. Shallow rock-pools.

G. STELLATA Batt. (*G. mamillosa* J. Ag.). S.W. E. 5.

PHYLLOPHORA EPIPHYLLA Batt. (*Ph. rubens* (L.) Grev. [N.W.4.] E. 6. W. 5, 7.

P. PALMETTOIDES J. Ag. [S. 5.] On *Lam. Cloustoni.*

P. MEMBRANIFOLIA J. Ag. [S. 2.] W. 4. On rocks.

GYMNOGONGRUS GRIFFITHSIÆ Martins. [S. 5.] W. 5. S.W. On small stones in sand.

G. NORVEGICUS J. Ag. [E. 10, 11. S. 3, 5.] W. 2. E. 5. On rocks.

C.I. G. PATENS J. Ag. r. N.W. 4. S.W. E. 6.

Hitherto the only British locality for this was Padstow, in Cornwall; specimens gathered in 1911 and 1912 at different stations show that it has now established itself on the shores of Guernsey. It grows at the base of low rocks under overhanging algæ.

Ahnfeltia plicata Fries. f. E. 2. S. 5. On stones in sand.

c.i. Actinococcus aggregatus Schm. r. On *Gymnogongrus Griffithsiæ*. S. 5. E. 3.

A. peltæformis Schm. r. On *G. norvegicus* and *G. patens*. S. 5.

g. Colacolepis incrustans Schm. On *Phyllophora epiphylla*. W. 2, 4. E. 1.

Callophyllis laciniata Kütz. f. E. 10, 6. W. 5, 1, 8. N. 2. On rocks.

c.i. C. flabellata Crn. E. 2, 11. Dredged.

g. Callocolax neglectus Schm. On *C. laciniata*. S. 3. E. 6. W. 1.

Callymenia reniformis J. Ag. r. [S. 5, 3. N. 2.] W. 4. S.W.—var. *Ferrarii* J. Ag. H. & B.

g. C. microphylla J. Ag. r. E. 2.

c.i. C. Larterlæ Holmes. r. E. 6. Floating.

Cystoclonium purpureum Batt. c. W. 8. On stones.

Catenella repens Batt. (*Catenella Opuntia* Grev.). c. E. 2. [E. 11. W. 7.] On sandy rocks.

Rhodophyllis bifida Kütz. f.c. E. 2, 7, 6. W. 1. On stalks of *Lam. Cloustoni*.

R. appendiculata J. Ag. [E. 2, 10, 11. N.W. 4.] N. 2. W. 2, 4 S. 6.

Sphærococcus coronopifolius Grev. [Fragments washed up at S. 5. E. 11.]

Gracilaria confervoides Grev. f.c. E. 2, 6, 10. S. 5. W. 3.

Calliblepharis ciliata Kütz. [E. 2, 10. N. 2.]

C. lanceolata Batt. (*Calliblepharis jubata* Kutz.). c. E. 2, 6. W. 4, 5. N.W. 7. S. 5.

Rhodymenia Palmetta Grev. [S. 5. E. 10. N. 2.] W. 5. S. 3. E. 1, 11.

R. palmata Grev. f. *typica*. c.—var. *marginifera* Harv. W. 5.—var. *sarniensis* Grev. [E. 2] E. 3. S.W.—var. *simplex* Harv. c.—var. *sobolifera* J. Ag. [E. 10, 11.] E. 5. On *Lam. Cloustoni*.

g. Cordylecladia erecta J. Ag. v.r. W. 5. In sandy pool.

Lomentaria articulata Lyngb. (*Chylocladia articulata* Grev.). c. On *Lam. Cloustoni* and on rocks.

L. clavellosa Gaill. (*Chrysymenia clavellosa* Harv.). [N.W. 4. E. 2. W. 5.] E. 6. N. 2.

Champia parvula Harv. (*Chylocladia parvula* Hook.). [S. 5. E. 2, 10. W. 4.] N. 2. W. 4.

Chylocladia kaliformis Hook. f.c. E. 2, 6. W. 1.—(c.i.) var. *patens* Harv. E. 10. W. 1.—var. *squarrosa* Harv. E. 2.

C. ovata Batt. (*Ch. ovalis* Hook.). f.c. E. 6. On stones.

C. reflexa Lenorm. [N.W. 4.] In a rock-pool.

Plocamium coccineum Lyngb. W. 1. E. 2. N. 2.

Nitophyllum punctatum Grev. [N.W. 4.] S. 3. E. 2, 6. On *Codium tomentosum*.—var. *ocellatum* J. Ag. [S. 3, 5. N.W. 4.] W. 1. N. 2.

N. UNCINATUM J. Ag. [E. 2.] E. 11, dredged. N. 1, in deep pools.

N. RAMOSUM Batt. (*N. laceratum* Grev.). f. N. 2. E. 6. Rocks.—(c.i.) f. *ciliifera* Kütz. N.W. 4. W. 1.—(c.i.) f. *lobata* Kütz. E. 2, 5.—f. *reptans* (Crn.). Lyle in New Phyt. xvii. p. 231, n. comb. On *Laminaria* stipes, and *Lith. polymorphum*.—var. UNCINATUM Grev. (non *N. uncinatum* J. Ag.). N.W. 3. On *Corallina officinalis*.—var. *Smithii* Kütz. W. 8.

N. HILLIÆ Grev. [E. 10.] N. 2. E. 2, 6. In shady pools, under ledges of rocks.

c.i. N. LITERATUM J. Ag. In shady pools. W. 1.

g. GONIMOPHYLLUM BUFFHAMI Batt. W. 5.

PHYCODRYS RUBENS Kütz. (*Delesseria sinuosa* Lamour.). [S. 3, 5. N. 2. N.W. 2.] W. 1. On *Lam. Cloustoni*.

DELESSERIA SANGUINEA Lamour. E. 6. N.W. 4.

D. ALATA Lamour. f. E. 6. W. 7. On stipes of *Lam. Cloustoni* and on rocks.

D. RUSCIFOLIA Lamour. c. S. 3. W. 6. On rocks.

D. HYPOGLOSSUM Lamour. Not common. N.W. 4. On rocks.—(g.) var. *angustifolia* Kütz. E. 10. N.W. 3. On rocks.

BONNEMAISONIA ASPARAGOIDES Ag. Small specimens washed up. [S. 5.] N. 2. E. 11. Dredged.

There is a notice by H. Kylin, see Journ. Microscop. Soc. 1915, p. 604, of the occurrence of bladder-cells (Blasenzellen) in the thallus of *Bonnemaisonia asparagoides* and other Florideæ. These cells are filled with a homogeneous, colourless, strongly refractive substance, from which iodine is liberated on the death of the plant by the bursting of the bladders. "The iodine stains blue any starch solution, and leaves a blue mark on paper." The function of these cells is considered by the author as protective against small animals which eat algæ.

RHODOMELA SUBFUSCA Ag. [E. 2, 10. N.W. 5.] W. 1, 4. Sandy stones and pools.—(c.i.) var. *gracilior* J. Ag. E. 6.

LAURENCIA OBTUSA Lamour.—f. *genuina* Hauck. [N.W. 4. W. 5. E. 2, 10.] W. 4. N.W. 7.—(c.i.) var. *crucifera* Hauck. W. 4, 5.—(c.i.) var. *pyramidata* J. Ag. N. 1.

L. CÆSPITOSA Lamour. c. On stones, in shallow sandy pools.

L. PINNATIFIDA Lamour. c. On rocks.—(c.i.) var. *tenuissima* Turner. One specimen on rock. S.W.

This was found in November among locally sheltering rocks in an exposed position. Dawson Turner's specimen of this variety is a very small plant, scarcely more than 1 inch in length and with mostly alternate branching. The Guernsey specimen is about $1\frac{1}{2}$ in. in height and differs in bearing mostly opposite branches.

HALOPITHYS INCURVUS Batt. (*Rytiphlæa pinastroides* Ag.). Dredged '11. W. 1, 4. a. In half-tide rock-pools and on rocks at low tide.

Chondria tenuissima Ag. (*Laurencia tenuissima* Harv.). [E. 6.] N.W. 4. In sand.

C. dasyphylla Ag. (*Laurencia dasyphylla* Grev.). [E. 10, 3. S. 5. N.W. 4.] E. 2, 6. On stones in sand.

c.l. C. cærulescens J. Ag. v.r. S. 4. In a rock-pool at low tide.

A large and luxuriant patch of this rare alga grew in an extremely sheltered position in Guernsey. Its only other British habitats are Hastings and Felixstowe.

Polysiphonia macrocarpa Harv. (*P. pulvinata* Phy. Br. & *P. sertularioides* Holm. & Batt. Rev. List). [S. 2. E. 4.] S.W. S. 4. W. 1, 5. On *Lith. incrustans* and in chinks of rock.

Summer specimens are typical, those gathered in autumn are more robust, characterized by thickened filaments, darker in colour, much broken, densely tufted, and interwoven. Particles of sand, shells, etc., held in the interstices of the filaments afford a shelter for sporelings.

P. fibrata Harv. f. W. 1. S. 5. N.W. 3.

P. urceolata Grev.—var. *typica* J. Ag. [S. 5.] E. 2, 5, 7. N.W. 4 W. 4. N. 1. f.—(g.) var. *patens* J. Ag. S.W. W. 1. S. 3. On *Lam. Cloustoni* and on rocks.—var. *formosa* J. Ag. (*P. formosa* Suhr.). W. 1.

g. P. elongata Grev. W. 4, 6. E. 2. On stones in sand and ropes of lobster-pots.—var. *denudata* Grev. W. 2.

This seems to have reappeared recently. It figures in the old lists for Guernsey, but Mr. Marquand was unable to find it. Abundant specimens occurred in shallow sandy pools at Rocquaine Bay and Lihou in 1911: in the autumn of the same year the ropes of some lobster-pots at Pezèrie were profusely covered with f. *nuda*. Only a few old plants were to be seen in 1914; they were beginning to put forth new shoots.

P. violacea Grev. c. On rocks and other algæ.

P. fibrillosa Grev. r. N. 2.

P. fastigiata Grev. c.

In addition to its usual habitat on *Ascophyllum nodosum* this was found on *Fucus vesiculosus* var. *evesiculosus* in exposed localities.

g. P. ceramiæformis Crn. v.r. E. 6. One small specimen.

P. simulans Harv. [E. 4, 10. S. 3.] E. 2, 7, 8. N.W. 2, 3, 4. N. 2. Fringing deep pools.

P. opaca Zan.—f. *simplicior*. [S. 2. In sand at half-tide level.]

P. nigra Batt. (*P. atro-rubescens* Grev.). [S. 2. N.W. 2.] S.W. E. 6. N. 1, 2.

P. obscura J. Ag. [N.W. 2.] W. 4, 5. r. In sand.

P. nigrescens Grev. c. [N.W. 4. S. 2. E. 10.] E. 2, 6, 8. W. I, 3, 4, 5. N. 1. S.W. In sand.—var. *affinis* J. Ag. (*P. affinis* Moore). E. 2.

P. Brodiæi Grev. [S. 5. N.W. 4. E. 10.] S. 2, 6. W. 1, 2, 4, 5, 7, 8. E. 2, 6. N. 1, 2.

P. subulifera Harv. [E. 6. S. 5.]

P. FRUTICULOSA Spreng. (*Rytiphlœa fruticulosa* Harv.). c. E. 2. W. 1. S.W. Among *Zostera*.—(B.) f. *Wulfeni* Kütz. W. 4. S. 6.

C.I. PTEROSIPHONIA COMPLANATA Schm. (*Rytiphlœa complanata* Harv.). S.W. One small specimen.

P. THUYOIDES Schm. (*Rytiphlœa thuyoides* Harv.). [S. 2, 3. E. 10. N.W. 2.] N.W. 1. E. 6, 9, 10. W. 5. N. 2. On *Bifurcaria tuberculata*.

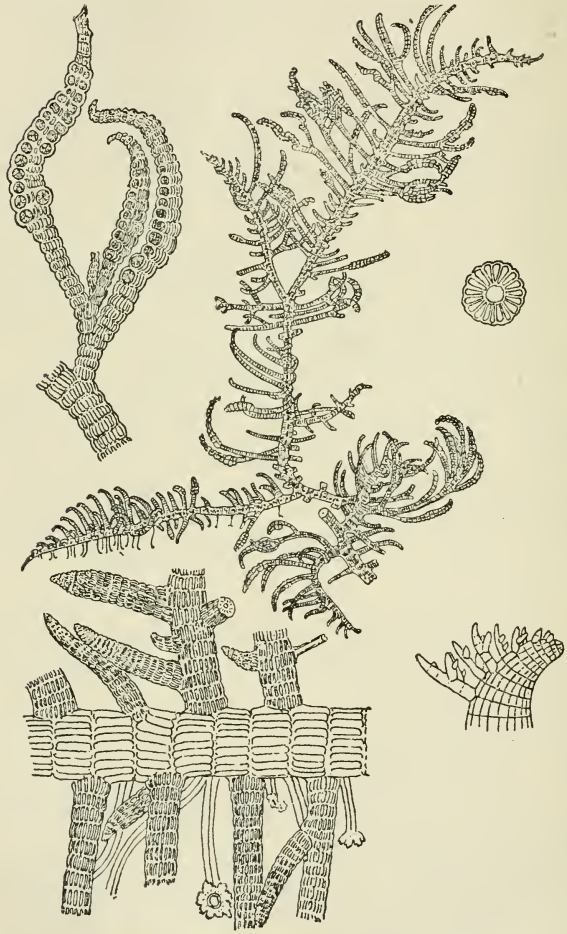

Fig. 4.—*Ctenosiphonia hypnoides* Falkenbg.

BRONGNIARTELLA BYSSOIDES Bory. (*Polysiphonia byssoides* Grev.). f. W. 1. S. 3. E. 2. N. 1. On rocks and *Rhod. bifida*.

B. CTENOSIPHONIA HYPNOIDES Falkenbg. (Polys. hyp. Welw.). Engl. & Prantl, Naturl. Pflanzenf. 1897, p. 466. (Fig. 4.)

Thallus prostrate and creeping, adfixed to the substratum by its under surface, rounded and gradually tapering. Apex incurved, ecorticate. Branching alternately on either side, and then afterwards irregularly. 12–18 pericentral siphons. Stichidia formed in the terminal segments of the branches, slightly incurved, enclosing a double longitudinal series of tetrasporangia. Cystocarps and antheridia hitherto unknown.

Ctenosiphonia differs from *Polysiphonia* by the arrangement of the tetrasporangia, which form two longitudinal series within the stichidium; on account of this, the genus approaches in a certain measure to *Halopithys*, but differs from it in the number of pericentral siphons. Colour, a dull purple, turning black when dry.

C. hypnoides was found in chinks of rock at half-tide in an exposed locality and is a new arrival on the coasts of Britain. Dense mossy tufts of dull purple filaments, about ¾ inch high, were closely matted and entangled; they measured 1–2 inches across and held sand, small shells, and stones in their meshes, serving as a shelter for spores of other algæ. The specimens were gathered in autumn, and did not show any reproductive bodies. The plant is a native of Spain, Portugal, and Morocco.

Dasya corymbifera Crn. (*Dasya venusta* Harv.). Miss Le Lièvre's list.

D. arbuscula Ag. [E. 10, 11. N.W. 4.] E. 2, 6, 8. S. 2, 5. N. 2. N.W. 3.—(c.i.) var. *cæspitosa* J. Ag. S. 2.

Heterosiphonia plumosa Batt. (*Dasya coccinea* Ag.). c. S. 3. On rocks and stones.

Sphondylothamnion multifidum Näg. a. S. 3. E. 6, 8, 9. Hanging from rocks.

Spermothamnion Turneri Aresch. (*Callithamnion Turneri* Ag.). f.c. Vertical rocks. [W. 5. N.W. 5. E. 2, 10.] S.W. W. 2, 4. S. 2, 5. E. 6. N.W. 4.—(c.i.) var. *monoica* Schm. (*Call. Turneri* var. *variabile* J. Ag.; var. *repens* Auct.; *S. roseolum* Pringsh.). S. 1, 2, 4. N.W. 1. W. 1, 5. N. 2. c. On *Fucus serratus* and *Furcell. fastigiata*.—(c.i.) var. *subverticillatum* Cotton. E. 11. v.r.

This was added to the British Flora by Mr. A. D. Cotton. Some small specimens were dredged at Bec du Nez in 1911 and 1912.

c.i. S. irregulare Ardiss. v.r. E. 10. W. 3.

Ptilothamnion pluma Thur. (*Call. pluma* Ag.). [S. 5.] N.W. 5. W. 1. On *Lam. Cloustoni*.

Griffithsia corallinoides Batt. (*Griffithsia corallina* Ag.). f. N. 2. E. 2. On rocks.

G. flosculosa Batt. (*G. setacea* Ag.). c. E. 2. W. 1.

Halurus equisetifolius Kütz. (*G. equisetifolia* Ag.). [N.W. 4. E. 2.] W. 2, 4, 7. On rocks.

Bornetia secundiflora Thur. (*G. secundiflora* J. Ag.). [N.W. 4. S. 3. E. 10, 11. W. 4.] E. 7. N.W. 3. On vertical rocks. (Fig. 5.)

A curious growth was gathered from a low-tide pool at Albecq. The median parts of the filaments are beset with a prolific number of downward growths. These descending processes emerge from any part of the filament cell, two may even be given off from the same cell; they are jointed, with blunt tips, somewhat paler in colour and about $\frac{1}{2}$ to $\frac{2}{3}$ narrower than the main branches: they are straight at first, but become wavy and irregular in their direction as length increases. The normal branching is pseudo-dichotomous. It is difficult to decide the significance of these appearances, which have not been observed before and may be merely the outcome of

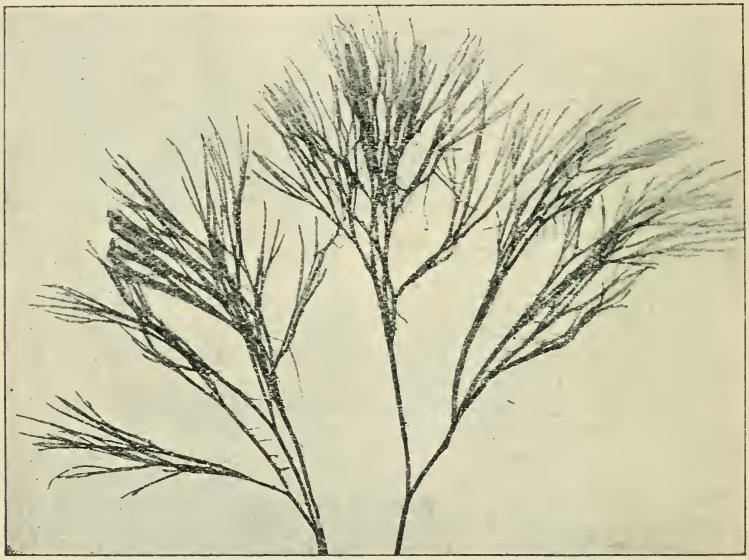

Fig. 5.– *Bornetia secundiflora* Thur.

special conditions. The presence of colour and the form of the extremities preclude the idea of rhizoids. The descending growths have rather the appearance of runners or off-shoots, which, after extending to a suitable distance, may possibly develop rhizoids and give off new plants. Sexual reproductive organs have not been observed in this country; it is possible they occur during the winter months and have escaped discovery. The development of runners may, however, be a method of propagation either supplementary to, or even superseding, the sexual method. The fact that the plant spreads in ever-increasing tufts over the surface of the rock is in favour of this idea.

Monospora pedicellata Sol. (*Callithamnion pedicellatum* Ag.). f. E. 9. W. 1, 5. On rocks.

Pleonosporium Borreri Näg. (*Call. Borreri* Harv.). [E. 10, 11. S. 2, 5.] E. 5, 6.

Rhodochorton Rothii Näg. c. S. 3.

R. floridulum Näg. [S. 2. N. 2.] S. 2. W. 1, 4, 5. In sand and on sandy rocks.

G. Callithamnion tenuissimum Kütz. r. E. 6. N. 1. S. 4.

C. byssoides Arn. [S. 3. N.W. 4.] E. 2. W. 1. On sides of rocks and other algæ.

C. polyspermum Ag. r. S. 4. On *Chondrus crispus*.

C. roseum Harv. Miss Lelièvre.

C. Dudresnayi Crn. (*C. affine* et *C. purpurascens* Harv.). r. E. 2.

C. Hookeri Ag. (incl. *C. lanosum* et *C. spinosum* Harv.). [E. 6, 2. N.W. 5. N. 1.] E. 2, 5, 10. N. 2. W. 1. S. 5. f.c. On other algæ.

C.I. C. Brodiæi Harv. S. 4. E. 1. W. 8. r.

G. C. fruticulosum J. Ag. S.W. E. 2, 6, 10. r. On *Poly. thuyoides*.

C. tetragonum Ag. a. *genuinum* Hauck. f.c. On *Rho. palmata* and *Saccorhiza polyschides*.—var. *brachiatum* J. Ag. (*Call. brachiatum* Harv.). W. 5, 6. On stipes of *Lam. Cloustoni*.

C. tetricum Ag. c. S. 3. W. 1, 5. E. 6, 8. Hanging from rocks.

C. corymbosum Lyngb. f.c. W. 1. E. 10.

C. granulatum Ag. (*Call. spongiosum* Harv.). [E. 10. S. 2, 3, 5.] E. 6, 7, 8. N. 2. S. 4. W. 8. On rocks and *Ch. crispus*.

G. Seirospora Griffithsiana Harv. On *Fucus* sp. Two very small specimens.

Compsothamnion thuyoides Schm. [E. 10.] N.W. 3. E. 6.

C.I. C. gracillimum Schm. v.r. E. 6.

Plumaria elegans Schm. (*Ptilota sericea* Harv.). c. E. 5, 6, 8.

Antithamnion Plumula Thur. N.W. 2. E. 11. Rock-pools.

G. A. crispum Thur. In Le Jolis' Liste, p. 112 (*A. Plumula* var. *crispum* J. Ag., Batters Cat. p. 89). N.W. 4. N. 2. Rock-pools.

I have followed Mr. Cotton in giving specific rank to this plant, thus differing from Batters, who classified it as a variety of *A. Plumula*.

Crouania attenuata J. Ag. f. S.W. N. 2. W. 1. On *Corallinæ*, etc.

Ceramium tenuissimum J. Ag. (*C. nodosum* Harv.). [W. 5. N.W. 4.] W. 5. E. 2.—(G.) var. *arachnoideum* Ag. r. W. 1.

C. strictum Harv. [N.W. 5.] S. 3. E. 6. N. 1. In crannies of rock.—(C.I.) var. *zostericola* Le Jol. W. 1. r.

G. C. fastigiatum Harv. W. 5. S.W.

C. diaphanum Roth. [N.W. 4, 5. E. 2.] S. 3, 2. W. 2, N.W. 4.

C. Deslongchampsii Chauv. [E. 2.]

c.i. C. circinatum J. Ag. (*C. decurrens* Harv.). S.W. W. 5, 8. E. 2, 3, 7.

C. botryocarpum Griff. [E. 2, 10. S. 4. N.W. 4.] N. 2.

C. rubrum Ag. c.

C. flabelligerum J. Ag. S. 4. One small specimen.

C. echinotum J. Ag. c. On *Codium tomentosum* and rocks.

C. ciliatum Ducluz. f. In muddy sand and on other algæ.

C. acanthonotum Carm. [N.W. 2.]

Microcladia glandulosa Grev. [S. 3. E. 11.]

Gloiosiphonia capillaris Carm. [N.W. 4.] N. 2. E. 6. N.W. 4. W. 8.

Grateloupia filicina Ag. [E. 2. S. 5.]—var. *intermedia* H. & B. [S. 3.] S. 4, 5. S.W. Shallow sandy pools.

c.i. G. dichotoma J. Ag. v.r. S.W. W. 2.

Only a single small specimen was collected in 1912; but in 1914 a prolific growth occurred in one locality which was moderately exposed, high boulders producing some slight shelter. Bushy tufts flourished in a series of narrow pools through which runnels of water streamed after the ebbing tide.

Dumontia incrassata Lam. (*Dumontia filiformis* Grev.). [S. 3. E. 10.] E. 2, 6, 10. N.W. 4.—(c.) var. *crispata*. E. 6.

Dudresnaya verticillata Le Jol. [W. 4.] N. 1. N.W. 2. r.

Dilsea edulis Stackh. (*Iridæa edulis* Harv.). [S. 3. E. 2, 10.] E. 6.

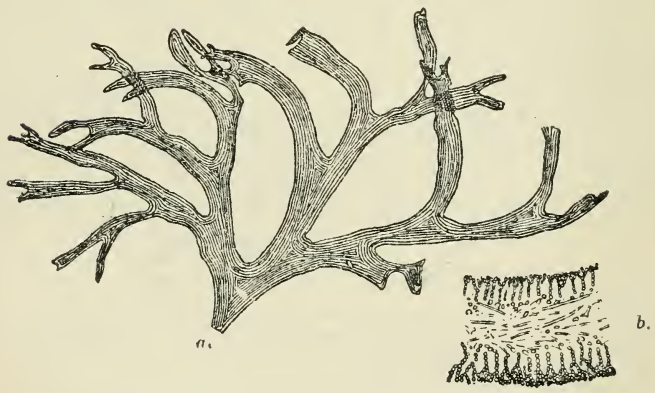

Fig. 6.—*Nemastoma dichotoma* J. Ag. *a*. Nat. size. *b*. Transverse section of thallus. × about 100.

Schizymenia Dubyi J. Ag. E. 6. N. 2.

Halarachnion ligulatum Kütz. [N. 2.] W. 1, 2. Very small specimens.

Furcellaria fastigiata Lamour. c.

B. Nemastoma dichotomum J. Ag. S. 5. One specimen growing on rock. (Fig. 6.)

This species, found growing in a rock-pool in a moderately exposed situation in September, is new to Britain. It is a native of the Mediterranean, whence it has travelled to the shores of Guernsey. The following description is taken from De Toni, p. 1662:—

Frond fleshy-gelatinous; stem round to compressed, loosely dichotomous, sub-fastigiate; segments patent, narrow linear, or cuneate, with obtuse ends mostly elongated.

Habitat: Ligurian Sea at Nice, the Tyrrhean Sea, coasts of Sardinia, Ionian Isles, Sicily, and Adriatic Sea.

Frond 4–10 cm. long, more or less regularly dichotomous, fastigiate; segments above the axils rounded, distinctly patent or sub-divaricate, below the axils linear, somewhat wedge-shaped, 2–5 mm. broad. The lower portion of the frond is generally narrower, the middle parts wider, the extremities again narrower. The terminal branches often 6–10 mm. long, linear attenuate but obtuse, sometimes short cuneate obtuse, sometimes sub-cornutely branched. Structure and fructification of the genus. Inner threads very dense, peripheral ones immersed in a small quantity of mucilage. Substance gelatinous-fleshy, thick and firm when dry, only slightly cartilaginous. Dried specimens adhere firmly to the paper. When fresh of a purple, almost wine colour.

Polyides rotundus Grev. [E. 1. S. 5.] W. 5. Shallow sandy pools and rocks.

Petrocelis cruenta J. Ag. [E. 10.] N. 1. E. 2. S.W.

Cruoriella Dubyi Schm. (*Peyssonnelia Dubyi* Crn.). [E. 2, 10. S. 5.] N. 2. E. 11.

Hildenbrandtia prototypus Nardo. c. Rocks and stones.

Schmitziella endophlœa Born. & Flah. On *Clad. pellucida*. [S. 2. N.W. 2.] N. 2. r.

G. Choreonema Thuretii Schm. N.W. 4. r.

Melobesia farinosa Lam. [On *Chy. kaliformis*. E. 6]; and on *Zostera* and *Clad. rupestris*. c.

M. Lejolisii Rosen. [On *Zostera*. N.W. 2. S. 2.]

Lithophyllum (Dermatolithon) pustulatum Fosl. (*Melobesia pustulata* Lam. and *M. verrucata* Lam.). [N.W. 2, 4. E. 10. S. 2.] W. 5. N.W. 5.—var. *Corallinæ* Fosl. (*Melobesia Corallinæ* Crn.). [S. 5.]—var. *Laminariæ* Fosl. (*M. Laminariæ* Crn.). [E. 2, 10.]

L. incrustans Phil. c. On rocks.

L. expansum Heydr. [E. 2, 10. N. 2. N.W. 2.] N.W. 1 On rocks.

L. lichenoides Phil. f. Lining rock-pools and on other algæ.

Lithothamnion polymorphum Aresch. (*Phymatolithon polymorphum* Fosl.). c. On rocks.

L. Lenormandi Fosl. c. On rocks, stones, and limpet-shells.

Epilithon membranaceum Heydr. (*Lith. membranaceum* Fosl. and *L. corticiforme* Fosl.). [E. 10. S. 5. N.W. 4 N. 2.] S. 5. E. 3, 6. W. 6. On other algæ.

Corallina officinalis L. c.

G. C. ELONGATA Johnst. (*C. mediterranea* Aresch.). W. 1. E. 6.
C. SQUAMATA Ellis. c. E. 9.
C.I. C. VIRGATA Zan. S.W. v.r.
C. RUBENS Ellis and Solan. (*Jania rubens* Lam.). f.c.—var. *corniculata* Hauck. (*J. corniculata* Lam.). [N.W. 4. S. 5. W. 4.] S.W. r.

III. Some Ecological Factors.

The methods of plant ecology have of recent years been applied to marine botany, and many new facts have been ascertained concerning the growth and distribution of Algæ. These subjects need still further investigation, though Harvey, Rattray, Murray, Darbyshire, etc., have furnished valuable contributions towards the knowledge of the subject.

One of the most recent workers in marine ecology is Mr. A. D. Cotton. His Report on the excessive growth of *Ulva latissima* in Belfast Lough (1911) and that on the Marine Algæ of Clare Island (1912) are standard works. The former deals very fully with the various conditions determining the presence etc. of Algæ, and clearly demonstrates the connection between a mud-formation and an Ulva-association. In the latter, Mr. Cotton has established the subject of marine ecology of Britain on a definite basis by subdividing the Algæ of a given district—that of Clare Island and the neighbouring shores—with regard to their habitat, degree of exposure, shelter, etc., into certain "formations" or types of vegetation and their concomitant "associations." For though foreign algologists, such as Kjelmann, Börgesen, Jonsson, and various others have dealt very fully with the subject of marine ecology, Mr. Cotton's are the first organised and comprehensive works of the kind produced in England. They therefore serve as a useful guide in subsequent studies of marine algal distribution in Britain.

(1) *Physical Position of the Island.*

The tidal stream flows up the English Channel in the direction E. by N., and falls W. by S.W. Guernsey is so situated that it stands right out in the southern portion of the stream and interrupts the normal flow of the body of water. Striking against the Channel Islands, the stream divides and flows on either side of them and also eddies round the Gulf of St. Malo. Spores, fragments, or plants of algoid nature carried as flotsam would stand a good chance of being intercepted by the obstructing rocks and islands, so that the prolific marine vegetation of the Channel Islands, including the presence of species not found on the British coasts, is largely owing to its geographical position.

(2) *Tides.*

Mean spring tides rise about 26 ft., with a corresponding fall. An enormous expanse of most varied character is exposed by the ebbing tide, thus affording a wide area for collecting; but the rapid rise and fall renders the ground somewhat dangerous—the collector, unless familiar with the shore, is apt to be cut off.

(3) *Currents.*

A note in *Nature* for Sept. 4, 1913, on the Oceanography of the Mediterranean—quoted from a Report of the Danish Expedition of 1908–10 to the Mediterranean and adjacent seas,—describes a "current of warm and highly saline water which flows eastwards . . . . and then northwards along the deep depressions of the sea-bottom, till it approaches the shores of Britain. It normally flows to the west of Ireland . . . . but if unusually strong, it may enter the shallower sea-basins. It has been suggested that it is owing to the presence of this highly saline Mediterranean water that the high salinities of the English Channel and the Irish Sea are due." The presence of this current would account for the appearance of many southern species, whose spores have been brought thither in its flow. *Padina Pavonia*, for example, is an inhabitant of the Mediterranean, but is well-established as a member of the British Flora; *Lithothamnion expansum*, *Corallina mediterranea*, *Nemastoma dichotomum*, *Colpomenia sinuosa* are among the more recent arrivals on our shores, and may have travelled hither by this means. The familiar Gulf Stream is also a carrier of spores and detached portions of seaweed, which are able to germinate and grow in the congenial warmth of the current which has brought them.

(4) *Nature of the Substratum.*

Apart from Plankton and other floating algæ, it is obvious that seaweeds require an anchorage or point of attachment; mud and sand are of too shifting a nature, and few species will be found growing on them. The abundant and varied marine flora of Guernsey indicates the peculiarly suitable and varied substratum which is afforded by the structure of the Island coasts. The following quotations, which will explain briefly the conformation of the island, are taken from Anstead's *Channel Islands* and from De la Mare's paper "On the Correlation and Relative Age of the Rocks of the Channel Islands," Trans. Guernsey Soc. Nat. Hist. Sci. ii. 1890–94:—

"The northern part of Guernsey consists of diorite sometimes approaching hornblende rock with syenitic and granitic veins." "These rocks are of a dark bluish-grey colour, remarkably fine grain, excessively hard, heavy and tough" (Anstead). "The southern part consists chiefly of gneiss, but diorite occurs in various parts . . . . . The diorite appears . . . . . to be associated with the gneiss in the form of inclusions rather than of intrusions . . . . . There is a considerable patch of fine-grained granite east of L'Ancresse." At Cobo the granite resembles some Jersey granite described thus—"generally of a pink colour due to the orthoclase felspar, which is abundant and contains both mica and hornblende . . . . . The mica traps are composed chiefly of mica and felspar" (De la Mare). The relative ages of these rocks De la Mare summarizes as follows:—"Some of the Guernsey granites, a large proportion of the dark blue diorite or diabase dykes, and perhaps some of the pink felsites . . . . . are Archæan (pre-Cambrian). The Cobo granite, the remainder of the diabase dykes, the quartz felsites and rhyolites . . . . . are comprised within the limits of the Cambrian system . . . . . The mica trap-dykes belong to the Carboniferous period . . . . . With the

exception of some superficial pleistocene deposits no newer rocks are found." Anstead notes that "the rocks are remarkably broken and fissured by mineral veins, the enclosing rock and its veins being of different degrees of hardness, and the equal action of the sea on rocks of unequal hardness has produced those long lines of projecting rocky islets, the many narrow inlets, and the intersecting floors of rock between high and low water mark . . . . . An extreme complication of the vein system is beyond doubt the original cause of this peculiarity." A more ideal habitat for the growth of seaweeds than this coast with its wealth of boulders, nooks and crannies, overhanging rocks and basins, deep or shallow, it would be difficult to imagine.

Further information on the geology of the island is to be found in contributions by Collinette and Derrick in their presidential addresses, and by Dunlop "On the Superficial Deposits of Guernsey" (Trans. Guerns. Soc. Nat. Sci. iii. 1895–99). Accounts are given of the successive periods of submergence and elevation of the island during the Quaternary period: these changes of level were accompanied by processes of denudation and subsequent deposition of disintegrated matter; the latter, consisting of yellow clay or brick-earth, sand and rubble, etc., occurs in the interstices of the cliffs and on the lower levels of the island.

These superficial deposits are thus classified by Derrick in his article on Guernsey clays (*op. cit.* ii. 212):

"(1) Raised and ancient beaches; (2) Peat and the submerged forests; (3) The sand deposits of the north-western coast; (4) The land-slips from the cliffs on the south and east coasts; (5) The clays and loams; (6) The varied soil of the island."

The clays are of two kinds:

"Kaolin clay is not a superficial deposit in Guernsey . . . . . It is a direct produce of the disintegration of certain veins in granitic and gneissic rock, and is formed from the felspar which those rocks contain. On our beaches bands of clay, or broad veins filled with clay are rather numerous, the daily action of the tide hastening the process of decay, as at Longshore and St. Sampson's." This clay is used commercially under the name 'Butt clay.' "Clays forming true superficial deposits are widely distributed and nowhere covered by the rock or intersected by the veins, which rise toward the clay and turn off horizontally beneath it."

(5) *Configuration of the Coast.*

The Island of Guernsey is a right-angled triangle: the east coast forms one side, that of the south a second, while the third or hypothenuse consists of the west, north-west, and north coasts, merging imperceptibly into each other. The features of each side differ markedly.

The east coast is moderately sheltered and the climate mild. The Islands of Herm, Jethou, and Sark, and the coast of Normandy in the distance protect it from rough weather to a great extent. The largest opening on this side is Belgrave Bay. A roadway and wall skirt the upper part of the shore. Northwards are St. Sampson's Harbour and granite quarries; beyond is the deep and sheltered creek, Bordeaux. In the other direction are Fermain Bay and two

or three inlets. Sand and pebbly beaches—with great upstanding boulders covered, or forming islets, at high tide,—reefs, platforms, and low-lying rocks, hollowed out into pools or chinks, comprise the main characteristics of the eastern side.

The south of the Island has two wide bays, within which are creeks running into the cliffs; this region is well sheltered and the temperature is warmer. Further along, the coast is difficult of access and moderately exposed, for the rocks rise sheer out of the water to a considerable height, but here and there are some narrow openings where the climb down to the boulder-beach, with rocky floors and pools, is steep and difficult. I was only able to examine one of these, Les Thielles. Pleinmont, the extreme south-west corner, is the most exposed part of the Island; the shores are rocky, very jagged and rough, and boulders of all sizes lie scattered about. The gigantic walls of rock screen off and afford some local shelter. Clefts between descending terraces give passage to runnels and streams, after the tide has receded. There are deep channels, pools, and lanes between the rocks.

The north-west coast is moderately exposed. Along it are five deep bays, sandy down the centre, but intersected with reefs, and rocky at the extremities. Large patches of *Zostera* occur low down on the beach. The northern arm of Rocquaine Bay is connected at low tide with the Island of Lihou by a causeway; on either side there is a vast area of sand and pebbles interspersed with rocks, pools, and *Zostera* beds. This is all covered at high tide and swept by a channel with a strong current. Here and there the rocks half encircle a terraced creek and give exceptional shelter. The whole coast from Pleinmont Point to Grandes Rocques is thickly fringed by countless islets, barriers, and reefs of rock, whose jagged and sharply-jutting crags break the huge waves which come rolling up the Channel into an enormous tract of surf and foam. The shores beyond and north of Grandes Rocques are much flatter and moderately exposed. There are several small bays with boulder-beaches. The rocks are less high and rough, the whole district lies at a much lower level than the south, the slope of land being from the south to the north downwards. Grande Havre and L'Ancresse are deep and land-locked bays; the former is a large quiet expanse with sandy beach and scattered masses of rocks. L'Ancresse is so hemmed round by rocks as to form a locally sheltered district with sharply-descending shores.

The coasts of Guernsey therefore possess aspects which range from extremely sheltered to quite exposed with the intermediates of moderately exposed or locally sheltered. The shores consist of sand, mud, and *Zostera* beds, with boulders and rocks of varying height and roughness.

(6) *Salinity.*

Owing partly to the smallness of the Island, there are only a few unimportant streams and an absence of any large body of fresh water discharging its contents into the sea. The general luxuriance of the marine vegetation is therefore unchecked by great variations in the degree of salinity, which, in the English Channel, is unusually

high. Results of experiments made by Dickson between Bolt Head and Berry Head at depths varying from 30 to 17 fathoms show that 1 kilogram of sea-water contains 19·41 to 19·31 grammes of chlorine: "the water of the English Channel as far east as a line joining the Isle of Wight and Cherbourg is constant in composition at different seasons of the year." One may therefore safely conclude that these figures indicate fairly correctly the degree of salinity for the waters bathing the Channel Islands. It is not, however, so much the amount of salinity which affects the growth of seaweeds as changes in its degree which is harmful to them.

On the other hand, almost every creek has its little stream of fresh water running down it; certain species, such as *Grateloupia filicina*, are to be found in localities where the water is clear and flowing quickly. *Zostera* beds also flourish in the neighbourhood of fresh water among mud and sand; upon their leaves and stalks are found many epiphytic Algæ. Ulvas, Enteromorphas, and even Porphyras are unaffected by the presence of streams, and the two former abound in brackish pools where rain-water is conserved.

At Pulias, on the north-west coast, there is a large brackish pool; formerly *Cladophora flavescens* and *Cl. fracta* were to be found there. In 1911 and 1912, I found *Calothrix crustacea*, *Lyngbya semiplena*, *Chætomorpha linum*, *Pringsheimia scutata*, *Enteromorpha prolifera*, and *Gayella polyrhiza*, but in 1914 only *Chætomorpha linum*, *E. intestinalis*, and *E. compressa*, so that the nature of the pool seems to have changed.

Val du Braye is a neck of land between L'Ancresse and St. Sampson's which has been reclaimed from the sea; it contains a brackish pool where marine algæ have been said to exist. I was unable to obtain access to it.

Many of the fields lying along the shores of the west and north coasts are flooded in winter by the sea, and one would expect to find some salt-marsh forms of Algæ, but I never succeeded in doing so.

All available ground which is not built on or under cultivation is utilized for grazing purposes, and the soil becomes highly charged with manure, etc. This has perhaps gradually effected the extinction of marine algæ in the above pools and fields; it is certainly the case with the Pulias Pool. Marquand alludes to this as a possible explanation of the paucity of fresh-water algæ.

Along the upper limits of the shore, such as the bases of cliffs etc., the following fresh-water algæ are often found mingling with the habitants of brackish conditions:—

Chlorophyceæ. *Pleurococcus vulgaris* Meneg.; *Glœocystis rupestris* Rab. [on moist rocks at the foot of the cliffs, Petit Port]; *Porphyridium cruentum* Näg. on earthy cliffs at Pleinmont; *Vaucheria sessilis* Vauch. [Moulin Huet Valley].

Phycochromophyceæ. *Chroococcus turgidus* Näg. [M.]; *Glœocapsa granosa* Kütz.; *Microcystis* sp.; *Merispomedia glauca* Kütz. [M.]; *Nostoc commune* Vauch. [M.]; *Oscillaria tenerrima* Kütz. [at base of the cliffs]; *O. limosa* Libert [roadside ditch near St. Sampson's bridge]; *Rivularia granulifera* Carm. [at base of the cliffs, Petit Port].

(7) *Temperature.*

"The mean winter temperature of the atmosphere is 6 degrees higher than that of Greenwich, the summer temperature being rather cooler. The mean temperature is 2½ degrees higher than that of Greenwich" (Black). As the temperature of the Island has a range of 8 degrees, this comparative equability has a distinctly favourable effect on the growth of Algæ, especially those exposed for several hours by the falling tide. The average annual sunshine is 42 per cent., and the average sunshine per day is 5 hours; the average rainfall in the island is about 29·07 inches (Collinette).

According to Rattray, temperature has a distinct influence in hastening the production and emission of spores and prolonging the reproductive capability of Algæ. The maintenance of an even and mild climate must therefore assist in promoting the marine fertility of this island. Harvey noticed "how those small and delicate kinds which grow within tide-marks are found in greater luxuriance or in more abundant fruit in a warm than in a cold season." He also remarked "how *Padina Pavonia* attains in warm summers on the south coast of England a size as large as it does in sub-tropical latitudes, while in a cold season it is dwarfed and stunted." The summer of 1912 was exceptionally cold and wet, and the specimens were then plentiful, but small in size.

With regard to the temperature of the sea, Dickson has observed that "the upper layers of water from 3 to 5 fathoms are apparently subject to temporary local weather conditions which may or may not produce a distribution similar to that formed underneath." At a depth varying from 17 to 30 fathoms, this writer has reported the temperature to be 50·8 to 54 C.

IV. Arrangement.

(a) *Terminology.*

Owing to differences of opinion as to the exact definitions of the various terms employed in marine ecology, I have restricted myself to the use of such geographical expressions as "*Region*" and "*Zone*" or "*Belt*."

"*Region*," as used by Kjellman, is a term universally accepted to denote a portion of the shore with relation to the tide. He divided off the algal vegetation into three regions:—"1. The *Littoral region* stretches between the high-tide and the low-tide mark, and includes many Green algæ, Brown algæ, and some Red algæ. 2. The *Sublittoral* ranges from below low-tide mark down to a depth of 20 fathoms (40 metres). Here algæ of all three colours are represented, but Green algæ cease, and Red algæ become more numerous with increased depth. 3. The *E-littoral region* is below the preceding and descends as deep as light; it is poorer in species and individuals—the latter are smaller and distorted. There is also a characteristic underlying vegetation of epiphytes requiring less light."

"*Zone*" or "*Belt*" indicates the lateral continuity of a genus or species along the shore. There is often over-lapping and intermingling of algæ in the respective zones; those of one zone may form undergrowths of others.

(b) *Types in relation to Habitat and Climate.*

The coast of Guernsey being mainly of a rocky nature, the marine vegetation is for the most part *saxicolous*, and the plants are either characterized by strong basal disks and attachments—e. g. *Fucus* spp., *Laminaria* spp., etc.—or form incrustations, such as *Ralfsia*, *Lithothamnion*, etc.

Here and there where disintegration of the rocks is complete, resulting in patches of sand along bays etc., the Flora is of a *psammophilous* nature. It includes various *Cyanophyceæ* whose gelatinous sheaths hold particles of sand together; "their threads permeate the sand to a depth of three millimetres" (Warming), *Catenella repens*, *Rhodochorton floridulum*, *Polysiphonia nigrescens*, *P. obscura*, etc., are also sand-dwellers; they hold the sand by means of filamentous rhizoids, thus forming tufts or pads which extend into compact masses. When disintegration is partial, exhibiting the intermediate stages of low rocks and pebbles, the character of the vegetation is *transitional*, pertaining partly to sand and partly to rock-floras, though possessing also distinctive characteristics. The plants are usually short, bushy, and much divided. The vegetation of shallow pools and channels also belongs to this category, which includes *Cladostephus*, *Mesogloia*, *Chondrus crispus*, etc. (Cotton).

Extreme conditions of disintegration have produced muddy patches often thickly beset with *Zostera*. This marine phanerogam by its horizontal roots acts as a capturer of the mud (Warming); upon its stems an abundant epiphytic growth occurs, including *Ceramium* spp., *Castagnea Zosteræ*, etc; these, together with such plants as *Laminaria saccharina*, *Chorda filum*, *Stypocaulon*, *Ectocarpus granulosus*, constitute the *vegetation of Zostera beds*. The series merge constantly into each other, following the varied nature of the coast-line.

Certain modifications in a Flora produced by differences in aspect, as described by Cotton, are clearly seen in Guernsey, where four distinct types of vegetation coincide in each case with certain climatic conditions. The dominant species are as follows:—

Type I. The exposed, on the S.W. coast:
Fucus vesiculosus var. *evesiculosus*, *Lichina pygmæa*, *Laminaria digitata*, *Corallina*, *Lithothamnion*.

Type II. The semi-exposed, on the W. and N.W. coasts:
Ascophyllum nodosum, *Rhodymenia palmata*, *Laminaria Cloustoni*.

Type III. The sheltered, on the S. and S.E. coasts:
Porphyra, *Enteromorpha intestinalis*, *Fucus vesiculosus*, *Rhodymenia palmata*, *Laminaria saccharina*.

Type IV. The moderately sheltered, on the N. and E. coasts:
Transitional flora with much intermingling of zones.—*Fucus serratus*, *Rhodymenia palmata*, *Himanthalia*, *Bifurcaria tuberculata*, *Laminaria digitata*.

I. *The Exposed Type.*

This type is well represented at Pleinmont, where the shore is rugged with a moderate slope, and the general appearance is desolate and bare. According to Rattray this bareness of rocks in an exposed position is "owing to the force of waves from deep water, whereby rhizoids or thalli are removed from the substratum, and the maturation of fruit is prevented. In such places there are fewer plants and of stunted growth." In view of this it is interesting to note in the chinks and fissures the occasional presence of certain matted species—e. g. *Polysiphonia macrocarpa*, *Ctenosiphonia hypnoides*—which hold sand, shells, etc., in their interstices and serve as a nidus for spores of other species, patches of *Lichina pygmæa* on the rocks and boulders also form whole nurseries for sporelings of *Fucus*, etc. *Laminaria digitata* occurs profusely, whilst beyond the limit of low tide, the erect snaky stipes of *L. Cloustoni* are seen standing up out of the water. There is very little *Pelvetia* or *F. spiralis*.

It was not possible to observe the extent of these growths owing to the difficulty of obtaining a boat. The inky patches of lichens, the dark tufts of *Fucus vesiculosus* var. *evesiculosus* along the mid-littoral, and the dull pads of *Cyanophyceæ* along the upper littoral, produce a sombre effect. Deep clefts and masses of rock afford considerable shelter, which brings about minor modifications of the general type.

II. *The Semi-exposed Type.*

The west and north-west coast of Guernsey, with its five bays, is distinctly exposed to the north-westerly winds and the force of Channel waves; the bays are cut by reefs running at right angles to the shore, and they are further sheltered by a fringe of islets and sharp rocks which form a barrier shutting them in from the open sea; these sheltering rocks profoundly modify the stormy nature of such a coast and give rise to conditions of semi-exposure.

Though not dominant, *Pelvetia* appears here and there in the upper areas in scattered tufts, increasing occasionally into large patches. *Fucus spiralis* also is well marked, but gives place lower down to *Ascophyllum nodosum*. The latter, according to Cotton, grows only in conditions of considerable shelter, but the opposite was found to be the case in Guernsey, where it prefers the semi-exposed and moderately sheltered habitats. It evidently thrives in the surf set up by the rocky conditions, and an enormous tract of this alga forms the great feature of the Semi-Exposed coast. *F. serratus* is infrequent, and is replaced in many instances by *F. vesiculosus*. *Himanthalia* is also scarce. Stretches of sand in this area form habitats for *Polysiphonia nigrescens*, *Ahnfeltia plicata*, *Cladostephus verticillatus*, *Gracilaria confervoides*, and *Chondria tenuissima*. *Zostera* beds with intervening groups of rock occur at low-water mark. Another dominant note is *Rhodymenia palmata*: heavy growths hang from rocks and boulders along the lower littoral, and take the place of *Ascophyllum nodosum* where there is less surf; for instance, along Portelet, Rocquaine Bay, etc. The *Laminariæ*

are represented mostly by *L. digitata* and *Saccorhiza polyschides* at low tide, but further from the shore towards the open sea they are replaced by *L. Cloustoni* (see p. 42).

III. *The Sheltered Type.*

In deep creeks and inlets in the south, Bordeaux in the east, and L'Ancresse in the north, this type of vegetation, as would be expected, is extremely luxuriant and diversified, and comprises many rare species.

The *Chlorophyceæ* are much in evidence, as are also profuse growths of *Porphyra, Rhodymenia palmata, Chondrus crispus, Gigartina stellata, Gracilaria confervoides*, etc. Of the *Fuci,—F. spiralis* var. *platycarpus, F. vesiculosus*, and *F. serratus* are the most noticeable species; *Ascophyllum nodosum* is only represented by a few plants here and there. Along the sides of bays, low rocks, when half buried in the sand, as at Petit Port, are often covered with tufts or cushions of *Rhodochorton floridulum*, etc. Patches of soft encrusting algæ such as *Codium adhærens, Petrospongium Berkeleyi, Hildenbrandtia rubra*, and *Ralfsia* sp. are found scattered over boulders and stones; the rare *Gigartina pistillata, Crouania attenuata, Nitophyllum Hilliæ, Cladophora pellucida*, and *Helminthocladia purpurascens*, may be gathered at low tide, or from shady rock-pools. *Dudresnaya verticillata, Bonnemaisonia asparagoides*, etc., frequently drift from deep water into the quiet bays, together with long fronds of *Desmarestia ligulata, D. aculeata*, and *Halidrys siliquosa*. Enormous plants of *Ulva latissima* are also characteristic of these localities. *Laminaria saccharina* is the typical plant of that genus in sheltered districts, as Mr. Cotton observed at Clare Bay.

IV. *The Moderately Sheltered Type.*

The features of this type are very varied and constitute a mingling of saxicolous, psammophilous, and transitional floras, together with the vegetation of *Zostera* beds. *Pelvetia* is extremely local—here absent, there scanty, then forming an enormous expanse of many square yards, as at Port Grat, etc. *Porphyra* is mostly a spring growth and occurs just about high-water mark. *P. leucosticta* appears about the same time, but at half-tide level. Enteromorphas and Cladophoras are abundant, and so are the species of the "Fucus belt," *F. platycarpus* and *F. serratus* being those most in evidence. *Ascophyllum nodosum* is present, though only in patches here and there, but not so scanty as in the previous type. There is much intermingling of the brown algæ. A widespread growth of *Chondrus crispus* occurs among the shallow rocks and pools, and masses of *Rhodymenia palmata* hang from platforms and rocky ledges. The encrusting algæ—*Peyssonnelia* sp. and *Ralfsia* spp.—are very prominent from half tide down to low water on small stones, they alternate with sand-dwellers such as *Rhodochorton, Chondria dasyphylla, Cladostephus spongiosus* where there are patches of sand; while here and there *Zostera* beds with their various epiphytes occur.

Laurencia pinnatifida exists as an undergrowth from half down to low-tide level.

Along the sub-littoral, there is a mixed assembly of brown weeds: *Bifucaria tuberculata* forms large patches, or mingles with *Laminaria saccharina*. *Himanthalia lorea* occurs only in colonies here and there along the coast; its best development seems to be in moderately and even locally sheltered positions on rocks at about the limit of low tide. A group of rocks north of the White Rock bears an extensive crop of these plants; at Pleinmont, which is an exposed locality, it grows only in deep pools. The growth is so restricted that a zone of the genus can hardly be said to exist. Few plants were seen along the W. and N.W. coasts, and then only where locally sheltered.

(*c*) Zonation.

The segregation of species into zones, and their arrangement at different levels along the shore with regard to the tide, is the result of various influences; among these may be mentioned the amount of insolation and desiccation that the respective species require or are able to withstand, and the periodic tidal exposures, rates of growth, etc. These have been indicated by Rattray and by Misses S. M. Baker and M. H. Bohling, who made extensive experiments and published valuable papers dealing with the causes of the zoning of *Fuci*.

Notwithstanding the mixed character of the Guernsey Marine Flora, the zones or belts are distinctly traceable. They vary considerably in width, become discontinuous and patchy, or even disappear for some distance where climate or substratum are unfavourable to their growth. The following notes deal with some of the most conspicuous zones and indicate in a small measure the interesting work awaiting a careful worker.

Beginning with the Upper Littoral and descending to low water, the various zones may be observed in the following sequence:—

	Algæ.		Lichens.
Upper Littoral Region.	*Pelvetia.* *Rivularia* & *Calothrix.* *Enteromorpha.* *Porphyra.*		*Verrucaria maura.* *Lichina confinis.* *V. mucosa.*
Mid-Littoral Region.	*Fucus.* — *F. spiralis.* *F. vesiculosus.* *Ascophyllum nodosum,* *F. serratus.*	or *Ascophyllum nodosum,* *F. vesiculosus.*	*Lichina pygmæa.*
	Encrusting algæ. Calcareous algæ. *Rhodymenia.* *Laurencia.* *Chondrus.*		
Sub-Littoral Region.	Encrusting algæ. Calcareous algæ. *Laminaria.*		

Upper Littoral.

Verrucaria Zone.

Verrucaria maura grows over the dry, jagged rocks, giving them a mottled appearance and forming a well-marked band a short distance above the *Pelvetia* zone. This extends round the island independent of aspect, but is interrupted here and there by the encroachment of sea-wall or dykes, or the absence of suitable rocks. *V. mucosa* occurs in infrequent patches, often dry and exposed to sunshine for a considerable period of time; it extends from the limit of *V. maura* down to about half tide, where it forms dark green, almost black greasy stains among *Ascophyllum nodosum*. Both of these Verrucarias have been fully dealt with by Knowles and Cotton.

Pelvetia, which occupies the upper reaches of the littoral, is most sensitive to exposure, and its line is very varied in width. It is scantily developed in the exposed districts, growing only on rocks covered at high tide, and disappears altogether with extreme exposure. Where the projection of a reef screens a portion of the shore, the *Pelvetia* band immediately widens, to the extent of several yards, according to the slope of the shore. In summer the orange-coloured receptacles lend a distinct note to the surroundings. Along the north arm of Rocquaine Bay, Lihou Causeway, and L'Erée Bay, where the conditions are semi-exposed, there are great patches about 15 feet in depth. Again, with moderate shelter, and where the shore is very flat, the zone widens out enormously, as at Port Grat, and Grand Havre, a land-locked bay; but at no point is there much *Pelvetia* above high-water mark. In several localities of moderate shelter there is only a scanty growth on account of the steepness of the rocks; where a wall and roadway skirt the shore, the *Pelvetia* band disappears for long distances.

Rivularia and Calothrix Zone.

About high-water mark, but just below the *V. maura* belt, a line of *Rivularia* and of *Calothrix* occurs to a depth of 2 or 3 feet in dots and patches, and corresponds to the *Rivularia* and *Calothrix* association described by other workers. It consists of *Calothrix crustacea*, *C. scopulorum*, *C. confervicola*, *C. hydnoides*, *Lyngbya æstuarii*, *L. majuscula*, *Schizosiphon Warreniæ*, *Isactis plana*.

The zone is more apparent in exposed and semi-exposed regions; it decreases with moderate shelter, and with the exception of a wide scattering of *Rivularia bullata* almost vanishes from sheltered positions.

Enteromorpha Zone.

The Enteromorpha Zone is very broad and consists for the most part of *E. intestinalis*. It extends from the *Rivularia* and *Calothrix* line down through the other belts to low-water mark, often as an undergrowth. In exposed regions the development is poor, forming only a scanty growth on low rocks, or in pools. With shelter it becomes more noticeable and is mixed with *Cladophora rupestris*, *Chætomorpha* spp., etc. Great luxuriance is attained with increased shelter.

Porphyra Zone.

Thin, even patchy at places, and abnormally wide in others, the zone is more or less continuous round the island, sometimes the line is so narrow as to consist of single plants. The poorest development seems to be in exposed localities, where the plants are umbilical in form, short and tufted, and occur mostly as a scattered undergrowth among *F. spiralis* and *Enteromorpha* spp. With semi-exposure the zone increases in width and takes a lower range. The growth is generally very unequal, and frequently mingled with *F. vesiculosus*. On one side of Lihou Causeway it measured 2 feet; at Cobo, Albecq, and along the north arm of Rocquaine Bay there are large patches 13 feet across. Increased shelter produces larger plants of more continuous growth, as at L'Ancresse Bay, where there is a broad band of the species several feet wide along the mid-littoral. A remarkable case is seen at Petit Bot in extreme shelter: the principal feature is a prolific growth of *Porphyra* down one side of the Bay which mingles at first with *F. spiralis* and *Enteromorpha* spp., and descends through the zone of *F. vesiculosus* to low-water mark. The plants here are of considerable size, laciniate in form on low rocks, but umbilicate on boulders.

MID-LITTORAL.

The Fucus Zone.

Fucus spiralis is very sensitive to climate. In exposed localities it is found only in chinks of the rocks, more especially choosing those which run parallel to the shore, the band therefore is patchy and discontinuous. With semi-exposure *F. spiralis* begins among the *Pelvetia* and then forms a well-marked belt about 5 or 6 feet wide. Where the beach is pebbly and the rocks are low, *F. spiralis* grows over them, but if the shore is very rough and composed of sharp, high-standing rocks, with deep clefts, this species is absent. With a little local shelter, *F. spiralis* develops into the var. *platycarpus*, particularly on the sheltered sides of boulders; the fronds are often as much as six inches in length.

There is besides an abundant undergrowth of the following species:—*Ceramium rubrum*, *Spermothamnion Turneri*, *Cladophora rupestris*, *Rhodochorton Rothii*, *Catenella repens*, *Enteromorpha intestinalis*, *Ectocarpus littoralis*, *Hildenbrandtia prototypus*, sporelings of *Fucus* spp., *Ascophyllum nodosum*, and *Cladostephus* spp.

F. vesiculosus occurs about half tide on low rocks and stones: it appears either above or below *Ascophyllum nodosum*, according to the nature of the rocks (see p. 38). It may ascend up into the *F. spiralis* band, or descend and mingle with *F. serratus*. In moderately exposed districts, as at Cobo, *F. vesiculosus* sometimes takes the place of *F. serratus* and extends down to the limit of low tide; the line is then rather wide, ill-defined, and sparse. The greatest development is in sheltered situations. The epiphytes of this species are:—*Polysiphonia fastigiata* and *Pylaiella littoralis*. The following plants frequently occur as undergrowths:—*Rhodymenia palmata*, *Cladostephus* spp., *Chondrus crispus*, and *Lithothamnion Lenormandi*.

In conditions of extreme exposure, *F. vesiculosus* disappears altogether; it is superseded by the var. *evesiculosus*, a characteristic plant on exposed shores, which forms the continuation of the band of *F. vesiculosus* along such districts at about half tide. The fronds are short, stout, about 4 inches long, very dark, with strong basal disks and branches of equal length, as if cut with a knife. The plants often protrude from patches of *Lichina pygmæa*, or from holes and chinks of the rock, wherever a little shelter is to be found for the sporelings to start growth. *Polysiphonia fastigiata* is a frequent epiphyte.

Ascophyllum nodosum extends in varying profusion from Pezèrie Point to Grandes Rocques, where the climate is semi-exposed. A vast expanse round Lihou and the adjacent islets measures many square yards. As indicated by Cotton this plant largely depends upon suitability of substratum, for it can only grow on rocks of a height that enables the fronds to hang down; where rocks are flat or give place to sand, it disappears.

The relative positions of *Ascophyllum nodosum* and *Fucus vesiculosus* on the shore are interchangeable along the Guernsey shores; sometimes the one, sometimes the other, takes the higher range and succeeds *F. spiralis*. The determining factors, as already pointed out, are very possibly the size and height of the rocks at the respective levels; the two algæ frequently intermingle.

The hummocks and rocks round Lihou seem specially favourable for the growth of *Ascophyllum*. Its luxuriance there is also probably due in great measure to the prevalence of surf; where the extreme roughness of the coast creating this condition ceases, as beyond Grandes Rocques, it no longer figures as a conspicuous feature of the shore. Further along the band becomes much broken. Patches of varying size can be seen in moderately sheltered localities in the north at L'Ancresse Bay, and in the east at St. Peter's Port; but in extreme shelter only a few plants are to be found scattered here and there among *F. vesiculosus*, *e.g.* Petit Bot.

F. serratus occurs along the lower portion of the littoral and is always found covering low flat rocks; hence where these do not exist, a break in the continuity of the band results. The growth is very restricted and does not form a well-marked zone: it is favoured by shelter, but exposure is inimical. Often, where there is partial exposure, *F. vesiculosus* takes its place and extends in that case down to low-water mark; except as a pool-plant *F. serratus* is absent where conditions of extreme exposure prevail. *Spermothamnion Turneri* and *Elachistea fucicola* are frequent epiphytes.

The following species form undergrowths of both *F. serratus* and *Ascophyllum nodosum*:—*Cladophora rupestris*, *Hildenbrandtia* sp., *Lithothamnion Lenormandi*, *Gelidium crinale*, *Enteromorpha compressa*, etc.

Lichina Zone.

Lichina confinis grows over rocks here and there, and was specially noted at Rocquaine Bay below the Hotel Imperial. Miss Knowles

describes this species as "semi-marine, and usually occurring along the inner fringe of high tide mark between the orange lichens and *Verrucaria maura*, and slightly overlapping these belts .... but it is occasionally coextensive with that of *V. maura*." It is found in the latter position along the shores of Guernsey in semi-exposed conditions.

L. pygmæa is conspicuous along the exposed districts of the Guernsey coasts. It grows in patches over the upper parts of rocks, more especially on stretches of boulder beaches where there are no algæ except in pools; this is contrary to the observations of Cotton, who points out the bad effect of extreme exposure on this species. According to Miss Knowles "*L. pygmæa* prefers rough surfaces and steep rocks which face the breeze and around which the sea breaks. Its range extends from the lowest limits of *V. maura* as far as low neap tide, and the growth is best developed in the upper part of its range among the Pelvetias and immediately below them." In the district round Pleinmont the maximum development was at about half-tide level. The growth of this lichen dwindles as shelter increases, though it can still be traced all along the coast. Wherever it occurs it affords a convenient site for the germination of sporelings of *F. spiralis*, *F. vesiculosus*, and several other species.

Zonation of Boulders.

It was interesting to observe how constantly tufts of *Ascophyllum nodosum* hung down from the lower parts of boulders in semi-exposed localities. Above them grew a few scattered plants of *F. spiralis* among the patches of *Lichina pygmæa*; further up appeared more *Lichina*, but the tops were bare. On the side of the rocks facing the sea there was less growth than on the landward side.

Rhodymenia Zone.

There is little or no *Rhodymenia palmata* in the south of the island; on the other coasts it frequently forms wide and extensive zones from below half-tide level down to the sub-littoral. Its luxuriance is for the most part unaffected by differences in climate, though changes of form accord with certain changes in climatic conditions. In the exposed district round Pleinmont, the plants of the littoral region are sparse, and nestle in chinks of the rock or hang from beneath over-arching boulders. They measure about 4 inches in length; the colour is dark red, and the stalks are stout and leathery with strong attachment disks. The prevalent form is wedge-shaped, with numerous stalked ovate proliferations along the edges. The plants of the sub-littoral are deeper in colour, thicker in texture, and considerably longer, increasing even to 2 feet in length. The form in this area varies from wedge to strap-shaped, with similar growths or proliferations superposed in stages upon each other, and apparently of greater significance than the leaflets of the var. *marginifera*. The undergrowths are *Chylocladia ovalis*, *Laurencia pinnatifida*, and *Hildenbrandtia* sp.

All along the west coast, where there is less exposure, the rocks at low tide are thickly covered with *R. palmata* var. *marginifera*. The plants are about 6 inches or so in length, reddish yellow in colour, much thinner in texture, and thickly fringed along their edged with long narrow processes. Occasional plants of *F. serratus* mingle here and there among the growth. With the moderately sheltered conditions of the east coast there is again a widely spread shaggy development over rocks of the same level, chiefly of f. *typica*, with fronds 4–6 inches in length. Here and there are specimens of vars. *sarniensis* and *marginifera*. Among the undergrowths are *Griffithsia setacea*, *G. corallina*, *Callithamnion tetricum*, and *Ptilota sericea*.

With increased shelter, as at Bordeaux and Petit Bot, etc., the same conspicuous and heavy growths are prevalent over the rocks at half-tide level, lower down the plants grow to enormous size, and are bright in colour and thin in texture. The epiphytes are *Phlœospora brachiata*, *Polysiphonia Brodiæi*, *Ectocarpus granulosus*.

Laurencia Zone.

L. pinnatifida occupies a similar position along the shore to that of *Rhodymenia*, but appears mostly as an undergrowth. Scanty, greenish procumbent patches creep over old *Lithothamnion Lenormandi* and *L. incrustans* at about half tide, where the perennial plants of *Laurencia* were seen sending up new shoots: their colour deepens towards the Sub-littoral and the growth increases in luxuriance. The best development was observed in moderate shelter.

Chondrus Zone.

C. crispus is fairly ubiquitous from the Mid-littoral down into the Sub-littoral regions. It is scanty in extreme exposure, but fairly abundant along the semi-exposed west coast, where masses of the deep water form are constantly thrown up: with greater shelter the zone is encroached on by other species—viz. *Gigartina stellata*, *Gracilaria confervoides*, *Cystoclonium purpureum*, *Laurencia dasyphylla*, etc. Of these, *Gigartina stellata* is the most abundant; it grows in patches here and there along the coast or inhabits rock-pools and flourishes best with moderate conditions of climate.

Zone of Soft Encrusting Algæ.

In sheltered districts *Hildenbrandtia* sp. grows over rocks and stones under the belt of *Fucus spiralis*, and descends occasionally to the lower littoral; at about half tide *Petrospongium Berkeleyi* and *Codium adhærens* form scattered patches over bare rocks down to low-tide level, as at L'Ancresse Bay and Saint's Bay. *Ralfsia* spp. and *Peyssonnelia* sp. are characteristic of greater exposure and have a wide range over the shore from above half tide down into the Sub-littoral, chiefly on small stones and limpet-shells under the shelter of the larger algæ. *Petrocelis cruenta* occurs very sparsely, irrespective of climatic conditions, at about the level of low-water mark.

Zone of Calcareous Algæ.

This Zone can be definitely traced round the island excepting where patches of sand or *Zostera* beds intervene. It is the widest of all the zones, spreading over the whole of the Littoral and Sub-littoral regions and extending beyond all other algæ to a considerable depth. Its maximum development is round Pleinmont in extreme exposure.

Corallina officinalis is at first short and tufted, increasing gradually in length as low-water mark is approached: it is replaced at low-tide level by *C. squamata*. *C. corniculata* and *C. mediterranea* appear with greater protection from storms.

Lithothamnion Lenormandi is always the uppermost of the calcareous encrusting species, appearing a little above the Mid-littoral. It prefers shady positions in chinks and crannies where some moisture is retained, and descends below half tide, mingling with and giving place to *L. incrustans*.

The delicate and beautiful *Lithophyllum lichenoides* forms a constant feature on the upper edges of rock-pools from half down to low-tide levels along the west, east, and north coasts. *L. incrustans* lines basins and pools up to the water's edge, then ceases abruptly, being unable to withstand desiccation. It occupies the lower Mid-littoral from about half tide to nearly low-water mark, and then mingles with *Lithothamnion polymorphum*. Where rocks have a smooth surface these Lithothamnions, by lining the pools and basins, create a roughness which affords a foothold for other algæ. *L. polymorphum* belongs exclusively to the Sub-littoral regions and beyond. It has a rounded knobby thallus.

Sub-littoral Region.

The various species of brown algæ connecting the Sub-littoral with the Littoral region, form a more or less continuous band along the shore, consisting chiefly of *Bifurcaria tuberculata* and *Cystoseira* spp. Where conditions of moderate shelter prevail, *Himanthalia lorea* mingles with the *Bifurcaria* or forms patches over the rocks and boulders at the same level; but with extreme exposure it disappears from the open and occurs only in locally sheltered pools. The condition of things therefore differs from that described by Cotton for Clare Island where he alludes to the plant as characteristic of moderately exposed shores. On the other hand, his statement that this alga is of a surf-loving habit in the British Isles is fully corroborated in Guernsey.

Zone of Calcareous Algæ.

The Zone of Calcareous Algæ is continued from the Littoral and extends far down into the Sub-littoral region, mostly as an undergrowth of other species. *Corallina squamata* and *Lithothamnion polymorphum* are most in evidence; they flourish best in fully exposed situations. With more moderate conditions, the following plants are often found creeping over the surface of *L. polymorphum*: *Gelidium crinale*, *Nitophyllum ramosum* f. *repens*, *Zonaria parvula*.

Laminaria Zone.

Owing to the impossibility of obtaining a boat except along the east coat, the study of the Laminarias was limited to observations at spring tides or of the weed thrown up on the shore. The enormous quantities of the latter heaped up in banks along the west coast, especially in autumn, lead one to conclude that there must be an extremely wide Zone of the genus in this district. Further round the island the débris decreases considerably, so possibly the Zone is narrower along the other shores. The influences of climate on a genus, resulting as pointed out by Cotton in changes of species according to changing conditions, are clearly illustrated by the Laminarias of Guernsey.

In the exposed type of flora, round Pleinmont, the *Laminaria* Zone consists in its upper portion of *L. digitata* and *Saccorhiza polyschides*, whilst extremely low tides reveal the presence of *L. Cloustoni*. Those plants nearest the shore are short, further out they increase to 3 or 4 ft. in length. The rough stipes of *L. Cloustoni* bear a plentiful crop of epiphytes, among which may be mentioned *Ectocarpus siliquosus*, *Rhodymenia palmata*, *Ptilothamnion pluma*, *Delesseria sinuosa*, *D. alata*, *Phyllophora palmettoides*, *Polysiphonia urceolata* var. *patens*, *Lomentaria articulata*. A plentiful growth of *Callithamnion tetragonum* occurs on the blades of *L. digitata*.

The epiphytes on the stipes of *Sacchorhiza polyschides* are *Ectocarpus Hincksiæ*, *E. arctus*, *E. Crouani*, *Myrionema reptans*, a thick felt of *Chantransia Lorrain-Smithiæ*.

Curiously enough some large and fine species of *L. saccharina* were seen in this district usually connected with shelter, they had possibly grown in deep fissures.

In the Flora of Type II., the Semi-exposed, along the west coast, there is first a small amount of *L. saccharina* mixed with *Chorda filum* and *Ulva latissima*; these are succeeded by *L. digitata* mixed with *Sacchorhiza polyschides*, whilst still further out *L. Cloustoni* becomes the dominant species. As shelter increases *L. saccharina*, the characteristic plant for protected areas, gains ground and finally displaces other species. It is almost the only *Laminaria* found in secluded creeks and quiet bays.

L. Cloustoni was not observed along the east and south coasts: it may have been overlooked. As the open sea is the more suitable habitat for this plant, viz. along the north and west coasts of Guernsey facing the English Channel, it is possible that the narrower and more confined waters between the Channel Islands and the French coast are less favourable to its growth.

(*d*) Pool Vegetation.

Shore pools above high-water mark are more or less brackish, as they collect rain water and are rarely flushed by the sea. Most of them are shallow and fully exposed to the sun's rays, and therefore during summer become quite warm. They contain few algæ; *Enteromorpha intestinalis* is the most frequent. In pools lower down,

within reach of the tide, *Cladophora* spp. and *Chætomorpha* spp. make their appearance.

Half-tide pools are sometimes shallow, with sand and pebbles. They contain such species as *Asperococcus fistulosus, Polysiphonia nigrescens, Cladophora rupestris,* and *Rhodomela subfusca.* Where the bottom is rocky, *Padina pavonia, Halopithys incurvus, Polysiphonia elongata,* etc. grow luxuriantly; whilst *Gelidium pulchellum, Griffithsia* spp., *Callophyllis laciniata, Laurencia* spp., *Lithothamnion Lenormandi,* etc. are to be found where there is sufficient shade.

Below half tide the vegetation of rocky pools becomes varied and abundant, including many sublittoral species. The edges of some pools are lined with the beautiful and brittle *Lithophyllum lichenoides,* below which there is a heavy growth of *Bifurcaria tuberculata* or *Cystoseira* spp. At the lower depth *Nitophyllum uncinatum* or *Calliblepharis lanceolata* send up hooked shoots which climb among the brown weeds. Other pools contain *Bryopsis plumosa, Codium tomentosum, Enteromorpha clathrata, Cladophora pellucida, C. distans, Dictyota dichotoma, Nitophyllum punctatum, N. ramosum, N. Hilliæ, Delesseria sanguinea, Chylocladia ovata,* etc.

Corallines and Lithothamnions line the bottoms of most of these pools with their pink and mauve incrustations: *Corallina officinalis, C. squamata, Lithophyllum incrustans, Lithothamnion polymorphus* are the most conspicuous species.

V. Composition of the Flora.

The mixed character of the Marine Flora which flourishes on the shores of Guernsey is doubtless owing to the geographical position of the island, which is so situated (see p. 26) that it lies well within the range of the Atlantic Flora. Guernsey is sufficiently near the shores of the English Channel and the west coast of France to participate also more or less in the type of vegetation fringing these littorals; this is composed very largely of a southern type of Flora, along with certain types of Atlantic and cosmopolitan marine vegetation.

Northern Element.

There is in Guernsey a well-marked element which belongs to the vegetation of the North Atlantic, a Flora which extends to the Norwegian Polar Sea; many of the species, however, do not penetrate farther north than Scotland or the Faeröes. Owing to the influence of the Gulf Stream, which flows along the coasts of Norway and round Cape North, the temperature there is much higher than in other parts of the Polar Seas, so that the district characterised by Kjellman as the "Norwegian Polar Sea" is not purely Arctic; the Flora there is very closely allied to that of the North Atlantic, and is of varied composition with luxuriant littoral and tidal-pool vegetation. Brown algæ are dominant, though green algæ are abundant, with a fair number of red species. Southwards, this Flora ceases gradually along the Scotch and English coasts, the coasts of Spain forming the southernmost limit of many species.

Pylaiella littoralis var. *varia* has not been recorded further south than Scotland; it is a native of the Norwegian Polar Sea, and occurs also in the Arctic Seas. The presence of this plant in Guernsey is unaccountable: it may have travelled southward in a current that flows down the east coast of England, and, being caught in some of the cross-currents of the Channel, have drifted finally to Guernsey; or it may have been brought by some other agency, such as ships or even sea-gulls. *Alaria* is also a northern species belonging to the Faeröes. The Atlantic coast of France forms the southern limit of its distribution; it has been found in Guernsey and Alderney. According to Sauvageau, *Chorda filum* descends as far south as Gigon in Spain, but specimens have been found in the Mediterranean; the same writer also mentions the Corogne as the southern limit of *Acinetospora pusilla*. *Fucus serratus* is said by Harvey to extend as far as Spain: it does not occur in the Mediterranean; while Crouan has noted that *Tilopteris Mertensii* ceases to appear beyond the Spanish coasts.

The following are some northern elements of the Atlantic Ocean and the Norwegian Polar Sea which also exist in the Guernsey Flora: those marked with an asterisk occur also in the Arctic Seas:—

Bolbocoleon piliferum.
*Rhizoclonium riparium.**
*Cladophora glaucescens.**
*C. arcta.**
C. lanosa.
*Desmarestia viridis.**
*D. aculeata.**
*Dictyosiphon fœniculaceus.**
Lithosiphon Laminariæ.
*Punctaria plantaginea.**
Ectocarpus tomentosus.
E. Lebelii.
Pylaiella littoralis var. *varia.**
*Myriotrichia filiformis.**
*Elachistea fucicola.**
*Sphacelaria olivacea.**
*S. cirrhosa.**
Myrionema reptans.
*Cordaria flagelliformis.**
Castagnea virescens.
C. divaricata.
Leathesia difformis.
Chorda filum.
Laminaria saccharina.
L. digitata.
L. Cloustoni.
Alaria esculenta.
Fucus spiralis.
F. vesiculosus.
F. serratus.
Ascophyllum nodosum.
Pelvetia canaliculata.
Himanthalia lorea.
*Porphyra laciniata.**
Chantransia virgatula and var. *secundata.**
*C. Daviesii.**
Gigartina stellata.
Phyllophora membranifolia.
*Rhodymenia palmata.**
Phycodrys rubens.
*Delesseria sanguinea.**
D. alata.
D. angustissima.
Polysiphonia fibrillosa.
P. nigra.
Callithamnion polyspermum.
C. Hookeri.
Plumaria elegans.
Ceramium acanthonotum.
Polyides rotundus.
Petrocelis cruenta.
Epilithon membranaceum.

There is moreover in the Atlantic Flora an endemic Arctic element, which, according to Kjellman, originated in a glacial sea and passed

from thence into the North Atlantic. The Arctic Algæ occurring in Guernsey are given below; they are also common to the English and French coasts, and three of them, marked with an asterisk, are cosmopolitan :—

Rhodochorton Rothii.
*Fucus vesiculosus.**
F. ceranoides.
Chorda filum.
Ralfsia deusta.
Elachistea fucicola.
*Scytosiphon lomentarius.**
Desmarestia viridis.
D. aculeata.
Dictyosiphon fœniculaceus.
Chætopteris plumosa.
Ectocarpus confervoides.
*Pylaiella littoralis.**
Enteromorpha compressa.
Rhizoclonium riparium.
Urospora penicilliformis.
Lithothamnion polymorphum.
Rhodymenia palmata.
Ahnfeltia plicata.
Ceramium rubrum.

The origin of this Arctic element is graphically described by Borgesen, from whom the following is taken :—"The European-American algal Flora of the North Atlantic has originated from a mixture of Atlantic and Arctic species. In tertiary times there was a land-connection reaching from Europe by means of the Faeröes and Iceland to America. . . . . The Arctic Flora has gradually developed north of the land-connection; it is an old Flora, which has developed in the seas about the Pole, and has been very rich in endemic species. But when the land-connection was broken up, probably in the later tertiary period, a commingling of the species from the two formerly separated territories began and continued into the Glacial Period. During the latter, when the Polar Sea and the northern part of the Atlantic Ocean were covered by great masses of ice, the algal Flora was forced to go southwards, so that a Flora of Arctic character probably occurred as far down as the coasts of South England and North France. On its way south, however, this Arctic Flora met and became intermingled with the species of the Atlantic Flora, which had been able to resist the climatic changes. When the ice again receded after the Glacial Period, this algal flora, now composed of species from two different territories, again wandered towards the north, yet a few Arctic forms which were able to adapt themselves to a higher temperature remained on the coasts of England and France, while others withdrew to the Polar Sea proper."

Southern Element.

The southern element of the Guernsey Flora includes a very large number of Mediterranean species ; some are even natives of the Indian Ocean, Brazil, West Indies, etc. There is a continual immigration northward of these southern species ; many have long established habitats in the warmer parts of the Atlantic Ocean, whence they have travelled to the shores of Northern France, Guernsey, South of England, and even Scotland. The *Florideæ* dominate the southern type of Flora, though the *Phæophyceæ* and

Chlorophyceæ are fairly well represented. The following are some of these more southerly forms:—

Oscillatoria Corallinæ.
O. amphibia.
Isactis plana.
Phæophila dendroides.
Cladophora prolifera.
C. Hutchinsiæ and var. *distans.*
C. rectangularis.
C. repens.
Codium Bursa.
Phycolapathum crispatum.
Ectocarpus Vaillantii.
Myriactis pulvinata.
Halopteris filicina var. *sertularia.*
Mesogloia Leveillei.
M. lanosa.
Castagnea contorta.
Petrospongium Berkeleyi.
Zanardinia collaris.
Cutleria multifida.
Aglaozonia reptans.
Cystoseira ericoides.
C. granulata.
Taonia atomaria.
Padina Pavonia.
Dictyopteris membranacea.
Gelidium attenuatum.
Gymnogongrus patens.
Callymenia microphylla.
Halopithys incurvus.
Polysiphonia opaca.
P. obscura.
Ctenosiphonia hypnoides.
Spermothamnion irregulare.
Bornetia secundiflora.
Pleonosporium Borreri.
Callithamnion byssoides.
Antithamnion crispum.
Grateloupia filicina.
G. dichotoma.
Nemastoma dichotoma.
Lithophyllum expansum.

Besides these there is a considerable number of species having a wide range in the Mediterranean and the Atlantic.

The following species, though occurring here and there on the French and Spanish coasts, have not yet appeared farther north than Guernsey:—*Polysiphonia obscura,* native of Cadiz. Adriatic Sea; *P. opaca,* native of the Mediterranean; *Ctenosiphonia hypnoides,* native of Spain; *Nemastoma dichotoma,* native of the Mediterranean; *Lithothamnion expansum,* native of the Mediterranean. All these are purely southern forms, and may possibly be considered as aliens, but it is quite likely that their range will extend, and in the future, when fully established, they may come to be regarded as part of the British Flora.

The following is a comparison of the Guernsey Flora with neighbouring coasts, etc.:—

There are 350 species and 78 varieties and forms of Marine Algæ hitherto found in Guernsey, of which 382 species and varieties are common to the south of England and 333 to Ireland. There are also 43 species and varieties which do not occur on the southern shores of England; 32 of them are found in Ireland and North Britain, 10 being of a southern type, and one is a new species. The close connection of the Guernsey Flora with Ireland and the south of England is therefore evident. On the other hand, there is rather more of the Atlantic element in Guernsey than in the south of England, and in a certain number of cases the southern element differs slightly. Some species grow along the English coasts which are wanting in Guernsey; other species occur in Guernsey which have not yet been found along the southern shores of England.

As regards the Continent, Guernsey has 356 species and varieties in common with the north and west coasts of France, and 230 in common with North Spain; so that here again there is a great affinity, though in a lesser degree. The Flora of Guernsey corresponds more to the British than to the continental type of marine vegetation.

The species listed for Jersey number 317, with 54 varieties and forms; of these, 264 species and varieties are common to Guernsey. Guernsey has 161 species and varieties not yet recorded for Jersey, as against 81 Jersey species and varieties not recorded for Guernsey. Mr. Lester Garland attributes the differences in the terrestrial Floras of the two islands to the variations of level owing to their complete or partial submergence at different periods, leading to the destruction of certain species. Inversely, it is possible that periods of elevation of varying degree to which the islands have also been subjected in past ages, may have caused the disappearance of many Marine Algæ.

The ecological factors that prevail in Guernsey are often different in Jersey: thus Jersey lies farther to the south and is less open to the influence of the Channel Stream bringing various new elements in its wake; the shores are more protected by the coasts of France, and the climate is warmer than that of Guernsey; the configuration of the coast is different, being characterized by wide sandy bays on the south, west, and east, the shores having a very gradual incline, while on the north there are high standing cliffs. These are only a few of the physical conditions that would tend to control the character of the Floras of Jersey and cause it to differ from that of Guernsey.

VI. Economics.

The inhabitants of Guernsey utilise the abundant harvests of marine vegetation to a considerable and praiseworthy extent. At stated seasons of the year the *vraic* (Fuci, etc.) is cut, and enormous masses of weed, thrown up especially on the west coast, are gathered from the shores, to the extent, according to Black, of at least 30,000 tons annually. While these activities are in progress, as many as twenty or thirty carts can be seen on the beach, whence they bring a varied assortment of species. Both drift and cut weed are spread on the adjacent land to dry; some is used for fuel, the rest burnt for kelp or employed as manure.

Kelp.—There is much indiscriminate burning of weed for kelp by the cottagers, who sell it for about 1*s.* per bushel. It varies in quality according to the species burnt. Sharp practice occurs among the less honest of the burners, who only partially burn the weed and even mix it with sand to increase the bulk.

The late Mr. Best of Guernsey established factories for preparing potash and iodine, which found a ready sale on the island: he told me that drying-frames had been erected on the island of Lihou in stacks one above another with intervals of about 18 inches between each; the weed was placed on the frames or racks and dried in the open. There was also a drying machine heated by the burning weed, and kelp was thus produced at the same time. The work met with such success that in 1916, 18 tons of 90 % muriate of potash, and over 18 tons of chloride of sodium containing 15 % of sulphate of potash

were obtained from seaweed. Mr. Best's success in extracting potash with the methods at his disposal, justify one in raising the question whether the vast quantities of weed that are allowed to rot on our coasts might not be utilized to some profit. He was of the opinion that this might be done if the problem of labour could be solved.

Manure.—The farmers plough the weed into the ground and use it in a general way. There is an old Guernsey saying: "No seaweed no cornyard." The advantages of using seaweed as manure are detailed in a pamphlet published by the Board of Agriculture and revised up to 1913. It contains much valuable information as to chemical constituents, etc.

Fodder.—Although it is known that the sheep on L'Ancresse common stray over the shores and browse with gusto on the Fuci, nothing is done on the island by way of utilizing seaweed as fodder. *Fucus vesiculosus* might well be used for this purpose in winter, while *Chondrus crispus* is valuable in fattening calves and pigs. Incidentally, it is interesting to note that successful experiments have recently been made with Laminarias as forage for horses instead of oats. The algæ were prepared and given to the animals, who accepted, digested, and assimilated the novel food.

Food for Man.—Considerable attention has been directed towards the use of seaweeds as food for man, more especially during the late War. According to Alsberg there is no proof that seaweeds have more than a moderate food-value, though they have a considerable value as antiscorbutics like cabbage and lettuce. Almost nothing is known about the proteids of seaweeds; but according to Cameron they have not anything like the food value of cereals. The value of seaweeds as a food is to a large extent due to the mucilage produced by the membranes of the cellular tissue, which is rich in pectics and hemicelluloses; it dissolves readily in boiling water and forms a jelly when cold. On account of this property the attention of experts is being directed towards the utilization of seaweeds both in cookery and in various commercial preparations.

Very little, however, is known about the chemical composition of these membranes. Among the green seaweeds the cellulose is associated with hemicellulose, a substance soluble in 3% sulphuric acid and containing a great abundance of xylane; there is also an insoluble portion rich in dextrane. Another hydrocarbon which has been detected in *Fucus* is called "fucine"; it is soluble in 1% sulphuric acid, and turns blue with iodine; it is localized in the middle lamella. Again, dextrose, and methylfurfurol occur in the brown algæ. The red seaweeds, according to Perrot & Gatin, contain galactans, mannans, lævulosans, dextrans, and sometimes methylpentosans. Some of these complex carbohydrates are a possible source of energy, but how far is not known. Fat is a negligible quantity.

As regards the general constituents of seaweeds, the analyses below indicate to some extent how far one is justified in considering the value of seaweeds as food.

Analyses by Turrentine (Cameron).

Gelidium corneum.

Water	22·29
Protein	6·85
Carbohydrates	60·32
Ash	3·81
Fibre	6·73

Laminaria spp.

Water	22·82–24·44
Protein	5·49– 5·82
Fat	1·52– ·74
Soluble non-nitrogenous material	47·83–45·57
Fibre	4·55– 6·44
Ash	18·69–17·00

Of other substances found in seaweed, bromine occurs more abundantly in *Fucus serratus*; *Laminaria digitata*, *L. saccharina*, and *F. vesiculosus* are richest in iodine, *Saccorhiza bulbosa* containing somewhat less. It is not yet known whether this element is contained in the form of alkaline salts or in organic combinations.

Perrot and Gatin state that minute quantities of arsenic have been found in marine algæ: it is possible that the tonic properties with which food or medicine prepared from seaweed is credited are owing in some measure to the presence of this substance.

The incrustations of calcareous algæ when produced in large quantities have a manurial value. Along the west coast of Ireland there are beaches composed of broken fragments of Lithothamnions, cartloads of which are conveyed inland for the sake of the carbonate of lime as a soil-dressing (Cotton). In Guernsey it would be quite possible to collect appreciable amounts of the calcareous algæ for agricultural purposes.

For suggestions of what might be done with our seaweeds, I have had recourse to Cameron's Report on the Fertilizer Resources of the U.S. of America, 1911, from which the following particulars have been extracted:—

Formerly the Americans imported the whole of their potash for agriculture and other purposes; they are now working up the resources of their own country, mineral and marine. A yield of $16,000,000 worth of potash has already been obtained from seaweed, and by organization of the industry and regulation of the harvests and preparation of the weeds, it is proposed to build up a recognized source of wealth and industry for that nation. Recent experiments have discounted the methods of drying and burning, whereby many valuable constituents of the seaweed are lost or destroyed; and the

burning of seaweed for the sole purpose of obtaining *iodine* has been compared to the wastefulness of using mahogany for firewood, or "burning down a cottage to boil a kettle." By the newer methods, all the soluble salts and a maximum amount of iodine can be extracted from seaweed. In addition, the production of certain residuals and by-products, as a result of these methods, seems to possess such a possible future value in textile and other industries as to warrant a return to the utilization of seaweed for the production of iodine. Thus, when seaweed is submitted to the process of partial burning and distillation in closed retorts, a porous and valuable charcoal results, from which all the soluble salts, including the iodides, can be dissolved out with readiness, leaving such residuals as ammonia, tar, and paraffin oil. This marine charcoal might serve as a fuel under the retorts or pans used for the purposes of distillation. Its extreme porosity makes it an effective deodorant and decolorizer and a valuable filter, for it has been subjected to the thickest town-sewage for several months without the least clogging, and its efficiency after this treatment remained unimpaired. As a substitute for bone-black, it is most highly recommended. The oily tar produced by the distillation of seaweed mentioned above, yields, on redistillation, large quantities of paraffin oil. As much as 617 galls. of oil can be obtained from one ton of Fucus.

In another method, devised by Stanford, the seaweed was submitted to repeated direct lixiviations or macerations in dilute solutions of carbonate of soda or other alkaline substances. After obtaining the requisite salts and iodine, the residuals were algin, cellulose, and dextrin.

Algin, when treated with sulphuric acid and other chemical processes, becomes a hard horn-like substance, having properties that enables it to be used as a substitute for india-rubber and parchment.

Sodium alginate, a derivative of algin, is a gum possessing 14 times the viscosity of starch, and 37 times that of gum arabic; it is distinguished from albumen in not coagulating by heat. It could be put to varied uses such as a mordant in dyeing and in sizing cloth; in cookery it might be used in thickening soups, puddings, and jellies. In pharmacy it would be useful as an excipient for pills, an emulsifier of oils, and for softening water. Mixed as a binding with charcoal, sodium alginate might serve as a coating for boilers and metal work; combined with shellac it forms a fine varnish, and owing to its resemblance to gutta percha it is said to be a good insulator. Cellulose, if combined with other materials which furnish the requisite amount of fibre, can be made into paper of an excellent grade.

Knife-handles are made by cutting lengths of *Laminaria Cloustoni* stipes and forcing blades into them. When dry the latter remain firmly fixed, and owing to the irregular shrinkage of the portions they assume a roughness similar to staghorn. Such handles are used in Scotland and in various parts of S. America. Imitation citron, orange and lemon-peel are made at Seattle from the bulbs and hollow parts of the stipes of *Nereocystis Luetkeana*, one of the large

Laminariæ. After the salts have been extracted the portions are boiled in flavoured syrup. "Seatron" is the name given to these preparations.

According to a writer in *Chambers's Journal* for 1917 (p. 555), seaweed is one of the many sources for obtaining *acetone*, a chemical used in the manufacture of *cordite*. Large quantities are obtained and used for that purpose in America.

Culture.—In view of the careful culture of seaweeds in Japan, as narrated by Yendo, and their productiveness as a source of revenue, it seems worth while to give the matter some attention. There is no necessity to sow the spores: a suitable substratum alone is requisite. In Scotland and Ireland where Fucus farms exist, stones are set down on flat sandy or muddy fore-shores on which abundant growths of vegetation soon appear. The rocky shores of Guernsey hardly require such preparation. Should, however, the seaweed industries of the Island increase, and necessitate further supplies of the weed, its growth might be augmented by putting down boulders and stones of suitable size, where there is a sandy bottom. The vast tracts in Grande Havre, on either side of Lihou causeway, and along the Vale coast, etc., could be treated in this way.

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