NEW OR CRITICAL
CALCAREOUS ALGÆ

BY

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The following preliminary communications about some new species or forms of calcareous algæ from different tracts as well as a few formerly described but hitherto not well known species will on a subsequent occasion be followed by a number of pictures.

Litothamnion brachycladum Fosl. mscr.

Thallus forming roundish balls of radiating short, 3—6 mm. thick branches which are knotty and rugged, more or less anastomosing and fastigiate, often with thickened ends. Conceptacles of sporangia seen from above 500—700 μ in diameter, slightly prominent and a little flattened in the central parts. Sporangia four-parted, 180—220 μ long and 70—80 μ broad.

The present species bears a striking likeness to coarse specimens of *Lithophyllum racemus* f. *crassa*. I have seen but a solitary specimen furnished with conceptacles of sporangia in the collection of British Museum. It is probably the same specimen referred by Prof. Dickie[1]) to *Lithophyllum racemus*, and not unlikely also the species mentioned by Melliss[2]) under the same name.

The conceptacles of sporangia are partly scattered partly rather densely crowded in the upper part of the branches, slightly prominent and as a rule a little flattened in the central parts, here traversed by about 40 delicate muciferous canals. The sporangia are four-parted, 180—220 μ long and 70—80 μ broad. The conceptacles at length grow down into the frond.

In structure it does not show any regular development. On a longitudinal section of a branch is to be seen indistinctly cup-

1) G. Dickie, The Marine Algæ of the Island of St. Helena. Linn. Soc. Journ. Bot. Vol. 13. Pag. 179.

2) J. C. Mellis. St. Helena: A Physical, Historical, and Topographical description of the Island, including its Geology, Fauna, Flora, and Meteorology. London 1875. Pag. 382, No. 1052.

shaped layers of tissue, the cells of which frequently are rectangular, 9—14 μ long and 7—8 μ broad, sometimes however smaller with rounded corners.

The said specimen has been dredged off St. Helena, but the depth is unknown.

Another but steril specimen in British Museum's herbarium according to the label from „Ilha do Principe — Welwitsch iter angolense" seems to belong to the same species. However, the structure has not been examined.

In Thuret's (Bornet's) herbarium is a steril specimen from Gran Canaria collected and determined as *L. racemus* by Vickers[1]). Also this resembles *Lithoph. racemus* in habit, but differing so much in structure that it cannot be referred to this. It is smaller and the branches not so coarse as the above quoted specimen of *L. brachycladum,* but it probably is to be referred to this species, as it stands very near to it in structure, only the cells most often a little smaller than the above quoted measures, and the corners of the cell-rooms frequently more rounded.[2])

Thus it seems as if the species in question is rather widely dispersed comprehending forms similar to those in *Lithoph. racemus.* It probably occurs nearly all along the west coast of Africa, while *L. racemus* is not with certainty known from this part of the African coast, but is on the other hand dispersed from the Mediterranean through the Red Sea and towards the south-eastern coast of Africa, apparently also following the coast of Asia even to Japan according to specimens however not yet quite determined.

Lithothamnion brasiliense Fosl. mscr.

f. *genuina.*

f. *heteromorpha* Fosl. mscr.

Thallus at first forming thin crusts on shells, from which issue subdichotomous branchsystems, at length forming angular balls

[1]) A. Vickers, Contribution à la flore algologique des Canaries. Annales des sciences naturelles. Ser. VIII. Bot. T. 4. Pag. 293.

[2]) There is also another and steril specimen referred to the same species, but different from the present.

about 4 cm. in diameter. Branches short, 2—3 mm. in diameter, with rounded ends, in f. *heteromorpha* branches very short with rounded-thickened ends. Conceptacles of sporangia subprominent, 450—600 μ in diameter. Sporangia 100 by 30 μ.

I have seen but one specimen of each form. The form *genuina* is attached to a fragment of a shell which it at length surrounds, forming a crust about 0.5 mm. in thickness, from which issue subdichotomously divided, short branches, in the lower part frequently much anastomosing, upwards more free, subfastigiate, with rounded ends. This form approaches in habit the above mentioned delicate form under *L. brachycladum.*

The form *heteromorpha* rather differs in habit from f. *genuina.* It agrees with the latter as regards the conceptacles, and in structure it also very nearly accords with this form. On the other hand, it has very much the habit of a small *Lithophyllum racemus* f. *crassa.* It is like f. *genuina* attached to a fragment of a shell. The branches are shorter, a little thicker and more fastigiate than in the said form, with rounded-thickened ends, here and there knotty, and forms a roundish ball about 2.5 cm. in diameter.

The subprominent conceptacles of sporangia are more or less crowded in the upper part of the branches, 450—600 μ in diameter seen from above, and flattened in the central parts, here intersected with about 30 delicate muciferous canals. They frequently at length grow down into the frond. The tetrasporangia are about 100 μ long by 30 μ. The walls between the sporangia are generally not dissolved. Especially overgrown conceptacles are in that case on a section easily to be confounded with the sporangia beds in *Archæolithothamnion,* sometimes forming a uniform bed even more than 1 mm. in length and of the same height everywhere, not unlikely owing to confluent conceptacles, with nearly cylindrical, densely crowded, emptied sporangia, with intervening, more-celled walls, and then much resembling the emptied sori in the said genus. However, this is not to be seen if a part of the roof of the conceptacle falls away which apparently often takes place. But it shows, on the other hand, a very close connection between *Lithothamnion* and *Archæolithothamnion.* Un-

fortunately the material at my disposal is too scanty to elucidate the significance of this connection.

A longitudinal section of a branch shows regular cup-shaped layers of tissue. In the upper part the cells are 14—24 μ long and 8—14 μ broad, the cell-rooms often with somewhat rounded corners and rather thick walls.

The species stands very near to *L. brachycladum* especially in habit, but is separated as regards the conceptacles, and particularly in structure.

It has been collected on the coast of Sao Sebastiao, Brazil, and kindly communicated to me by the Director do Museo Paulista, Dr. H. von Ihering. No. 1047 and 1048.

In Thuret's (Bornet's) herbarium are two specimens from Florida, collected by Wærdemann, one of which rather approaches the above f. *heteromorpha,* though still coarser and less branched, the short and in part undivided branches 4—5 mm. or more in diameter. It is steril but shows overgrown conceptacles of sporangia of about the same size as those in the present species. The structure also stands near to that in the latter, the cells, however, frequently being a little smaller. It perhaps represents a separate species, although the present one probably is much varying.

Lithothamnion japonicum Fosl. mscr.

The solitary specimen of this species that I have seen has the shape of a small bush, 3,5 by 2—2.5 cm. in diameter, and has been attached to the holdfast of a *Laminaria.* It is subdichotomously branched, with short, cylindrical, rather bent and somewhat spreading branches, almost uniform in thickness, 2—3 mm., here and there knotty, with rounded ends. The specimen is much burdened with *Squamariaceae,* other algae as well as divers extraneous objects. New formations occasionally are developed so as to cover these objects, and sometimes even looking as small independent crusts on the branches, or stretched between the lower part of two branches.

The conceptacles of sporangia are somewhat crowded in the upper part of the branches, convex but very little prominent,

200—250 μ in diameter seen from above, and the roof intersected with a small number of delicate muciferous canals. The conceptacles at length grow down into the frond in great numbers. I have not seen the sporangia.

A longitudinal section of a branch shows a rather indistinct stratification, according to a solitary section, the cells 12—15 or up to 18 μ long and 7—9 or up to 11 μ broad, but on the whole rather varying.

The species stands very near to *L. glaciale,* but approaches, on the other hand, certain forms of *L. Ungeri* in habit.

It has been found at Mororan, Prov. Iburi, on the Pacific coast of Japan, where coald and warm currents mingle. Prof. K. Miyabe. No. 7.

Lithothamnion Dickiei Fosl. mscr.

Lithothamnion polymorphum Dickie Linn. Soc. Journ. Bot. Vol. XV. Pag. 452.
„ imbricatum Dickie, herb.

In British Museums and Kew Gardens herbarium ar some few mostly fragmentary specimens which partly are named *L. imbricatum* partly have been referred by Dickie l. c. to *L. polymorphum.* On one of the labels is written: „*Lith. imbricatum* n. sp. Fronde adnata, super repititim imbricata, lamellis crassis, ramis subhorizontalibus, compressis, lobatis, apicibus obtusis. Keramidiis minutis, dense aggregatis, hemisphericis. 3—4 inches, much imbricated, lobed and branched. Colour very pale green". It appears however, as if Prof. Dickie afterwards has referred the species to *L. polymorphum.* In Suppl. Alg. Tahiti[1]) it is mentioned such: „„A calcareous alga in rounded masses forming the bottom in 10 fathoms off Great Island (Santa Cruz Major), Zambonga. The dredge came up filled with this masses"". „*L. polymorphum*". Therefore, I make free to call this species after Prof. Dickie, who dealt with the algæ from the Challenger expedition.

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[1]) Dickie, Notes on algæ collncted by H. N. Moseley of H. M. S. „Challenger", chiefly obtained in Torres Straits, Coasts of Japan, and Juan Fernandez. Linn. Soc. Journ. Bot. Vol. XV. Pag. 452: 8. Algæ eollected on the Reefs of Tahiti. 9. Supplement to preceding collection.

The plant is perhaps attached at first to some hard object, but afterwards detasches itself and lies free on the bottom. The thallus has a short, either flattened and upwards broadening, or extremely short and almost terete mainstem, from which there issue repeatedly subflabellate or irregular branchsystems spreading almost in one plane, the one over the other. The more or less compressed branches are about 1.5 mm. thick, and frequently much confluent with each other. The tips of the branches partly are rounded partly almost truncate. The solitary apparently entire specimen that I have seen is 7.5 by 5.5 cm. in diameter and about 2 cm. thick.

The conceptacles of sporangia are scattered or somewhat crowded, but upon the whole very scarce in the specimens examined, subprominent, seen from above 350—400 μ in diameter, flattened in the central parts, or almost disk-shaped, though sometimes not sharply defined. The roof is intersected with about 30 coarse muciferous canals. Sporangia not known.

A longitudinal section of a branch shows indistinct stratified tissue, the cells nearly always longer than broad, with thick walls, according to a solitary section 10—18 μ long and 7—12 μ broad.

The only locality known is Prospeetee Harbour, off Tahiti, 20 fathoms. Cp. the locality above stated.

Lithothamnion superpositum Fosl. mscr.

Thallus forming irregular crusts growing over each other, sending forth short, simple or irregularly divided, knotty branches about 2 mm. thick. Conceptacles of sporangia rather crowded in the branches, subprominent, 400—500 μ in diameter, depressed in the central parts.

I have seen but a solitary specimen of this characteristic species, the longest diameter at the base being about 2,5 cm. and of about the same height. It has been fastened to the rock or any hard object, at first forming irregular crusts growing over each other, in part also over a small tuft of *Corallina,* and especially in the central parts rising to a height of about 1 cm., forming irregular cup-shaped layers of knotty crusts here and there sending forth short branches, but from the central part of the last developed

crust it sends forth a bundle of simple or irregularly and scantily divided, short and rather anastomosing branches up to a height of about 1 cm. The branches are about 2 mm. thick with rounded tips. Also the lower parts of the crust occasionally issue short and simple branches.

The conceptacles of sporangia are rather crowded especially in the upper part of the branches, subprominent, 400—500 μ in diameter, at first convex but afterwards depressed in the central parts and here intersected with about 25 rather delicate muciferous canals. The latter are not visible till the roof becomes depressed, and this depression appears perhaps to be due to a decortication of the named parts. I have not seen the sporangia, as several conceptacles examined have been attacked by inferior animals, and the sporangia destroyed but not the conceptacle itself.

A longitudinal section of a branch shows regular cup-shaped layers of tissue, the upper cells of which are rectangular, often with rounded corners, 12—20 μ long and 7—10 μ broad.

The plant appears to be most nearly related to *Lithothamnion Bornetii,* the conceptacles much resembling those in the latter, only larger, but also differing by the crust sending forth short branches, as well as with reference to the structure.

It has been taken at the Cape of Good Hope, but the locality is unknown to me, kindly communicated by Dr. H. Becker.

Lithothamnion erubescens Fosl. mscr.

Syn. Lithothamnion mamillare Dickie.[1])

Thallus forming on corals or rocks up to 0.7 mm. thick crusts from which issue subdichotomous, crowded branchsystems, with terete or subcompressed, 1.25—1.75 mm. thick, short, fastigiate

[1]) Dickie, Enumeration of Algæ from Fernando-Noronha. Linn. Soc. Journ. Bot. Vol. XIV. Pag. 363.

Report on the Botany of the Bermudas and various other Islands of the Atlantic and Southern Ocean: Fernando-Noronha and Contiguous Islets. Rep. Challenger Exp. I. Sec. Part. Pag. 27.

The specimens under the above name determined by Dickie include more than one species, but not identic with *G. mamillare* (Harv.), according to authentic specimens of the latter that I have seen.

branches. Conceptacles of sporangia subprominent, 300—400 in diameter.

The specimens that I have seen are 3.5—4.5 cm. in diameter by a height of 2—3.5 cm. The crust appears frequently to be feebly developed, attaining a thickness of up to about 0.7 mm. and no considerable extent. It sends forth densely crowded, in old specimens repeatedly divided, subdichotomous branchsystems. The branches are short, terete or subcompressed, 1.25—1.75 mm. thick, fastigiate, especially in the lower parts much anastomosing. The ends are rounded, here and there thickened.

The conceptacles of sporangia are somewhat prominent, seen from above 300—400 μ in diameteter, the roof flattened in the central parts and here traversed by about 20 muciferous canals. The sporangia are unknown.

In a longitudinal median section of a branch are to be seen regular and distinct, more or less cup-shaped layers of tissue. The cells are commonly about twice as long as broad, with rather thin walls, or 12—22, frequently 15—18 μ long and 7—10 μ broad.

The species stands between *L. brachycladum* and *L. falsellum,* especially somewhat approaching the latter in habit, but also reminding one of delicate forms of *Lithophyllum racemus.*

It is only known from Chaloup bay, Fernando do Noronha (Brazil), Ridley, Lea and Ramage, according to specimens in British Museum.

Perhaps is *L. fasciculatum* Möb.[1]) from Bahia referrible to this species, although the ramification seems to be somewhat different.

Lithothamnion falsellum Heydr.
in Ber. d. deutsch. bot. Ges. Bd. 15. Pag. 414.

f. *genuina.*
Lithothamnion falsellum Heydr. l. c.

f. *plicata* Fosl. mscr.

In Ber. d. deutsch. bot. Ges. Bd. 15, Pag. 61 is described an alga under the name of *Lithophyllum Marlothii* Heydr. This

[1]) M. Möbius. Bearbeitung der von H. Schenck in Brasilien gesammelten Algen. Hedwigia. Bd. 28. 1889. Pag. 309. T. XI., fig. 14.

species is l. c. p. 410 and p. 414 divided into three differend species, in part with reference to the same figures, and one of the latter recorded under the name of *L. falsellum.*

I do not think to be in the wrong in referring some specimens from the Cape of Good Hope to the above species, which appears in two different forms. The one I consider the typical form of the species, and the other I propose to name f. *plicata.* This form differs from f. *genuina* the branches being more or less folded or plicate, regularly fastigiate and rather confluent with each other. It is a characteristic form and I have not seen any true transition to f. *genuina,* but it coincides with this as to the conceptacles of sporangia as well as in structure. However, in both forms I found the conceptacles intersected with 30—40 muciferous canals, and as regards the structure the measures given by Heydrich do not fully correspond with the general size of the cells in the specimens examined by me.

The species is hitherto only known from the Cape of Good Hope.

Lithothamnion synanablastum Heydr.
in Ber. d. deutsch. bot. Ges. Bd 15. Pag. 54.

f. *conspersa* Fosl. mscr.
Lithothamnion synanablastum Heydr. l. c.

f. *speciosa* Fosl. mscr.

This species appears like several other Lithothamnia to be much varying. In f. *conspersa* the surface is often more or less uneven, partly on account of the substratum partly owing to overgrown extraneous objects, but old specimens also produce wartlike or small branchlike excrescences. Sometimes more crusts grow over each other. In parts of old specimens I have seen up to three crusts, each loosely clinging to the subjacent and but here and there anastomosing. Otherwise this form clings rather firmly to the substratum especially in a young state.

The form *speciosa* is perhaps to be considered only a local form of the species, but, on the other hand, at first sight so remarkable that it makes the impression of a separate species, and

ought to be specially mentioned. It grows on dense tufts of other algæ. Over a very small primary crust is formed a 0.5—0.7 mm. thick crust of indefinate shape loosely clinging to the subjacent and the substratum, with more or less irregular surface, the edges free and frequently bent downwards, and with indistinct concentric striæ. It especially differs from f. *conspersa* being in the lower part provided with rather numerous rhizoids which often are cup-shaped and then much resembling those in *Lithophyllum expansum*. This in part free development corresponds with some modification in structure, though in the main coinciding with that in f. *conspersa* and especially in parts of that form with new and loosely connected crusts over each other. The structure is on the whole rather varying in the present species. The conceptacles of sporangia are similar in both forms.

With reference to relationship may be remarked, that f. *speciosa* much approaches in habit such forms of *Lithothamnion Muelleri* which cover the lower part or the root of other algæ, and especially resembling certain forms of *L. Engelhartii,* but differing as regards the conceptacles, and in structure most nearly agreeing whit that in the present species. However, I have seen but a solitary specimen.

Also this species is hitherto only known from the Cape of Good Hope.

Lithothamnion lichenoides (Ell. et Sol.) Fosl.

Norv. Lith. p. 7; Ell. et Sol. Zooph. p. 131.

f. *pusilla* Fosl. mscr.

Lithophyllum lichenoides Rosan. Melob. pl. 5, fig. 1 a. b. c.

Lithothamnion lichenoides f. epiphytica Fosl. On some Lith. p. 4.

f. *patena* (Hook. fil. et Harv.) Fosl.

List of Lith. p. 7; Melobesia patena Hook. fil. et Harv. Ner. austr. p. 111.

f. *depressa* Fosl.

Calc. alg. Fuegia (in press).

Melobesia lichenoides Harv. Phyc. Brit. pl. 346.

Lithothamnion lichenoides f. rupincola Fosl. On some Lith. p. 4; ex parte.

f. *agariciformis* (Johnst.) Fosl.

Calc. alg. Fuegia; Nullipora agariciformis Johnst. Brit. Sp. and Lith. p. 241, woodcut, no. 23.

Melobesia agariciformis Harv. Phyc. Brit. pl. 73. Non Aresch. in J. Ag. Spec. Alg. 2, p. 516.

Lithothamnion agariciforme f. hibernica Fosl. On some Lith. p. 5.

Millepora agariciformis Pall. Elench. p. 263?

f. *heterophylla* Fosl. mscr.

Lithothamnion agariciforme f. decussata Fosl. On some Lith. p. 5.

I do not include *Lithothamnion antarcticum* (Harv.) here, as I have not yet had the opportunity to examine authentic specimens. Cp. Fosl. Calc. Alg. Fuegia.

The above f. *pusilla* partly much approaches *L. antarcticum,* which as remarked l. c. scarcely is any separate species, partly showing transitions to f. *patena.* It also passes into f. *depressa* and is not any well defined form, but owing to its often peculiar development ought to be specially mentioned. As regards the structure in this form contrary to that of f. *patena* cp. Rosan. l. c. pl. 5, fig. 3, 4 and 14.

The form *depressa* is a characteristic form, recognisable by its more or less plain and imbricate lamels, sometimes with the edges bent a little downwards sometimes a little upwards, or now slightly convex now slightly concave, and in the latter case by and by passing into f. *agariciformis.* The semicircular or reniform lamels, with entire, crenate or slightly lobed and often more or less undulate margin, frequently are to be found in great number over each other, at length forming crust-complexes up to about 1.5 cm. in thickness. Old specimens sometimes are nearly loosened from the substratum which partly may be the rock itself partly at first dense tufts of *Corallina,* but then at length also spreading over the rock. In the Irish specimens examined the imbricating lamels are most commonly but here and there anastomosing, while in specimens from the Atlantic as well as Mediterranean coast of France the lamels sometimes are to be found coarser and more anastomosing, or sometimes forming an almost solitary, more or less extended crust closely clinging to the substratum, thus in fact even approaching *Lithothamnion Philippii* in habit.

The form *heterophylla* which once was considered by me to form a separate species together with the below mentioned f. *agariciformis* is in fact a form of *L. lichenoides*. Mediterranean specimens of this form on the one side stands near to f. *depressa* and, on the other hand, often rather approaching f. *agariciformis* in habit. However, it is coarser, the lamels larger and not so fragile as in the latter. It often has a tendency to develop plain or nearly plain lamels, although they are most frequently to be found more or less rising, curled round into little cups, or irregularly folded. Two lamels trumbling often rise against each other and grow upwards into irregularly folded forms or even double-walled cups. Sometimes the lamels are seen to be decussate, ur upon the whole much varying in shape.

A specimen that I have seen from the Chatam islands[1]) is to be referred to the same form. It is nearly hemispherical, about 6 cm. in diameter by a thickness of about 3 cm. in the thickest part. The lamels are smaller than in Mediterranean specimens but of about the same thickness, partly rather depressed and irregularly formed over each other partly with more or less cup-shaped or cupulate, now nearly free now hear and there anastomosing lamels. This specimen fully coincides in structure with Mediterranean ones, and also as regards the conceptacles of sporangia, except that the latter occasionally are slightly smaller.

With reference to f. *agariciformis* formerly considered as a separate species, there has been a good deal of dissent, or differently interpreted by different writers. The plant described by Areschoug l. c. under this name belongs to *Lithophyllum decussatum*. Cp. below. Hauch, Meeresalg. considers it a form of *Lithophyllum expansum*. It has also been considered identic with the plant mentioned below by the name of *Lithophyllum dentatum* f. *Macallana*.[2]) On the other hand it is impossible to know what underlies the description by Pallas. But the identily

1) Cp. Reinbold, Ergebnisse einer Reise nach dem Pacific (Prof. Dr. Schauinsland 1896—97). Meeresalgen. — Abh. Nat. Ver. Bremen 1899. Bd. XVI. Pag. 300.

2) Cp. Johnson, A List of Irish Corallinaceæ. — Scientific Proceedings of the Royal Dublin Society. Vol. IX. (N. S.). Part I. No. 3. Dublin 1899.

of the plants described by Johnston, Brit. Spong. and Lith., and Harvey, Phyc. Brit. is no doubt according to specimens in Science and Art Museum's herbarium, Dublin, and in other herbaria. However, the woodcut by Johnston l. c. gives a better idea of the plant in question than the picture by Harvey l. c. There seems perhaps to have been some mistake as regards the latter which partly resembles f. *agariiformis* partly reminds of *Lithophyllum dentatum* f. *Macallana*. However, the description by Harvey refers to f. *agariciformis* in the sense here taken, except that it is quoted to be hollow which scarcely applies to the latter but on the contrary to the said f. *Macallana*.

Among the specimens of f. *agariciformis* that I have seen the largest is about 16 by 11 cm. in diameter and about 4 cm. thick, but I am not quite sure whether they have in fact been taken at Roundstone, nor by whom collected, though probably either M'Calla or Dr. Farran. The plant is also said to have been collected at Roundstone by Dr. Robertson. The specimens are at any rate from the west coast of Ireland, but all of them unfortunately being sterile. At present I do not, however, hesitate to ascertain it a form of *L. lichenoides*. Cp. Harvey's remarks under the latter species in Phyc. Brit. pl. 346, and Manual, ed. 2, p. 109. It fully agrees in structure especially with f. *depressa*. As mentioned in A visit to Roundstone in April[1]) Mr. Hanna and I did not succeed in finding typical specimens of it, though in the lower part of the litoral region transitions were found. And from the Isle of Man I have seen small specimens which almost fully coincide with the said specimens in Science and Art Museum. They are furnished with typical conceptacles of sporangia.

The said form is quoted by Harvey l. c. to be found „lying on the sandy bottom of quiet bays, in 2—3 fathoms water". Johnston refers l. c. p. 241: „Dr. Farran of Feltrim near Dublin informs me that it is found on a small bank in water about fifteen feet deep, and appears like paving stones at the bottom: the only locality he knows is Roundstone bay, Connamara, where he observed it seven or eight years ago (Wm. Thompson)". I

[1]) The Irish Naturalist. Vol. VIII. 1899. Pag. 175.

have examined fragments of other algæ in one of the above mentioned doubtlessly authentic specimens. Here I found *Sphacelaria radicans* partly loose between the lower lamels partly one small specimen attached to the species in question. *Sph. radicans* grows according to Harvey on „sand-covered rocks, between tide marks". It scarcely descends to any greater depth. Besides I met with *Ceramium ciliatum, Cladophora* sp. (probably *Cl. albida* Phyc. Brit.) apparently loose, fragments of *Calothrix,* and some bleached *Protococcus*-resembling colonies. Thus it seems as if the present form occurs both in the lower part of the litoral region, which accords with the transitions Mr. Hanna and I met with at Roundstone, as well as farther down. It probably lives in somewhat sheltered places but scarcely in quiet bays which, on the other hand, is the case with *Lithophyllum dentatum* f. *Macallana,* a remarkable and large form strange to say not recorded by Harvey, although apparently collected in great number by M'Calla. Therefore as above remarked we may be allowed to suppose that some mistake has been committed in Harvey's communications.

In British Museum's herbarium is a fragmentary specimen of f. *agariciformis* exactly resembling Irish specimens, but it is labelled „West Indies". It is difficult to know whether this is wrong or not. However, it is recorded in Rep. Challanger Exp. Vol. I, p. 113 from Bermudas, Lefroy.

L. lichenoides is a well known species since long ago, but it has scarcely been considered so varying as is to be seen from the above remarks. I do not here mention more nearly the structure, in which respect it is somewhat varying, though not much, partly and most frequently with rather long central cells but now narrow now broader even in one and the same specimen, and here and there with remarkably short cells. The most characteristic form is in my opinion f. *heterophylla,* being coarser and commonly with a little smaller conceptacles of sporangia than in the allied forms, but not or very slightly varying as to structure. Otherwise the variation in this species is very often due to the shape of the substratum as well as in part local conditions.

Lithothamnion Muelleri Lenorm.

in herb.; Rosan. Melob. p. 101.

f. *cingens* Fosl.

Calc. alg. Fuegia.

Lithothamnion Muelleri Rosan. l. c. t. 6, fig. 8.

f. *neglecta* Fosl.

Calc. alg. Fuegia.

Lithothamnion lichenoides Dickie in Journ. Linn. Soc. Vol. XV. Pag. 200, and Phil. Trans. Royal Soc. London. Vol. 168, Pag. 58.

This species is like most other Lithothamnia much varying. The form described by Rosanoff l. c. accords with the original type, but is perhaps not to be considered the typical form itself of the species. I have named it f. *cingens,* because it frequently surrounds partly the stem partly also other parts of other and especially rather coarse cylindrical algæ. So it also covers the root of divers algæ and then forming transitions to f. *neglecta.* Such an intermediate form is probably that described by Heydrich in Ber. d. deutsch. bot. Ges. Bd. 15, Pag. 51 under the name of *Lithophyllum rhizomae,* with conceptacles of cystocarps, which in the present species generally are to be found in other individuals than those of sporangia.

In specimens of f. *cingens* surrounding other cylindrical algæ the crust sometimes send forth in a right angle lamels which grow free in a rather considerable extent, to a certain degree resembling the below mentioned formations in *Lithophyllum incrustans* and other species.

The form *neglecta* is characterized by its rather extended and more or less imbricate thallus, often with smaller or larger lamels which are more or less confluent, at length forming rather thick crust-complexes.

The present plant represents an intermediate species in a link of a group of the genus *Lithothamnion,* the species of which are mutually nearly connected, and apparently almost running into each other, as *L. lichenoides, L. Engelhartii, L. capense, L. kerguelenum* and *L. Philippii.* It is, however, on the one side most nearly related to *L. lichenoides* and on the other to *L.*

Engelhartii mentioned below, but also approaching *L. kerguelenum* and *L. Philippii,* while *L. capense* is as yet a species not at all well known and ought to be more nearly compared when larger material is procured than that I at present possess.

The most extreme limit of f. *neglecta* seems to be represented in the specimen mentioned by Dickie from Kerguelen land, referred by him to *L. lichenoides.* According to Dickie l. c. it has been taken in „Swain's Bay, common, Eaton. The only example preserved was grappled in about 2 fathoms in a tideway between two islands, incrusting two sponges *(Microciona atrosanguinea,* Bk., and *Halichondria incrustans,* Jtn.; both British species)". I have had the opportunity to examine this specimen. The longest diameter is about 24 cm. by a thickness of about 4 cm., growing over and between sponges, but also covering a great number of other and smaller organisms. The lamels are more or less plain, 0.5—1 or up to 1.5 cm. in diameter, and often rather anastomosing. It reminds one much in habit of *L. lichenoides* f. *depressa,* but shows in other respects a nearer relationship to f. *heterophylla* of the said species. However, it differs from *L. lichenoides* by a little smaller and less prominent conceptacles of sporangia. Besides the cells are on a section shown to be frequently rather short with thin walls, and in this respect pretty well agreeing with *L. Muelleri.*

Among a number of specimens of the present species which I got through the kindness of Dr. Aug. Engelhart, collected at Cape Jaffa, South Australia, is a specimen in part covering a globular sponge and referrible to f. *neglecta.* The crust which clings rather closely to the substratum is composed of a number of very small lamels here and there stretched over one another. It bears conceptacles of sporangia coinciding with those in *L. Muelleri,* and stands nearest to the above mentioned specimen, but the lamels are frequently much confluent with each other.

Lithothamnion Engelhartii Fosl. mscr.

f. *umbonata* Fosl. mscr.

f. *imbricata* Fosl. mscr.

Thallus forming irregular, more or less extended, thin crusts loosely connected with the substratum, with uneven, knotty surface, or (f. *imbricata)* composed of small and irregular lamels, irregularly imbricate or decussate, at length forming crust-complexes up to 1.5 cm. thick. Conceptacles of sporangia prominent, at first disk-shaped, then depressed in the central parts, 250—300 μ in diameter. Sporangia four-parted, 80—90 μ long and 25—30 μ broad.

This species is closely related to *L. Muelleri* in habit, and in part possesses forms similar to those in the latter. However, as far as hitherto seen it does not form tubes surrounding other algæ. The form *umbonata* grows in the same manner as specimens of the said species attached to the root of other algæ, but I do not know the nature of the substratum. The crust is thin, of irregular shape, with distinct concentric striæ especially in the lower part, and the surface more or less uneven or knotty. This uneveness is in part caused by the shape of the substratum, and the knots often by growing over extraneous objects.

The form *imbricata* is composed of irregular crusts, or small imbricate or sometimes even decussate lamels, now loosely connected now rather confluent, and at length forming crust-complexes up to about 1.5 cm. in thickness.

The conceptacles of sporangia are generally densely crowded almost all over the surface, often so densely that the roofs become angular. They are frequently prominent, at first disk shaped or nearly so, then especially in f. *umbonata* more or less depressed in the central parts, and here intersected with about 25 delicate muciferous canals. The sporangia are four-parted, 80—90 μ long and 25—30 μ broad. The conceptacles do not seem to become overgrown.

In structure the species also stands near to *L. Muelleri,* the cells appear however generally to be a little shorter than in the latter.

This species must be considered specifically distinct from *L. Muelleri,* the conceptacles being quite different, and no transitions are to be seen in this respect. However, the material at my disposal is too small to ascertain the mutual connection between the two forms quoted which, on the one side, correspond with similar

forms in *L. Muelleri,* but on the other hand do not show transitions as in the latter. Besides, in f. *imbricata* the conseptacles are more densely crowded and the roof often not depressed in the centre.

The plant is known from Cape Jaffa, South Australia, apparently scarce. Dr. Aug. Engelhart.

In Thuret's (Bornet's) herbarium I have seen a specimen of f. *umbonata* labelled „Australie?", showing that the species probably is not quite local.

Lithothamnion tenuissimum Fosl. mscr.

Thallus crustlike, attached to stones, smooth or nearly so, of indifinite extent, 100—250 μ thick. Conceptacles of sporangia scattered or somewhat crowded, convex and slightly prominent, 180—200 μ in diameter. Sporangia four-parted, 75—90 μ long and 50—55 μ broad.

The species at first forms small, very delicate, partly orbicular partly irregular crusts most often with crenulate margin, in a young state very much resembling a *Melobesia,* or *Lithothamnion membranaceum* in habit, with subpellucid thallus. However, it frequently soon increases in thickness as well as circumference, at length attaining a thickness of 100—250 μ, or when two crusts growing over each other occasionally up to about 400 μ thick. If there are more than one crust founded on the same substratum they soon become confluent, partly with limits visible in the shape of very small ridges partly fully anastomosing, or now and then the one crust stretches itself over the other. It clings firmly to the substratum, and at length forms crust-complexes of indefinite extent. The surface is smooth or provided with scaly thickenings, in an old stage sometimes finely rugged, and the marginal portions now and then with indistinct concentric striæ.

The conceptacles of sporangia partly are scattered partly more or less crowded, convex but slightly prominent, seen from above 180—200 μ in diameter, and the roof intersected with about 10 very delicate muciferous canals. The sporangia are four-parted, 75—90 μ long and 50—55 μ broad.

With reference to structure, the hypothallus is formed of cells which are up to 10 μ long, frequently shorter, and the anticlines sometimes with a slow sometimes with a rather rapid convergence towards matrix, however now and then with an almost imperceptible contrast between hypothallus and perithallus. The cells of the latter are very small with rather thick walls, frequently 3—5 μ in diameter, square or rounded, or 3 by 4—5 μ, often with the longest diameter in horizontal direction.

The plant stands nearest to *Lithothamnion Lenormandi*, resembling certain forms of this species in habit, but it sometimes also reminds one of *L. læve*. On the other hand, it in structure and sometimes also in habit approaches *Lithophyllum decipiens*. The conceptacles are nearly related to those in *Lithoth. synanablastum*. On a cursory examination it may be confounded with a very young specimens of the latter.

It is hitherto but known from the west coast of Africa, at St. Thomé, where it seems to be of pretty common occurrence. One of the specimens is labelled „Bahia de Anna Chaves et Praia Lagarto, leg. A. Moller". Herb. Univ. Coimbra, Prof. Henriques, no. 23.

Goniolithon (Cladolithon[1]) Notarisii (Duf.) Fosl. mscr.
Melobesia Notarisii Duf. Quadr. Melob. p. 37.

f. *genuina*.[2])
Melobesia Notarisii Duf. l. c.; sec. spec.

f. *propinqua* Fosl. mscr.

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[1]) The section *Cladolithon* in Fosl. List of Lith. p. 8 is to be considered as a subgenus and to be given a somewhat other limit than there. Some of the species preliminary referred to it l. c. are to be referred partly to the subgenus *Lepidomorphum* partly (one or two species) to *Lithophyllum*.

[2]) There can scarcely be any doubt that the alga described by Heydrich in Ber. d. deutsch. bot. Ges. Bd. XVII, p. 221, t. XVII, fig. 5 under the name of *Lithophyllum Chalonii* very nearly represents an old specimen of the type of the present species, such as the latter has been comprehended by Dufuor, according to young specimens distributed by himself which I have seen, or at most to be considered as a denominated form, f. *Chalonii*, as the new formations seem to be more free than in the type, and the heterocysts more numerous.

This species appears to be much varying both in habit and with regard to structure. The material at my disposal is too scarce to draw any defined limit of the species, as it seems to vary according to local conditions as well as the substratum. The form considered to be the typical one, or at least that which underlies Dufour's description, in a young state on the one side rather reminds one of *Lithothamnion Lenormandi* in habit and, on the other hand, *Dermatolithon hapalidioides,* in general appearance especially approaching certain forms of the latter after the upper part of the conceptacles has fallen away. As regards structure the said variation is especially due to the hypothallus as well as the cells considered to be heterocysts (cp. Solms, Corall. Monogr. t. 1, fig. 2). The latter partly are numerous partly rather scarce even in one and the same specimen, and much varying also with reference to the size. In one of Dufour's specimen I have seen them even in the lower part or towards the base of the roof of a conceptacle.

The form *propinqua* differs from f. *genuina* by the new formations over the primary crust fully or almost fully anastomosing, so that it sometimes even looks as if a ticker crust consists of a continuous layer of cells, but really being composed of new formations over each other, only more closely united than in the most extreme forms of f. *genuina.* Therefore, the structure in this form is also somewhat differing, but this is especially due to the hypothallic cells, while the perithallic cells agree with those in f. *genuina,* being, however, generally a little smaller. In the latter the perithallic cells vary between 12 and 25, now and then up to 30 μ long, and in f. *propinqua* 10—20 μ, and commonly with thicker walls, but of the same breadth in both. The heterocysts are more scarse and frequently a little smaller in the last mentioned form. Now and then we find in both forms solitary cells in the perithallic layer which are perceptibly larger than the adjacent cells.

The species appears to be widely dispersed in the Medditeranean. I have seen specimens from the Italian coast (Dufour), the Mediterranean coast of France, Antibes (Bornet), and the African coast, near Alger (Debray).

A specimen in Bornet's herbarium from Key West, Florida (leg. Farlow) stands very near to the present species, the crust being, however, more continuous and the structure more regular. I have not seen heterocysts between the epidermal cells, but here and there in the perithallic layer appear the above mentioned large cells. It also shows here and there on the surface a layer of subhyaline cells agreeing with similar formations in the true *G. Notarisii*. However, I am uncertain whether it is to be considered a separate species or not, as I have seen but a solitary specimen and the present species being much varying. This specimen also shows a near connection with the following species.

Goniolithon (Cladolithon) elatocarpum Fosl. mscr.

Thallus crustlike of indefinite extent, up to about 7 mm. thick, with frequently small wartlike excrescences. Conceptacles of sporangia 500—700 μ in diameter, with an elongated tip soon falling away and then hemispheric-conical. Sporangia bisporic about 100 μ long and 50 μ broad.

In British Museum is to be found a solitary specimen of the present alga which, on the one side, is closely related to *Goniolithon Notarisii*, but on the other so much differing that I venture to regard it a separate species.

The said specimen is fragmentary, nearly 6 by 4.5 cm. in diameter and appears to have formed a part of a larger crust of indefinite extent. In the thickest part the crust is about 7 mm. thick, plainly decreasing in thickness towards the rather thin marginal portion. The surface is uneven, provided with small wartlike or more or less irregular and low excrescences, some of which are due to growing over of the conceptacles of sporangia or extraneous objects. The colour is a dark rosy with a purplish shade.

The conceptacles of sporangia are scattered, 500—700 μ in diameter, with elongated tip, including the latter up to about 1.5 mm. high, but the tip soon falls away and then the conceptacles are hemispheric-conical, with thick walls, and at length growing down into the frond. The sporangia are two-parted, however only

according to a solitary and apparently mature one that I have seen, about 100 μ long and 50 μ broad.

In structure the species stands near to *G. Notarisii,* but not showing heterocysts, nor the large cells in the perithallic layer which most often are to be found in the said species. The hypothallus resembles that in the latter, only the cells smaller and especially more narrow, frequently about 20 μ long, sending forth a stratified perithallic layer the cells of which are 12—15 or up to 18 μ long by a breadth of 6—8 μ. As in *G. Notarisii,* the present species also shows here and there on the surfase or even farther down a layer of subhyaline cells with thinner walls which on a section are shown to be 15—24 μ long and 8—10 μ broad.

The species has been found at the Cape of Good Hope, but the locality is unknown, collected by W. Tyson.

Goniolithon (Cladolithon) verrucosum Fosl. mscr.

Thallus crustlike, the crust irregular, with wartlike excrescences 0.5—1.5 cm. in diameter. Conceptacles of sporangia at length hemispheric or hemispheric-conical, 600—800 μ in diameter. Sporangia four-parted, 100 by 40 μ.

This species forms irregular crusts which often are rather extended. It sticks to a kind of loose sandstone (quartz-grain), and sometimes nearly surrounds irregular masses of the latter. The shape of the crust depends on that of the substratum. It is of a very hard consistency, and develops numerous smaller or larger wartlike excrescences which in general are 0.5—1.5 cm. in diameter, including the latter attaining a thickness of up to about 2 cm. Sometimes and especially in a young stage of the crust the excrescences are small, and then rather approaching *G. mamillare* in habit.

The conceptacles of sporangia are densely crowded nearly all over the frond, but especially in the excrescences. They are seen from above hemispheric or hemispheric-conical, 600—800 μ in diameter, but probably having been rather high, as it seems as if the upper part has fallen away, similar to what is the case in several other species. A great number of conceptacles examined

have been attached by inferior animals, at length entirely filling the cavity and destroying the sporangia, but not the conceptacle itself. Therefore, I have but succeeded in finding a solitary sporangium which is four-parted, about 100 μ long and 40 μ broad. Some other and larger conceptacles probably are those of cystocarps, but everywhere examined has been attacked by the said organisms.

In structure it is rather varying, as far as seen not showing any stratification, the cells often rather different in size, varying between 10 and 24 μ in length, partly nearly square partly a little longer or up to $1^1/_2$ times longer than broad. The walls of the cell-rooms are thick.

The species stands nearest to *G. mamillare* which it approaches even in structure, but is on the other hand separated by essential characters.

It is known from Cape Jaffa, South Australia, where it does not seem to be scarce. Dr. Aug. Engelhart.

Goniolithon (Lepidomorphum) Yendoi Fosl. mscr.

Thallus crustlike, at first forming thin, purplish, suborbicular or irregular crusts on stones. More than one crust founded on the same substratum soon become confluent, the limits sometimes not to be seen, sometimes as more or less distinct ridges, or the one crust stretches itself over the other. It attains a thickness of about 1 mm., and is smooth even in an advanced state, developing numerous reproductive organs. But when older it often becomes more and more uneven, producing small wart-like excrescences, or some uneveness is caused by the substratum, or by covering up small extraneous objects.

The conceptacles of sporangia are rather crowded here and there in the crust, subhemispheric-conical, 200 μ in diameter seen from above, with an apical pore and a few very delicate bipores, the latter extremely difficult to detect, and often apparently not to be found. The tetrasporangia are about 90 μ long by 25 μ.

Some other conceptacles almost coinciding with the latter in external appearance probably are those of cystocarps, and some

minute ones densely crowded in other crusts or other parts of a crust-complex appear to be those of antheridia, only about 100 μ in diameter seen from above.

With reference to structure, the hypothallic cells are up to 12 μ long, and the perithallic ones are square or somewhat rounded, often, however, with the longest diameter in horizontal, now and then in vertical direction, 3—5, or 3—4 by 5 μ in diameter.

The species stands near to *G. subtenellum*, but differs especially as regards the structure, in which respect, however, it stands very near to *Lithothamnion tenuissimum*.

It has been collected in Shimoda harbour (Prov of Izu), and at Otaru, both places on the Pacific coast of middle Japan, kindly communicated to me by Mr. K. Yendo. No. 66, 194, and 196.

It is also known from Monterey, California, collected by Farlow, according to specimens in Thuret's (Bornet's) herbarium.

Lithophyllum craspedium Fosl. mscr.

From a crustlike holdfast 4—5 cm. in diameter issue coarse and irregularly divided branchsystems, in the lower part much confluent with each other. The branches are commonly upwards dilated into more or less compressed, 15—25 mm. broad expansions 4—6 mm. in thickness, or in their lower part up to 10 mm. thick, now and then slightly lobed. Occasionally the branches are subterete, about 8 mm. thick, with rounded ends. The solitary specimen seen is 16 by 11 cm. in diameter and about 7 cm. in height. It is of yellowish-white colour, here and there with a rosy tinge.

The conceptacles of sporangia are shown on the surface of the frond as minute, convex knots about 150 μ in diameter which soon become decorticated. They are on a section 200 μ in diameter and at length growing down into the frond. The sporangia are unknown.

With reference to structure, the cells are on a longitudinal section of a branch pretty regular, frequently about twice as long as broad, or 15—25 μ long by 8—11 μ.

In habit the species stands nearest to *Lithophyllum(?) platy-*

phyllum from West India, but they are separated by essential characters.

The plant is known from Onoataa Gilbert Islands, Funafuti, collected by Finckh. Britisch Museum no. A. 27.

Lithophyllum hyperellum Fosl. mscr.

f. *fastigiata* Fosl. mscr.

f. *heteroidea* Fosl. mscr.

Thallus in f. *fastigiata* forming roundish balls 2—5 cm. in diameter, in general freely developed on the bottom, repeatedly but irregularly branched from the centre, branches radiating, short, 0.5—1 mm. thick, knotty or rugged, densely crowded, fastigiate, frequently with thickened ends; f. *heteroidea* attached to shells or stones, branches more scantily divided and subfastigiate. Conceptacles of sporangia at first convex. Sporangia four-parted, about 50 μ long by 20 μ.

I am not quite sure whether the above forms perhaps ought to be considered specifically distinct, as the conceptacles in one of them are not well developed.

The form *fastigiata* grows in the same manner as *Lithophyllum racemus*. It is either partly attached to small stones, from which it apparently at length loosens itself, or occasionally surrounding stones, but most often developed free on the bottom, forming roundish or slightly compressed balls 2—5 cm. in diameter. The radiating branches are nearly always much confluent, especially in the lower or inner parts of the ball, so that the branch-systems are difficult to follow, 0.5—1 mm. thick with roundish thickened ends and particularly here knotty or rugged, but regularly fastigiate. Especially in old specimens and in the side that probably has turned upwards, the ends often are truncate or even nearly disk-shaped This is evidently due to the fact, that the plant grows in places where the tides are running rather strong.

The form *heteroidea* differs in habit rather much from f. *fastigiata*. It is attached with a very thin crust to shells, stones or other hard objects and very irregular in outline. The branches agree with those in the latter, but are less divided, in young spe-

cimens with simple branches or nearly so sometimes widely dispersed over the substratum, in older specimens not so densely crowded, and not or but here and there regularly fastigiate. However, this is at least in part due to the very irregular objects to which it sticks and sometimes surrounds, as old specimens show transitions to f. *fastigiata.* It is probably but a form of the present species, and the rather considerable difference in habit even between young specimens of both forms not unlikely being due to local, especially tidal conditions. In both forms grains of sand become overgrown in smaller or greater number which appear to contribute to the more or less anastomosing of the branches.

The conceptacles of sporangia are developed in the upper parts of the branches, solitary or somewhat crowded. They are at first slightly convex, not sharply defined and often difficult to detect. On a transverse section they are only about 120 μ in diameter. The sporangia are four-parted, about 50 μ long by 20 μ. The structure has not yet been examined.

This species is known from Phillip Island, east off Port Phillip Bay, and from Western Port, Victoria, Australia, in both places growing on a depth of 2—5 fathoms, in company with another species which not unlikely is identic with *G. brassica-florida* (Harv.) or *G.(?) mamillosum (Hauckii),* the latter two species however not yet perfectly known. Here it has been found by Mr. J. Gabriel.

Lithophyllum incrustans Phil.
in Wiegm. Arch. 1837.

f. *depressa* (Crn.) Fosl.
Norv. Lith. p. 94.
Lithothamnion depressum Crn. Fl. Finist. p. 151.

f. *Harveyi* Fosl.
Norv. Lith. p. 94.

f. *angulata* Fosl.
Some new or. cr. Lith. p. 17.

f. *lobata* Fosl. mscr.
Melobesia polymorpha Harv. Ner. austr. p. 110?

As remarked in Some new or cr. Lith. p. 17 the present species is much varying, but the forms run into each other so that any limit frequently is difficult or impossible to draw, the variation generally being consequent only to local conditions.

The obove quoted f. *incrassata* is however one of the more characteristic forms of the species. It forms thick crusts propably on rocks or stones, with coarse, wartlike or lumpy, crowded lobes, or blunt branches increasing in thickness upwards and occasionally attaining a height of up to about 1.5 cm. by nearly the same thickness. In structure it differs from the other forms quoted, the cells of the perithallic layer frequently being a little larger. Otherwise it stands nearest to f. *angulata* but also showing some relation to f. *Harveyi*. It is probably the same form recorded by Harvey l. c. from Algoa Bay. I have specimens from the Cape of Good Hope, kindly communicated by Dr. H. Becker, but the locality is unknown.

I do not adopt three forms of this species described by Heydrich in Ber. d. deutsh. bot. Ges. Bd. 17, p. 225 under the names of f. *flabellata*, f. *subdichotama* and f. *labyrinthica*, as they in my opinion belongs to forms formerly known, or not being so characteristic that they ought to be denominated as separate forms. Thus f. *flabellata* is in fact as Heydrich remarks himself „eigentlich weiter nichts als eine f. *depressa*, von der zwei Exemplare an einander fächerförmig und horizontal emporwachsen". I have seen this formation from several places, and especially met with it on the west coast of Ireland where *L. incrustans* is very abundant, fringing the rocks in the lower part of the litoral region, surrounding stones or shells almost everywhere in exposed places, or covering the bottom of rock-pools even in the upper part of the litoral region. In the latter places f. *depressa* especially is to be found. It often entirely covers the bottom of large but generally shallow rock-pools with a nearly smooth and uniform layer, but just below the surface of the water the pools often are fringed with the most curious forms of the species. So especially if there are even small projecting parts of the bottom or other objects, and when two crusts here trumble they grow together and at

length form both *flabellata* and other apparently characteristic forms. The said formation is also to be found in crust-complexes of f. *Harveyi* as well as f. *angulata*. Besides they are to be seen in *Ph. polymorphum*, *L. varians*, and other species, but they are only due to quite local conditions. The form *subdichotoma* is nothing more than f. *angulata*, and f. *labyrinthica* old and in part worn specimens. I have at least specimens resembling fig. 7 l. c. of the latter, and they are in my opinion not at all to be considered as a separate form. Cp. Harv. Phyc. Brit. pl. 345, fig. 2, f. *Harveyi*, which when old also assume the same shape. If such are to be maintained, the recording of forms not only in this species but in the calcareous algæ at all would be so to speek endless.

Lithophyllum fasciculatum (Lam.) Fosl.

List of Lith. p. 10; Millepora fasciculata Lam. An. s. vert. 2, 203 (ed. 2, p. 311)

f. *incrassata* Fosl.

On some Lith. p. 8.

Melobesia fasciculata Harv. Phyc. Brit. pl. 74, fig. 1.

f. *divaricata* Fosl. mscr.

f. *compressa* Fosl. mscr.

f. *eunana* Fosl.

Lithophyllum calcareum f. eunana Fosl. Some new or cr. Lith. p. 15.

How the calcareous algæ described by Lamarck as well as some of those recorded by Harvey were to be understood has often amounted to mere conjecture, partly because the descriptions are rather scanty partly owing to the fact, that specimens from different collections considered to belong to the one or other of the species almost constantly have been sterile. Therefore, I took the opportunity last spring to visit Roundstone on the west coast of Ireland,[1]) where especially those critical species described by Harvey have been collected. Thanks to the valuable company of the Irish algologue Mr. Henry Hanna, facilitited by the kindness of Prof. T. Johnson, I was so successful as to find most probably at least one of the localities where M'Calla collected

[1]) M. Foslie. A Visit to Roundstone in April. The Irish Naturalist, Vol. VIII. 1899.

some of the calcareous algæ which underlie Harvey's descriptions. The result of these investigations shows, that *L. calcareum* Harv. is a true *Lithothamnion,* while on the other hand *L. fasciculatum* in the sense taken by Harvey is a true *Lithophyllum.* These two species are in fact rather easy to separate even in a sterile state. But *L. fasciculatum* and certain forms of the below mentioned *L. dentatum* are sometimes extremely difficult to distinguish.

The above f. *incrassata* corresponds in the main with the quoted figure in Harv. Phyc. Brit. This form appears however to be rather scarce. It passes into f. *divaricata* which characterizes itself by the more or less spreading and not or but in part fastigiate branches, which moreover often are more or less attenuating with rounded tips. This two forms are analogous to *Lithothamnion tophiforme* f. *globosa* and f. *typica.*

The form *eunana* is most nearly related to f. *divaricata,* but is scantily branched or simple, and much smaller.

A delicate form of the species is f. *subtilis,* characterized by its thin branches partly attenuating partly an more frequently thickened upwards, truncate and moreover often depressed in the centre, or ending into a more or less expanded disk depressed in the centre, or dentate and nearly funnel-shaped, or sending forth a mumber of short and nearly verticillate branchlets. This form is very varying, and it even approaches certain forms of the following species. Characteristic specimens have been taken in Fahy Bay, Ballinakill Harbour, on muddy bottom together with other algæ in 1—$1^1/_2$ fathoms water by Mr. Henry Hanna. Is is also known from Roundstone. Cp. l. c.

The form *compressa* on the one side stand nearest to f. *divaricata,* but difiers by its in the upper part compressed, sometimes even broad branches and then so much approaching the following species that a certain limit is difficult to draw.

I have hitherto but seen certain specimens of this species from the west coast of Ireland.

Lithophyllum dentatum (Kütz.) Fosl.

List of Lith. p. 10; Spongites dentata Kütz. Polyp. calc. p. 33.
Lithothamnion dentatum Hauck, Meeresalg. p. 273.

f. *aemulans* Fosl. mscr.

L. dentatum Hauck l. c. t. II, fig. 2.

f. *gyrosa* Fosl.

L. fasciculatum f. gyrosa Fosl. On some Lith. p. 8.

f. *dilatata* Fosl.

L. fasciculatum f. dilatata Fosl. l. c.

f. *Macallana* Fosl. mscr.

Lithothamnion agariciforme (M'Calla?) in herb. Sc. et Art Mus. Dublin; ex parte.

In places where the present species grows gregarious with *Lithophyllum fasciculatum,* the limits between these two species are extremely difficult to draw. It does not seem to be debarred that we have here hybrids developed from two in their typical forms so different species. In one of the localities at Roundstone mentioned in Irish Natur. l. c., both species grow together in abundance, although *L. fasciculatum* frequently in greatest number of individuals, partly and most commonly showing well developed and easily recognized specimen of the one or other species, partly however specimens to be seen which appear to partake of the characters of both. Sometimes specimens of both species are anastomosed, with a rather distinct limit, sometimes however looking like a solitary individual, but with characters now peculiar to the one now to the other species. This is on the one side due especially to *L. fasciculatum* f. *compressa* and on the other hand f. *aemulans* of the present species. The latter likely seems to be the typical form of this species, nearly as represented in the quoted figure by Hauck. It is however much varying, partly with shorter and narrower branches, on the one side approaching *L. fasciculatum* f. *compressa,* and on the other showing transitions to f. *Macallana,* but partly with much broader branches than in the said figure, and then even much approaching *Lithophyllum decussatum.* Besides it passes into f. *gyrosa* which represents a characteristic form, with plicate, depressed-emarginate, fastigiate or nearly fastigiate branches. The figure formerly referred to as regards the latter form, Harv. Phyc. Brit. pl. 74, fig. 2 *(M. fasciculata),* does not represent a typical specimen of this form, but approaches those not unlikely hybridous specimens. Therefore, I

referred this form l. c. to *L. fasciculatum,* while it in fact belongs to *L. dentatum.*

The forms *dilatata* and *Macallana* stands near to each other. The former attains a diameter of 10 cm. by a thickness of about 2 cm., and the latter chiefly differing by forming roundish or slightly compressed, often hollow balls up to 12 cm. in diameter, the irregular branches resembling those in f. *dilatata,* but frequently more upright. The form *Macallana* is only known form M'Calla's collections from Roundstone, and has not at least in its typical shape afterwards been found. This form now and then also shows connection with f. *gyrosa,* but frequently being rather different. I have even been in doubt whether f. *dilatata* and f. *Macallana* really are forms of the present species, or in part perhaps represent hybrids between *L. fasciculatum* and *L. dentatum.* However, in structure they rather accords with the latter than otherwise.

This species is known from the Adriatic, the eastern part of the Mediterranean, and the west coast of Ireland.

Lithophyllum decussatum (Ell. et Sol.) Phil.

in Wiegm. Arch. 1837, p. 389; Millepora decussata Ell. et Sol. Zooph. p. 131, t. 23, fig. 9. Non Solms, Corall. Monogr. p. 14; Hauck, Meeresalg. p. 270; Fosl. On some Lith. p. 5.

f. *typica.*

Melobesia decussata Aresch. in J. Ag. Spec. Alg. 2, p. 517; sec. spec.

f. *decumbens* Fosl. mscr.

Syn. Melobesia agariciformis Aresch. l. c. p. 516; sec. spec.; excl. syn.

The alga that I l. c. referred to the species described by Ellis and Solander l. c. has in some respects and outward resemblance to certain forms of the species in the sense here taken, but the former is a *Lithothamnion,* while *L. decussatum* as limited by Areschoug l. c. is a *Lithophyllum,* according to specimens of the latter that I have afterwards seen. Consequently I adopt the species as understood by Areschoug, especially as one of the specimens in his collection comes very near to the figure l. c.

I refer *M. agariciformis* Aresch. to the same species, also according to a specimen in his collection. This is a form which

much approaches certain forms of *L. dentatum,* and the limits sometimes being difficult to draw both in habit and structure, but the said specimen stands nearest to the typical form of the present species.

In British Museum's herbarium is a large and well developed specimen under the name of *Lithophyllum expansum* which appears to represent the typical form of the species in question, and agreeing with the quoted type in Areschoug's herbarium, only much larger. The place where this specimen has been found is unknown, but probably being in the Mediterranean. The longest diameter is about 17 cm. by a thickness or height of about 8 cm. The leaf-like branches issue from an extended disk of irregular outline, and not unlikely composed of more confluent disks, occupying about one third of the lower part of the plant. The disk has a thickness of 1—1.5 mm., and fragments of it show a great resemblance to *Lithophyllum expansum,* with overgrown conceptacles of sporangia, showing that also the present species develops reproductive organs in an early stage, while like a number of other species often being sterile in an appararently not very old stage. The more or less upright, bent and decussate, fastigiate branches attain a breadth of 3.5 cm., generally 1.5—2 cm. by a thickness in the middle or lower part of 1—1.5 or up to 2 mm., plainly decreasing in thickness upwards.

I have seen a solitary but old specimen of f. *decumbens,* with somewhat worn branches. It is smaller than the above mentioned specimen of f. *typica,* the longest diameter about 12 cm. It separates itself from the latter as the branches are a little smaller, more uniform in thickness, frequently more or less depressed, often horizontal or nearly so, and much anastomosing. It has been collected on Ile rousse, Corsica.

The present species stands between *Lithophyllum expansum* f. *foliacea* and *L. dentatum* f. *aemulans,* or the most extreme formations of the latter, and especially nearly related to this. It is known from the Mediterranean, Portugal and the west coast of Ireland, but everywhere apparently scarce.