NOTES ON ALGAE FROM THE TROPICAL ATLANTIC OCEAN

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(Received for publication April 30, 1929)

As a consequence of the writer's interest in the marine algae of Florida, a few collections of algae from the Caribbean area and from the American mainland have been placed in his hands for study, since the flora is fairly homogeneous throughout the western tropical Atlantic from Cap San Roque in Brazil to northern Florida and from the most eastern islands to the shores of the Gulf of Mexico. Little is known about the flora of the western and southern limits of the Gulf and thence down the coast to Venezuela and Brazil, where reports again give us a fair idea of the flora. The greater part of the material involved in the present paper came from the Farlow Herbarium of Harvard University through the kindness of Dr. C. W. Dodge. In addition, a considerable amount of Jamaican material was submitted by Dr. B. M. Davis. For the opportunity to work over and report upon these specimens the writer's thanks are extended to both. For critical advice and for the determination of certain troublesome specimens he also acknowledges the kind assistance of Dr. Marshall A. Howe.

The result of the naming of the contents of these packages of specimens has been a very considerable extension of the known algal flora from certain districts. Indeed, for Trinidad, Tobago, and Panama the lists, small as they are, comprise almost all we know about the marine algae of those districts, which have been singularly neglected by phycologists. We have a very few other records for Trinidad and Panama, but not enough to give a good idea of their floras. The earlier records are incorporated in Murray's catalogue (1889); the later records are of few species and are scattered. No attempt is made to insert here these older records, as this short paper is primarily a list of new stations.

In the introduction to Murray's catalogue a statement appears to the effect that the flora of Grenada was found by him to be notably poor in Florideae, and he attributes this to a possible effect of fresh water from the Orinoco. The present collections from Tobago and Trinidad do not confirm any such peculiarity, the proportion of Chlorophyceae not being at all large, although the islands are nearer the mainland than is Grenada. As all are somewhat northwest of the main outlets of the river it may be that the drift takes the fresh water seaward to pass by the islands mentioned here and to affect Grenada only, but this is improbable. Beyond this remark there are no general conclusions to be drawn from these collections,

which in each case probably represent only a casual sample rather than a thorough survey of their respective areas.

JAMAICA

The collection by Dr. B. M. Davis was a fairly extensive one. However, Collins (1901) has given us a rather complete sketch of the flora, and so it is not surprising that the proportion of novelties is small. In addition to these, two species collected by A. E. Wight appear to be new to the flora. The plants already recorded from the island but present in the two collections are not listed here, since to do so would add little information of value.

Enteromorpha Linza (L.) J. Ag. Port Antonio (Wight). Cells in surface view large, reaching 20–40 μ in longer diam.; thallus clearly showing marginal tubular separation of layers in lower portions of thallus.
Chaetomorpha gracilis J. Ag. Montego Bay (Davis).
Padina Sanctae-Crucis Bφrg. Montego Bay (Davis).
Padina Vickersiae Hoyt. St. Ann's Bay (Davis).
Sargassum polyceratium ovatum (Collins) Taylor.[1] Montego Bay (Davis).
Ceramium fastigiatum flaccidum H. E. Petersen. Dunn's River (Davis).
Ochtodes secundiramea (Mont.) Howe. Port Antonio (Wight).

TOBAGO

The material from Tobago was collected by Prof. R. Thaxter in May 1893. With the exception of the *Lyngbya*, it all appears to have been secured from the territory of Roxborough Beach, or the locality does not appear on the labels (*Ernodesmis*, *Siphonocladus*, *Struvea*).

Lyngbya majuscula Harv., Studley Park Beach.
Cladophora prolifera (Roth) Kg. Det. F. S. Collins.
Cladophoropsis membranacea (C. Ag.) Bφrg.
Ernodesmis verticillata (Kg.) Bφrg.
Siphonocladus tropicus (Crn.) J. Ag.
Struvea anastomosans (Harv.) Picc.
Caulerpa crassifolia mexicana (Sond.) J. Ag.
Caulerpa cupressoides elegans (Crn.) W.-v.B.
Caulerpa racemosa clavifera (Turn.) W.-v.B.
Caulerpa racemosa (near) *laetevirens* (Mont.) W.-v.B.
Caulerpa sertularioides brevipes (J. Ag.) Sved.
?Pylaiella antillarum (Grün.) DeToni. Det. by F. S. Collins as *Pylaiella Hooperi* Crn., but the determination not confirmed.
Ralfsia expansa J. Ag.
Neurocarpus Hauckianus (Möb.) Ktze.

[1] Phycotheca Boreali-Americana No. 776, collected by Pease and Butler, is also this plant in the writer's copy of the Collins, Holden, and Setchell exisccata.

Neurocarpus Justii (Lamx.) Ktze.
Wrangelia Argus Mont.
Gymnogongrus Griffithsiae (Turn.) Möb.
Gracilaria damaecornis J. Ag.
Acanthophora muscoides (L.) Bory.
Amansia multifida Lamx.
Bryothamnion Seaforthii disticha J. Ag.
Centroceras clavulatum (C. Ag.) Mont.
Grateloupia dichotoma J. Ag.?
Ochtodes secundiramea (Mont.) Howe.
Jania rubens (L.) Lamx.

TRINIDAD

This material was secured by Prof. R. Thaxter in April–May 1912–13, principally from Manzanilla Point and Maqueripe Bay.

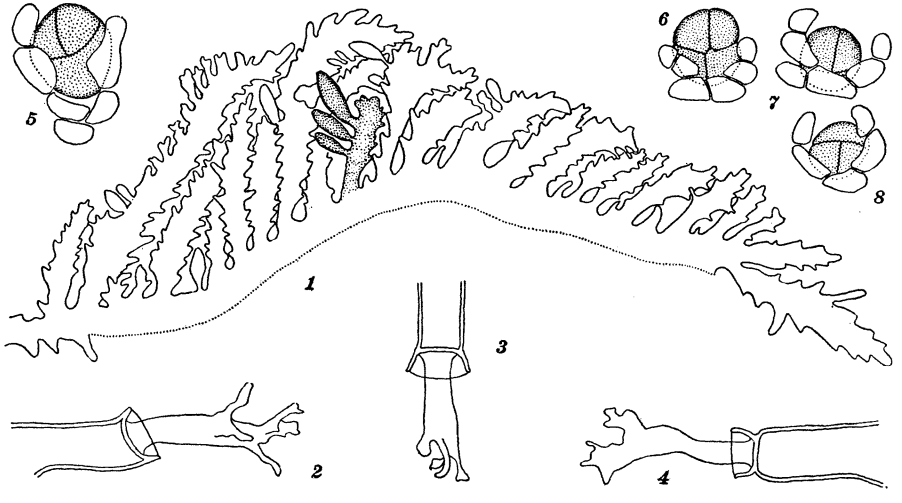
The following lacked definite station names:
Cladophora prolifera (Roth) Kg.
Struvea anastomosans (Harv.) Picc.
Neurocarpus delicatulus (Lamx.) Ktze.
Neurocarpus Justii (Lamx.) Ktze.
Dictyota dentata Lamx.
Erythrocladia subintegra Rosenv.
Amphibia Sertularia (Mont.) Howe.

The following came from Manzanilla Point:
Dermocarpa prasina (Reinsch) Born. & Flah.
Chaetomorpha media (C. Ag.) Kg. (Maqueripe Bay also).
Bryopsis hypnoides Lamx.
Gelidium crinale (Turn.) J. Ag.
Gracilaria lacinulata (Vahl) Howe.
Hypnea musciformis (Wulf.) Lamx.
Bryocladia cuspidata (J. Ag.) DeToni.
Bryothamnion Seaforthii disticha J. Ag.
Laurencia papillosa (Forsk.) Grev., a slender form, often with the branches widely spaced.
Cryptonemia luxurians J. Ag.
Grateloupia filicina (Wulf.) J. Ag. (Maqueripe Bay also).

The following came from Maqueripe Bay, with the two indicated in the last group:
Gelidium corneum (Huds.) Lamx.
Gelidium serrulatum J. Ag.
Gymnogongrus tenuis J. Ag.

Carpoblepharis repens n. sp.—Plant epiphytic, appressed; main axes to 5–10 mm. long, alternately pinnately branched, lateral axes to 5 mm. long; main axis and irregularly placed principal indeterminate branches flattened,

165–250 μ broad, bearing close-placed branches of limited growth 0.5–2.0 mm. long which are contracted at the base, flattened and coarsely serrate or else the axis with small spinelike branchlets 150–200 μ long, or the two types intermixed; branches of all orders containing an axial row of large cells 80–160 μ broad, 0.5–1.2 times as long as broad; cortex continuous above, of at least 1 cell thick, cells in surface view angular, 5.5–13.0 μ in diameter; a subcortex of larger cells surrounding the nodal regions, and to 4 cells broad laterally forming the expanded sides of the blade; cortex of ventral side interrupted, absent from the swollen median region of each axial cell, cells enlarged and compressed around this area and grading into the close-placed angular type above the nodes; branches attached to the host by tufts of branched hapteres; spermatia tufted, forming a swollen antheridial belt about subcylindrical branchlets; cystocarps appearing at the end of small swollen branches, partly surrounded by curved branchlets; tetraspores forming bands in swollen stalked stichidial branchlets about 135 μ in diam., and 250–400 μ long in the fertile portion, which are single or seriate, especially upon the margins of the smaller branchlets.

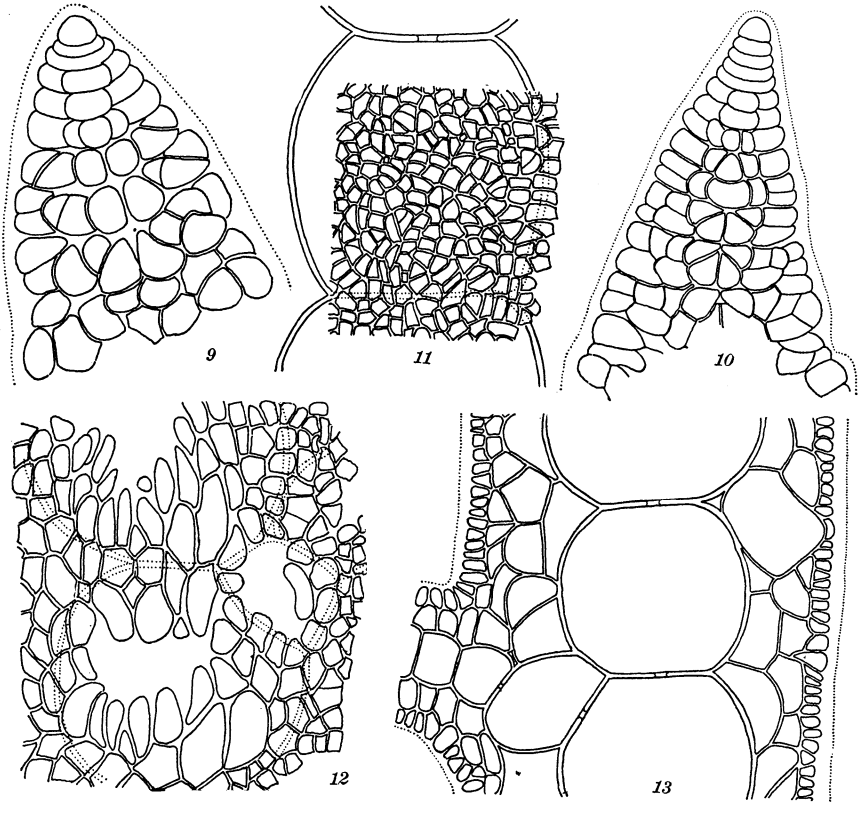


TEXT FIGS. 1–8. *Carpoblepharis repens*. FIG. 1, habit of portion of plant showing good example of more regular branching, × 15. The incompleted side of the main axis had the lateral branches rather intricately overlapped. FIGS. 2–4, terminal portions of hapteral filaments showing collar and thin-walled penetrating portion, × 330. FIGS. 5–8, surface views of portions of the tetrasporic stichidia showing spores with the associated partially-covering filaments, × 500.

Growing upon *Grateloupia*, possibly *G. dichotoma* J. Ag., collected on Trinidad, B. W. I., by R. Thaxter in 1912–13. The particular group of specimens bearing this epiphyte had no more exact station data; another *Grateloupia* which was probably of the same species was collected during

the same period around Maqueripe Bay but did not bear the epiphyte, nor did material secured by the same collector in Tobago in May, 1893.

This pretty little plant (text-fig. 1; Pl. LXII, figs. 1, 2) formed patches of considerable extent upon the host, the size—1.0–1.5 cm.—being probably limited as much by the width of the host branches as by the ability of the *Carpoblepharis* to spread. The color of the patches of dried material was



TEXT FIGS. 9–13. *Carpoblepharis repens*. FIGS. 9, 10, tips of lateral branchlets as seen from the ventral side, showing development of segments, × 515. FIG 11, dorsal view of axis in part, showing surface cell layer over node and internode areas, and underlying axial cells, × 330. FIG 12, ventral view of main axis and base of lateral branch, showing surface cell layer over node and internode areas, with underlying axial cells, × 330. FIG. 13, optical longitudinal section in plane of growth, showing base of a lateral branch attaching to main axis. The 1–3 celled subcortex is shown forming the winged margin of the axis, × 266.

a dark reddish-purple after some 16 years, and rather dull. The plant is closely attached to the host by tufts of a few to about a dozen hapteres which appear upon the under side of the *Carpoblepharis* at frequent intervals. They appear to originate in the subcortex rather than from the surface

layer, but this may be due to an embedding of the end of the swollen basal cell. The entire hapteron appears two celled, the main (upper) shaft of one cell, terminating in a much more delicate walled portion which penetrates the host and branches at the free end. About the lower end of the upper cell there appears a collar suggesting that the penetrating portion may have been formed by a regenerative phenomenon (text-figs. 2–4). Development of the thallus and of the branches originates from a prominent apical cell by transverse divisions. Since most of the little branchlets curve toward the host at their tips, and since the main and secondary axes quickly develop the rudiments of branchlets, progressive development from the tip is hard to follow. However, it can be easily seen that upon the upper side the close cortex of small cells is completed only a few segments behind the apex, while on the ventral side the process is much slower so that the subdivision can be followed for 10–12 segments at least (text-figs. 9, 10). The surface on top shows little difference between the nodes and the internodes (text-fig. 11). Below the case is quite different. On the larger and closely adherent branches the internodes do not acquire complete cortication, and even the lower portions of the lateral branches show this lack near the base (text-fig. 12). The side portions of the flattened thallus naturally have a complete cortex and a broad sub-cortex which frequently reaches 3, sometimes 4, cells in width (text-fig. 13).

So far as was noted the sexual plants were distinct from each other and from the tetrasporic ones, but were all of similar vegetative morphology. The tetrasporic plants bear the stichidial branchlets among or replacing the spine-like ultimate branchlets (text-fig. 1; Pl. LXII, fig. 8). The spores in these are in rather definite rows, irregular to cruciate in division, borne singly on the upper side of whorled branched filaments and partly covered externally by the somewhat expanded cells of the last dichotomy (text-figs. 5–8). The spore groups seen were oval, elongated parallel to the stichidial axis, and to about 12 μ long, but probably immature.

The male plants were not seen intact, but a number of fragments bore the antheridial branches, which were cylindrical rather than compressed, and bore a belt of spermatial filaments which extended for a large part of their length (Pl. LXII, fig. 3). The female plants were much better preserved, or more numerous, and resembled the asexual ones in general, except that the small branches which bore cystocarps were more scattered, hardly forming rows as did the stichidia-like tetrasporic branches. They were rather swollen at the tip, and the cystocarp was somewhat sunken into a slightly depressed distal part, where slender branchlets somewhat surrounded them (Pl. LXII, figs. 4–7). No procarps were recognizable in the dried material on which the study was based.

It is of course with diffidence that this material is placed in what is primarily a South African genus. However, material which has the same creeping habit (though somewhat different branching) and found in Japan

has been attributed to *Carpoblepharis* by Okamura (*C. Schmitziana* (Reinb.) Okam.). The original species from South Africa were large, erect ones, but Barton has described a small one of about 1 cm. extent (*C. minima* Bart.). The features which seem to favor the inclusion of this plant in *Carpoblepharis*, which is rather isolated in the Ceramiaceae, are the type of apical growth, the morphology of the reproductive organs, and the histology of the axis. However, there is much variation in the last respect within the genus as amended by DeToni and Okamura in turn. It is important to remember that DeToni in his supplement to the "Rhodophyceae" volume (Sylloge Algarum 6) does not accept Okamura's disposition of *C. Schmitziana*, although Svedelius was willing to do so in the supplementary volume to the "Rhodophyceae" in Engler-Prantl's Pflanzenfamilien. If a repent habit is to be accepted as an important feature in segregating genera from *Carpoblepharis*, *C. repens* and *C. Schmitziana* must be placed in other and different genera, for the alternate branching and filiculoid habit of *C. repens* is very different from the somewhat cervicorn division of sub-cylindrical branches of *C. Schmitziana*. Consequently the acceptance of *Reinboldiella* DeToni does not provide a better place for *C. repens* than does the parent genus, and the new plant may best be placed in the older genus until it is better known.

Ceramium floridanum J. Ag.
Grateloupia cuneifolia J. Ag.
Grateloupia dichotoma J. Ag.?
Ochtodes secundiramea (Mont.) Howe.

From Gaspares Id. there was secured *Bryopsis pennata* Lamx.

Venezuela

This material consists of two collections, both small. The more important was assembled by Dr. A. F. Blakeslee in 1903; the smaller by Curran and Haman. Since Sluiter (1907) has published a very considerable list of algae from Curaçao and the neighboring Venezuelan coast some of the plants collected did not constitute the first records for the country. The characteristic West Indian type of algal flora found on Curaçao is to be expected on the neighboring mainland also. Except as noted the material came from Margarita Island, collected by Blakeslee:
Chaetomorpha clavata (C. Ag.) Kg.
Chaetomorpha gracilis Kg.
Sargassum polyceratium Mont.
Galaxaura squalida Kjellm.
Eucheuma Gelidium (J. Ag.) J. Ag.?
Gracilaria confervoides (L.) Grev. Medanos Peninsula (Curran & Haman).
Gracilaria cornea J. Ag.
Gracilaria ferox J. Ag.

Gracilaria lacinulata (Vahl) Howe. Margarita Id. (Blakeslee) and Medanos Peninsula (Curran & Haman).
Gracilaria mamillaris (Mont.) Howe.
Hypnea cornuta (Lamx.) J. Ag.

PANAMA

The specimens available from Panama were collected by Dr. C. W. Dodge in September of 1925. They were in part remounted for study and determined by Miss Anne C. Hof, a fairly complete set having then been sent to the present writer, who later went over the unique part of the prime set and the undetermined residue. The determinations given are those made by Miss Hof, except for *Chnoospora* and *Archaeolithothamnion* recognized by Dr. Howe and those marked (T) as representing the writer's determinations.

Ulva Lactuca latissima (L.) DC. Careening Cay.
Chaetomorpha brachygona Harv. Nancy Cay.
Chaetomorpha media (C. Ag.) Kg., (T). Nancy Cay, Columbus Id., Provision Id.
Rhizoclonium Hookeri Kg., (T). Careening Cay.
Cladophora repens (J. Ag.) Harv. The filaments reached 100–126 μ in diameter. Careening Cay.
Cladophoropsis membranacea (C. Ag.) Bφrg. Columbus Id.
Anadyomene stellata (Wulf.) C. Ag. Columbus Id.
Valonia utricularis (Roth) C. Ag., (T). Columbus Id.
Caulerpa fastigiata Mont., (T). Careening Cay.
Caulerpa racemosa uvifera W.-v.B. Columbus Id.
Caulerpa sertularioides (Gmel.) Howe. Columbus Id., Provision Id., Nancy Cay.
Halimeda Opuntia typica Barton. Careening Cay, Columbus Id., Provision Id.
Chnoospora pacifica J. Ag. Provision Id.
Dictyota cervicornis Kg., (T). Provision Id.
Dictyota dentata Lamx. Careening Cay.
Dictyota Bartayresii Lamx.? The plants correspond closely to the illustration in Vickers (1908) pl. 13, figs. 1, 2, rather than to those of the writer (1928) pl. 16, figs. 11, 16. Careening Cay.
Dictyota volubilis Kg. Careening Cay and Provision Id.
Neurocarpus delicatulus (Lamx.) Ktze. Careening Cay.
Neurocarpus Hauckianus (Möb.) Ktze., (T). Columbus Id.
Padina Vickersiae Hoyt, (T). Columbus Id. and Nancy Cay.
Spatoglossum Schroederi (Mont.) J. Ag. Careening Cay.
Zonaria zonalis (Lamx.) Howe. Columbus Id.
Galaxaura cylindrica (Sol.) Lamx., (T). Provision Id.
Galaxaura lapidescens (E. & S.) Lamx. Columbus Id.

Galaxaura marginata (E. & S.) Lamx. Nancy Cay, Careening Cay, Provision Id.
Galaxaura oblongata (E. & S.) Lamx. Nancy Cay.
Galaxaura rugosa (E. & S.) Lamx. Columbus Id.
Gelidium corneum (Huds.) Lamx. Careening Cay.
Gelidium rigidum (Vahl) Grev. Columbus Id.
Eucheuma Gelidium (J. Ag.) J. Ag. Careening Cay.
Gracilaria ferox J. Ag. Columbus Id., Careening Cay.
Gracilaria lacinulata (Vahl) Howe, (T). Columbus Id.
Hypnea musciformis (Wulf.) Lamx. Nancy Cay and Columbus Id.
Acanthophora muscoides (L.) Bory, (T). Columbus Id.
Amansia multifida Lamx. Careening Cay.
Bryothamnion triquetrum (Gmel.) Howe. Columbus Id.
Herposiphonia secunda (C. Ag.) Ambronn, (T). Columbus Id.
Laurencia microcladia Kg., (T). Provision Id.
Laurencia papillosa (Forsk.) Grev. Provision Id., Nancy Cay, Columbus Id.
Centroceras clavulatum Mont., (T). Columbus Id.
Grateloupia filicina (Wulf.) J. Ag. Columbus Id.
Ochtodes secundiramea (Mont.) Howe. Columbus Id.
Peyssonnelia rubra (Grev.) J. Ag. Columbus Id.
Amphiroa fragilissima (L.) Lamx., (T). Provision Id.
Amphiroa rigida Lamx., (T). Columbus Id.
Amphiroa Tribulus (E. & S.) Lamx., (T). The plants provisionally listed under this name are so much larger in the size of the articulations as to cause some concern as to their identity. Terminal segments, usually tapering to a sub-cylindrical tip, reached a length of 3.2 cm. Expanded segments, probably from near the middle of the plant, reached a length of 2.0–2.5 cm., and a breadth (exclusive of branches) of 7 to 10 mm.; they were usually plano-convex, the flat side (sometimes concave) bearing the conceptacles, the convex side without trace of a midrib. Upper and lower segments were frequently palmately divided, with 2–5 divisions. The specimens were completely disarticulated, which made an estimate of their height impossible. Columbus Id.
Jania capillacea Harv. Careening Cay.
Dermatolithon pustulatum (Lamx.) Fosl.? (T). Columbus Id.
Archaeolithothamnion episporum Howe. Columbus Id. Det. M. A. Howe.

Miscellaneous

A small group of specimens dredged off the Cuban coast was found with the material sent from the Farlow Herbarium. Of it only *Vidalia obtusa* (Mert.) J. Ag., from off Havana, is of interest.

The interesting *Amphibia Moritziana* (Sond.) Ktze. appeared (labeled

with name) among the Trinidad specimens as derived from Maronal Brook in the Senia Valley. Further material has reached the writer's hands from Barro Colorado Island, Gatun Lake, Panama Canal Zone, through the kindness of Prof. W. H. Weston, Jr. Both of these localities are freshwater ones, but some specimens received from Haiti in collections made by Dr. C. H. Arndt appear to be this species and are certainly marine. Howe (Torreya **2**: 149–152. 1902) discusses cases of Rhodophyceae of characteristically marine genera which are found in tropical freshwater streams, with particular reference to *Caloglossa* and *Amphibia*.

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DESCRIPTION OF PLATE LXII

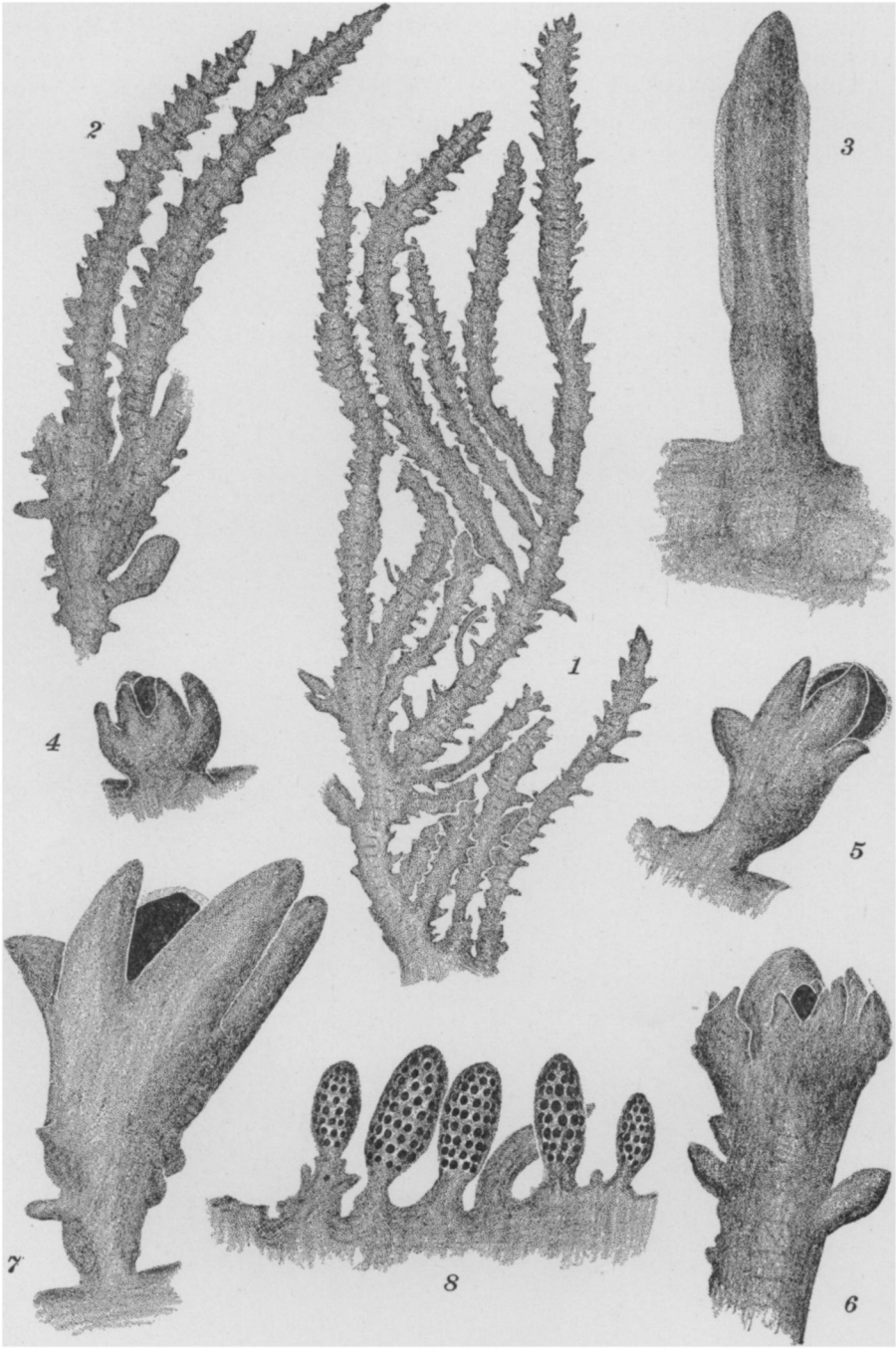
FIG. 1. Habit of portion of plant of *Carpoblepharis repens* showing rather irregular branching. × 15.

FIG. 2. Habit of two lateral branches and attachment to main axis. × 32.

FIG. 3. Lateral branchlets of last order with antheridial band. × 100.

FIGS. 4–7. Stages in the growth of the cystocarp-bearing branchlets, the carpospore mass being black and the gelatinous investment showing in figures 5 and 7. × 100.

FIG. 8. Edge of large lateral branch with five tetrasporic branchlets of stichidia, probably nearly mature. × 100.



TAYLOR: TROPICAL ALGAE