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MARINE SPONGES OF NORTH CAROLINA[1]

By Harry W. Wells, Mary Jane Wells, and I. E. Gray

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Introduction

Although the sponge fauna of North Carolina has in the past received the attention of such authorities as M. W. de Laubenfels, W. C. George, and H. V. Wilson, recent collections from this coast have revealed many gaps in our knowledge of this phylum. In this report we have attempted to organize and correlate the collections of these and other workers, including our own, and to present information in a form that will be useful for the identification of North Carolina sponges with a minimum of reference to other works. This study is the result of many personal collections, analyses of collections of previous workers, extensive consultation of sponge literature, and comparisons with museum specimens.

Historical Review

The earliest published enumeration of marine sponges from North Carolina is that of Coues and Yarrow (1879) who, from specimens collected at Beaufort Inlet near Fort Macon, listed those species identified by Verrill. Because there are no descriptions and few identifying remarks accompanying their names, this work is of no value in sponge identification. In 1919, George and Wilson described seventeen forms in an excellent paper on sponges in the Beaufort area. Actually there were sixteen species, for one was discussed twice under different names. Although de Laubenfels (1947) attempted to bring the taxonomy of these sixteen species up to date, the lack of representatives of certain species resulted in much synonymizing. The species described by George and Wilson are here listed with corrections.

1. *Spirastrella andrewsii*, new = *Spheciospongia vesparia* (Lamarck)
2. *Cliona celata* Grant
3. *Poterion atlantica*, new = *Spheciospongia vesparia* (Lamarck)
4. *Suberites undulatus*, new = *Cliona viridis* (Schmidt)
5. *Tetilla laminaris*, new = *Craniella laminaris* (George & Wilson)
6. *Reneira tubifera*, new = *Adocia tubifera* (George & Wilson)
7. *Stylotella heliophila* Wilson = *Hymeniacidon heliophila* (Parker)
8. *Esperiopsis obliqua*, new = *Tenaciella obliqua* (George & Wilson)
9. *Lissodendoryx carolinensis* Wilson = *Lissodendoryx isodictyalis* (Carter)
10. *Phloeodictyon nodosum*, new = *Rhizochalina oleracea* Schmidt
11. *Phoriospongia osburnensis*, new = *Xytopsues griseus* (Schmidt)
12. *Microciona prolifera* Verrill = *Microciona prolifera* (Ellis & Solander)
13. *Axinella acanthifera*, new = *Endectyon tenax* (Schmidt)
14. *Acanthella corrugata*, new = *Higginsia strigilata* (Lamarck)
15. *Aplysilla longispina*, new = *Aplysilla sulfurea* Schulze
16. *Pleraplysilla latens*, new = *Pleraplysilla minchini* Topsent
17. *Hircinia ectofibrosa*, new = *Ircinia fasciculata* (Pallas)

In his study of boring sponges along the Atlantic coast, Old (1941) collected in the Beaufort area and added four species of the genus *Cliona* to the sponge fauna of the state: *Cliona lobata* Hancock, *C. robusta* Old, *C. spirilla* Old, and *C. vastifica* Hancock.

De Laubenfels (1947) added several more species for the Beaufort area:

1. *Haliclona permollis* (Bowerbank)
2. *Haliclona excelsa* (Schmidt) = *Haliclona areolata* (Wilson)
3. *Craniella crania* Müller
4. *Calyx poa*, new = *Halichondria bowerbanki* Burton

Pearse and Williams (1951) published a list of sponges from reefs located off New River Inlet, North Carolina. These were identified by de Laubenfels. We have been able to examine most sponges of this collection. The published list, with corrections, follows:

1. *Spongia graminea* Hyatt
2. *Phyllospongia lanuga* de Laubenfels
3. *Ircinia fasciculata* (Pallas)

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4. *Ircinia campana* (Lamarck)
5. *Dysidea* sp. = *Dysidea fragilis* (Montagu)
6. *Haliclona ?coerulescens* (Topsent) = *Haliclona areolata* (Wilson)
7. *Haliclona oculata* (Linné) = *Tenaciella obliqua* (George & Wilson)
8. *Microciona prolifera* (Ellis & Solander) = *Microciona juniperina* (Lamarck)
9. *Thalyseurypon carteri* (Topsent) = *Homaxinella waltonsmithi* de Laubenfels
10. *Thalyseurypon foliacea* (Topsent) = *Thalyseurypon carteri* (Topsent)
11. *Myrmekioderma* n. sp. = *Higginsia strigilata* (Lamarck)
12. *Higginsia coralloides* Higgin = *Higginsia strigilata* (Lamarck)
13. *Phakellia folium* Schmidt
14. *Homaxinella* sp. = *Teichaxinella lata,* new
15. *Pseudaxinella* sp. = *Pseudaxinella rosacea* (Verrill)
16. *Hymeniacidon heliophila* (Parker) = *Oxeostilon burtoni* de Laubenfels
17. *Ciocalapata* n. sp. = *Ciocalapata gibbsi,* new
18. *Pseudosuberites melanos* de Laubenfels
19. *Cliona caribboea* Carter
20. *Dorypleres* n. sp. = *Dorypleres carolinensis,* new
21. *Myriastra fibrosa* (Schmidt)
22. *Geodia gibberosa* Lamarck
23. *Craniella crania* Mueller = *Trachgellius cinachyra* de Laubenfels
24. *Cionchyra cavernosa* (Lamarck) = *Cinachyra cavernosa* (Lamarck)
25. *Lucetta floridana* (Haeckel) = *Leucetta floridana* (Haeckel)

In addition, *Cliona truitti* Old has been reported in North Carolina waters by Wells (1959).

Of these works, only those of George and Wilson and of Old are particularly useful for identification purposes. Most of the sponges covered in the former paper are also figured in Fieldbook of Seashore Life by R. W. Miner (1950), but their nomenclature required considerable revision, as de Laubenfels pointed out in 1947. Because both northern and southern sponges occur in North Carolina, it has been necessary to use numerous works for identification. In particular, for northern species, the papers on sponges of the New England region by Hartman (1958) and by de Leubenfels (1949a) have been very useful; and for southern species, the publications by de Laubenfels on the sponges of the Dry Tortugas (1936b), of Bermuda (1950a), and of the Gulf Coast of Florida (1953) have been particularly helpful.

MATERIAL

Much of the material treated in previous studies of North Carolina sponges has been made available to us. Through the cooperation of Dr. M. R. Carriker and the Department of Zoology, University of North Carolina, we have examined a collection of sponges made by H. V. Wilson from the Beaufort area. Through the courtesy of Mr. D. E. Giles and the Department of Zoology, Oregon State College, we have examined the collection of sponges from the Beaufort area made in 1946 by de Laubenfels; and through the cooperation of Dr. C. G. Bookhout of the Department of Zoology, Duke University, we have examined the sponges from New River fishing banks collected by Pearse and Williams and identified by de Laubenfels. In addition to these, extensive collections have been made by the authors in the Beaufort and Cape Hatteras regions. A large number of the species collected represent new records for North Carolina.

Collections at the United States National museum have been consulted with the valuable assistance of Dr. C. E. Cuttress of the Division of Marine Invertebrates. Inquiries made to the American Museum of Natural History (New York), Academy of Natural Science (Philadelphia), Peabody Museum of Natural History (New Haven), Charleston Museum (Charleston), and the British Museum (London) for sponge collections from the North Carolina area, produced small lots duplicating other materials already available.

For species described here as new, type material has been deposited in the United States National Museum, Washington, D. C. Whenever possible, representative specimens of all species have been deposited in the U. S. National Museum, and are indicated by "U.S.N.M." and a collection number.

METHODS

Sponges are, of course, best studied in a living condition. Preservation in alcohol is next best, with drying preferred over preservation in formalin for long periods of time. Before preservation, notes on color and consistency are usually important, for these characters will often change.

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In the best procedure, a fresh sponge should be placed into 95% alcohol for several hours to allow time for hardening of the tissues and the precipitation of certain insoluble complexes. Permanent storage can then be made in clean 70% alcohol.

The form of a sponge colony is often of primary importance in recognizing species in the field, and indeed, is often of great value to a taxonomist for its identification. Although growth form may be a subject to a certain range of ecological variation, it generally is stable enough to serve as an important taxonomic character. Some workers have placed complete reliance on the size and shape of spicules as criteria for the identification of sponges; the variability of spicule shapes and sizes and the occasional absence of spicules of a particular type have consequently resulted in a number of misidentifications. The British spongologist, Maurice Burton, has written (1932): "As a result of my own experience, I am coming to the conclusion that, for the identification of species, the external form is a more reliable feature than the skeleton; that it is more constant than the shape of the spicules, and far less variable, under normal conditions, than is usually assumed." Actually, no one character is sufficient for sponge identification, but rather a combination of characters, including spiculation, growth form, color, and life history. However, recognizing the validity of Burton's remarks, we have included illustrations of the growth form for as many North Carolina species as possible, omitting only those which are thin, featureless encrustations or which are extremely plastic species.

One character that may vary with ecological conditions is the number of oscules on a sponge and the relative development of chimneys around them. Apparently this is related to their function as excurrent channels that carry excretory materials and water from which nutritive particles have been captured. In quiet waters where circulation is minimal, sponges show a maximum number of oscules per volume of sponge tissue and they may be elevated on chimneys well above the incurrent pores distributed over the surface of the sponge body. This arrangement confers obvious advantages to the sponge. On the other hand, sponges growing in surf or strong currents may have fewer and less conspicuous oscules. Common species that illustrate this type of variation include *Lissodendoryx isodictyalis* and *Haliclona loosanoffi*.

Another type of variation in form in different habitats is shown by the common northern sponge *Microciona prolifera*. Generally, this species forms only thin encrustations in the more exposed situations in high salinities. Just outside Hatteras Harbor it may form lamellate processes, and on the pilings within that harbor it produces beautiful head-sized masses of erect, finger-like lobes.

Usually, spicules are essential for final identification. Together with lesser or greater amounts of spongin, they comprise the skeleton of a sponge. Because their shapes and sizes are diagnostic features, they must be freed from surrounding tissue for microscopic examination. This is most easily accomplished by placing a tiny piece of sponge in a drop of sodium hypoclorite (Clorox) on a glass slide. When bubbling has ceased, the spicules can be viewed microscopically, but care must be taken to avoid contact between the basic fluid and the microscope. Calcareous spicules can be recognized by the effect of acid upon them: they will dissolve, while siliceous spicules will not. Spicule types are shown in Figure 1. The types found and their dimensions are included in descriptions and are illustrated for many species.

Several factors that affect the size of spicules should be mentioned. In many sponge preparations, extremely slender spicules can be found that represent early stages in the development of normal spicules; there is usually a series of intermediate stages relating these slender forms to thicker mature spicules. Ranges of spicule sizes given in descriptions do not include the extremely thin forms that clearly represent growth stages.

In addition, there is a clear-cut correlation of spicule size with water temperature, with the larger size in colder northern waters. For example, Hartman (1958) found for *Haliclona oculata* that the average measurements of oxeas from colonies north of Cape Cod were 133 μ long and 8.8 μ wide, while those from colonies south of Cape Cod were 114 μ long and 7.8 μ wide. Hentschel (1929) showed such a correlation of spicule length with water temperature within several genera. These observations indicate that spicular sizes may vary within the range of certain species, with an increase in size more likely in colder waters. This is particularly important in interpreting the differences in spicule sizes in specimens from North Carolina compared with spicules in specimens from the West Indies for

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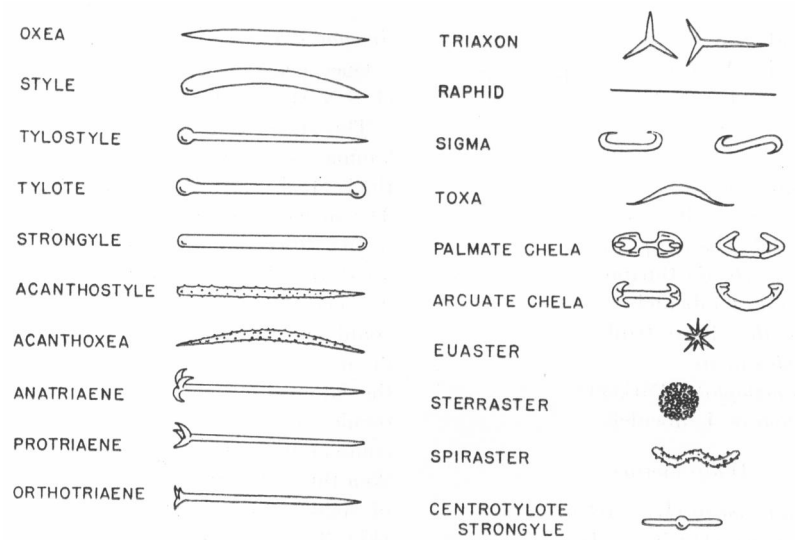

FIG. 1. Spicule types.

example; quite often, North Carolina representatives of northern species may possess slightly smaller spicules than is typical of that species at a locality farther north. Such ecophenotypic variation apparently occurs in several species of *Haliclona*. This type of variation must be kept in mind when one compares North Carolina specimens with descriptions of sponges from other localities.

Often the placement of spicules in the sponge is of importance also. Some sponges contain distinct fibers composed of a horny substance (spongin) that completely surrounds the individual spicules, while others possess structures that are best described as spicule tracts, in which bundles of spicules can be seen with very little spongin material present. The organization of spicules in these and similar patterns that are characteristic of certain groups can be readily observed by mounting small sections in Hoyer's mounting medium. Of course, permanent slides of spicules and secions can be made in balsam.

I. Systematic Treatment

by Harry W. Wells and Mary Jane Wells

Species, listed in the order of treatment are:

DEMOSPONGIA

Keratosa

Spongia graminea Hyatt
Phyllospongia lanuga de Laubenfels
Ircinia campana (Lamarck)
I. fasciculata (Pallas)
Dysidea fragilis (Montagu)
Aplysilla sulfurea Schulze
Pleraplysilla minchini Topsent

Haplosclerina

Haliclona areolata (Wilson)
H. canaliculata Hartman
H. loosanoffi Hartman
H. palmata (Ellis & Solander)
H. permollis (Bowerbank)
H. viridis (Duch. & Mich.)
Xestospongia halichondrioides (Wilson)
Callyspongia vaginalis (Lamarck)

Poecilosclerina

Adocia tubifera (George & Wilson)
Rhizochalina oleracea Schmidt
Lissodendoryx isodictyalis (Carter)
Mycale cecilia de Laubenfels
Xytopsues griseus (Schmidt)
Microciona prolifera (Ellis & Solander)
M. juniperina (Lamarck)
Thalyseurypon carteri (Topsent)
Eurypon clavata (Bowerbank)
Dictyociona adioristica de Laubenfels
Endectyon tenax (Schmidt)
Hemectyon pearsei n. sp.
Tenaciella obliqua (George & Wilson)

Halichondrina

Axinella bookhouti n. sp.
A. polycapella de Laubenfels

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A. reticulata Ridley & Dendy
Homaxinella rudis (Verrill)
H. waltonsmithi de Laubenfels
Pseudaxinella rosacea (Verrill)
P. wilsoni n. sp.
Teichaxinella grayi n. sp.
Phakellia folium Schmidt
Higginsia strigilata (Lamarck)
Halichondria bowerbanki Burton
H. melanadocia de Laubenfels
Ciocalypta penicillus Bowerbank
Ciocalapata gibbsi n. sp.
Hymeniacidon heliophila (Parker)
Oxeostilon burtoni de Laubenfels

Hadromerina

Spheciospongia vesparia (Lamarck)
Spirastrella coccinea (Duch. & Mich.)
Anthosigmella varians (Duch. & Mich.)
Suberites ficus (Johnston)
Pseudosuberites sulphureus (Bowerbank)
Prosuberites microsclerus de Laubenfels
Terpios fugax Duch. & Mich.
Polymastia robusta Bowerbank
Cliona caribboea Carter
C. celata Grant
C. lobata Hancock
C. robusta Old
C. spirilla Old
C. truitti Old
C. vastifica Hancock
C. viridis (Schmidt)

Epipolasida

Dorypleres carolinensis n. sp.
Trachygellius cinachyra de Laubenfels

Choristida

Myriastra fibrosa (Schmidt)
Geodia gibberosa Lamarck
Cinachyra cavernosa (Lamarck)
Craniella crania (Müller)
C. laminaris (George & Wilson)

CALCISPONGIA

Scypha barbadensis (Schuffner)
Leucetta floridana (Haeckel)
Leucosolenia canariensis (Miklucho-Maclay)

●

DEMOSPONGIA

ORDER KERATOSA

Skeleton of spongin fibers. Sand and foreign spicules (often broken) may be embedded in the fibers of some species.

Spongia graminea Hyatt Key grass sponge

One specimen from New River fishing banks (U.S.N.M. 23652).

This sponge is represented by a piece of curved lamina 54 mm high, 35 mm wide, and 13 mm thick. It is brown colored and stiffly spongy. The surface is conulose, covered with stout, projecting fiber ends over which fine, narrow fibers are draped like a spider web. Conules often occur in vertical ridges 2 to 3 mm apart. Between conules are abundant small pores, 1 to 2 mm in diameter. Large channels run vertically within the lamina, opening at the upper edge through oscules 3 to 6 mm across. The dermis is almost completely destroyed; apparently it was about 25 μ thick. The interior is composed of a network of small spongin fibers 25 to 40 μ in diameter (Fig. 3), and many vertical fibers 30 to 100 μ in diameter, which may contain foreign debris in their core.

This species typically forms columnar colonies 12 to 25 cm in diameter in which the base is smaller and the upper surface is truncate (de Laubenfels & Storr 1958). Oscules as large as 1 cm in diameter occur on the upper surface, and may be surrounded by thin chimneys 1 cm high in which the coarse vertical fibers are conspicuous.

This species was first described by Hyatt (1877, p.516). It is typically a West Indian sponge.

Phyllospongia lanuga de Laubenfels

This species has been reported from New River fishing banks (Pearse & Williams 1951), but no specimens have been available for examination.

It was described by de Laubenfels (1936b) as an irregularly lobate mass, marked by dome-shaped protrusions 1 to 3 cm in diameter. It is gray in color, and stiffly elastic. The surface is hispid with protruding fibers. A tough cortex, 600 to 1200 μ thick, is packed with sand and foreign spicule fragments, all about 20 μ in greatest dimension. There are extensive subdermal spaces. Oscules are conspicuous, 2 to 5 mm in diameter. Internal fibers, 30 to 45 μ in diameter, branch and anastomose to form a network with meshes 125 to 700 μ across. These fibers rarely have foreign material embedded in them, although foreign material occurs in the flesh.

This species was originally described as *Coscinoderma lanuga* by de Laubenfels (1936b, p.10), and was transferred to the genus *Phyllospongia* by de Laubenfels (1948, p.52).

Ircinia campana (Lamarck) de Laubenfels

One specimen from New River fishing banks.

This species is consistently cup-shaped and

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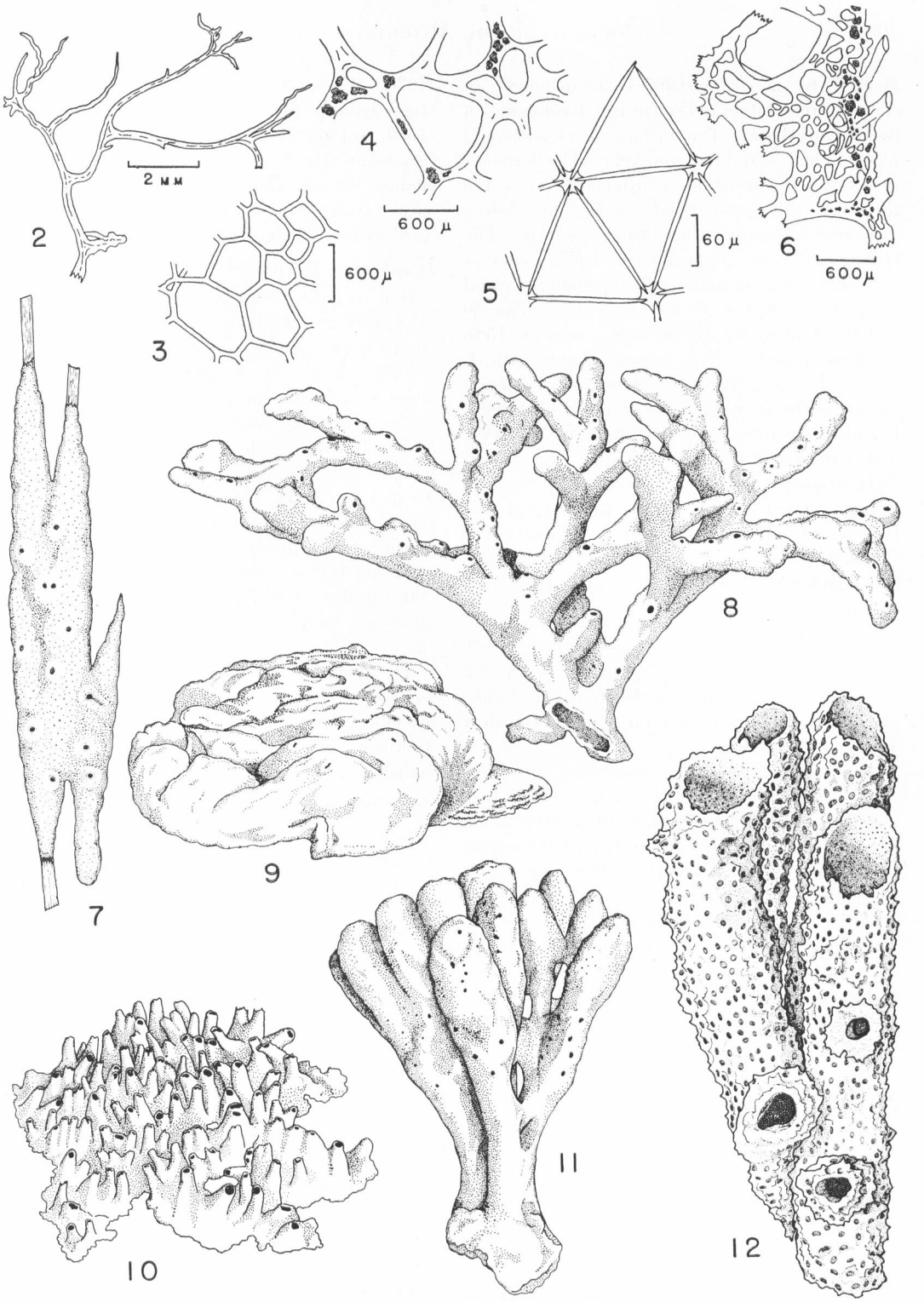

FIG. 2. *Aplysilla sulfurea,* dendritic fiber. FIG. 3. *Spongia graminea,* superficial fibrous network. FIG. 4. *Dysidea fragilis,* fibers containing foreign material. FIG. 5. *Haliclona permollis,* unispicular reticulation. FIG. 6. *Ircinia fasciculata,* fascicular fiber containing some foreign material. FIG. 7. *Haliclona palmata.* FIG. 8. *Haliclona viridis.* FIG. 9. *Xestospongia halichondrioides.* FIG. 10. *Haliclona loosanoffi.* FIG. 11. *Haliclona areolata.* FIG. 12. *Callyspongia vaginalis.*

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marked by a coarse surface arrangement of conules. It exhibits a brownish-red color and a tough consistency. The surface bears conules 2 to 4 mm high and 3 to 8 mm apart. The dermis is perforated by numerous conspicuous pores 125 to 200 μ in diameter. Oscules 1 to 7 mm across are found primarily on the concave surface. The tissue bears many filaments 2 to 4 μ in diameter with ball-like terminations. The primary skeletal elements are unusually broad sheets of fiber 50 to 130 μ in diameter; the secondary ones are 15 to 35 μ in diameter. This sponge shares with *I. fasciculata* a fetid odor, the abundance of foreign matter in the fibers, and the occurrence of peculiar filaments in the flesh—all characteristics typical of the genus *Ircinia*.

This species was first described as *Spongia campana* by Lamarck (1813, p.385), and was transferred to the genus *Ircinia* by de Laubenfels (1948, p.71). It has also been treated as *Hircinia* (de Laubenfels, 1936b). It is primarily West Indian in distribution.

Ircinia fasciculata (Pallas) Schmidt — Stinker sponge

One specimen from New River fishing banks (U.S.N.M. 23563), and several from the Beaufort area.

This species produces finger-like processes marked by vertical rows of small conules 1 to 2 mm high that are 1 to 4 mm apart. By the fusion of these upright lobes, an erect, massive colony may be formed. These later stages are represented by single specimens from Beaufort and from New River fishing banks (U.S.N.M. 23653). Beach specimens may be an off-white or pale yellow color, although a brownish color is more typical of the species. The consistency is tough and resistant. Fresh specimens have a distinctive garlic odor.

The dermis, 70 to 100 μ thick, often contains foreign debris as well as typical *Ircinia* filaments —long filaments with spherical swellings at each end. Large oscules, darker than surrounding tissue, are obvious on massive specimens but are inconspicuous on younger stages. Pores are abundantly scattered over the surface.

Internally, main longitudinal fibers 150 to 800 μ thick give off branches that radiate to the surface and lift the dermis into the conules. Actually many of these fibers are sheets or bundles of fiber (Fig. 6). They often contain foreign debris.

This species was first described as *Spongia fasciculata* by Pallas (1766, p.381). De Laubenfels (1936b) treated it as *Hircinia variabilis*, and early stages have been described by George and Wilson (1919, p.166) and Miner (1950) as *Hircinia ectofibrosa*. De Laubenfels explained the name changes in his Bermuda paper (1950a). This species is distributed from North Carolina southward as far as Panama.

Dysidea fragilis (Montagu) Johnston

One specimen from New River fishing banks (U.S.N.M. 23654). It has also been reported from the Beaufort area (Coues & Yarrow 1879).

This specimen is a gray-colored mass from which arise hollow processes, about 1 cm high and in diameter, that bear large oscules 3 to 7 mm across. It is 5 cm high. The entire mass is soft and compressible. Upon its surface are minute conules about 1 mm apart. The dermis is 20 μ thick, overlying extensive cavities and a fibrous endosome. In the interior, primary fibers often contain much sand and broken spicules and are usually 100 to 200 μ in diameter (Fig. 4). Smaller fibers (under 50 μ) may be relatively free of such foreign material.

This species was first described as *Spongia fragilis* by Montagu (1818, p.114). De Laubenfels (1936b, 1950a) has redescribed specimens from Tortugas and Bermuda. It is a typical West Indian form.

Aplysilla sulfurea Schulze — Sulfur sponge

Represented by U.S.N.M. 23641, collected at Beaufort by Dr. I. E. Gray.

This sponge is an irregular, amorphous mass 9 by 6.5 cm and up to 3 cm thick. It was bright yellow colored and very soft in consistency. The surface is composed of a smooth dermis stretched over the tips of projecting skeletal fibers to form prominent conules 3 to 5 mm high and 4 to 10 mm apart. Because of the contraction of the dermis with preservation, the fiber ends project several millimeters beyond the conules. Oscules 1 to 2 mm in diameter are present on the upper surface, but no pores are visible. The skeletal fibers branch but do not coalesce, exhibiting a characteristic dendritic form (Fig. 2). They arise from a basal plate of spongin as a fiber about 200 μ in diameter, narrow to about 30 μ at the conular tips. They are dark brown, translucent, obviously laminated, and free of foreign matter. In death, the sulfur-yellow color of this sponge turns to an indigo or purple, which is especially evident in preservatives.

This species is more often seen as small, young

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specimens that encrust shell or rock. Their slippery, shiny yellow surface is distinctive.

This species was first described by Schulze (1878, p.404). De Laubenfels (1947, 1950a) suggested that it is conspecific with *Aplysilla longispina* George and Wilson (1919, p. 163), described from the Beaufort area. The type specimen of *A. longispina* (U.S.N.M. 23608) has been examined and found to agree with characteristics of this species from other areas. *Aplysilla longispina* George & Wilson is hereby placed into the synonymy of *A. sulfurea*. This species is also treated by Miner (1950) as *A. longispina*. Typically, it is found in the West Indian region.

Pleraplysilla minchini Topsent

Two specimens (U.S.N.M. 23609) from Beaufort Harbor, and one from off Ocracoke Island.

This species is represented by thin colorless encrustations 1 to 2 mm thick. The largest specimen is 6 cm in diameter. The surface is marked by many acute conules 0.5 to 1.5 mm high and 0.5 to 3 mm apart. The dermis, about 20 μ thick, is extended over projecting fibers to form these conules. Oscules 200 to 350 μ in diameter lead into subdermal spaces. The interior region is dense. Clusters of flagellated chambers 50 to 120 μ in diameter can be found.

Extending to the surface conules are spongin fibers that are principally non-branching and simple, measuring up to 250 μ in diameter near the base, and tapering to 40 to 60 μ near the conular tip. In thick portions of the sponge, however, side branches 40 to 60 μ in diameter may develop; these never fuse with other fibers. At the base of the fiber is an expanded spongin plate that was attached to the substrate. The basal portion of primary fibers contains dark foreign material, while other parts show a distinct lamination of the yellow spongin.

This species was first described by Topsent (1905, p.clxxxv) from a depth of 30 meters off the coast of France. George and Wilson (1919, p.165) have described *P. latens* from Beaufort Harbor, with larger flagellated chambers and smaller conules, fibers, and other features being the chief differences. We have examined the syntypes of *P. latens* (U.S.N.M. 23609); they are thin, less-developed representatives of *P. minchini*. Although George and Wilson emphasized the simple nature of the spongin fibers, they did note occasional side branches, typical of *P. minchini*. In addition, we have observed small flagellated chambers (about 50 μ in diameter) in the Beaufort material, well within the size range described for *P. minchini* from France. The Ocracoke specimen is better developed and contains conules, fibers, and other structures that are as large as those described for *P. minchini*. With the discovery of small flagellated chambers in Beaufort material, and the collection of a specimen sharing fratures with both forms, *P. latens* must fall to the synonymy of *Pleraplysilla minchini*. The Ocracoke specimen was collected from a depth of 10 meters, while the Beaufort specimens were collected in the intertidal zone. Apparently age or ecological conditions were responsible for the differences in the Beaufort specimens.

This is only the third report of this species known to science.

ORDER HAPLOSCLERINA

Skeleton of silicious spicules and spongin, the spicules being primarily of one kind—oxeas, i.e. with points at both ends. Modifications of this spicule form may produce styles or strongyles as a small percentage of the total spiculation.

Haliclona areolata (Wilson), new combination

One specimen from New River fishing banks, and one (U.S.N.M. 23649) from off Beaufort Inlet.

The first specimen is a crust from which rise cylindrical or club-shaped lobes 5 to 18 mm in diameter. The entire colony is 47 mm high and 32 mm long. The second is an erect branching colony 10 cm high that rises from an expanded attachment to a shell (Fig. 11). From a basal stalk 2 cm across rise several primary branches which quickly divide to form short swollen digitate processes. These processes are 0.8 to 1.7 mm in diameter and are often attached to adjacent processes, either because of incomplete separation or anastomoses. The consistency is stiffly spongy and the coloration is a rich brown in alcohol and light brown in the dried specimen.

The surface appears punctate from evenly distributed pores 80 to 120 μ in diameter. Irregularly scattered over the surface are oscules 0.5 to 2.0 mm in diameter, some of which are closed by a thin sphincter-type membrane. Between these, the surface is formed by a layer of closely-packed fiber ends and spicule tufts. In protected areas, a thin translucent dermal membrane 20 to 25 μ thick can be found with only the tips of a few spicules projecting through it.

The skeleton is composed of a reticulation of multispicular fibers and scattered individual

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spicules. The interior contains many parallel fibers 40 to 100 μ in diameter that run toward the surface. Transverse fibers, anastomoses, and individual transverse and projecting spicules are common. Near the surface, these tracts branch and narrow to about 30 μ. The spicules are oxeas 180-320 × 6-10 μ, usually somewhat curved.

This species was first described from Puerto Rico as *Pachychalina areolata* by Wilson (1902, p.392), and has also been described from Bermuda as *Pachychalina millepora* by Verrill (1907, p.336). De Laubenfels (1947) identified the Beaufort specimen as *Haliclona excelsa*, a form described by Schmidt (1870, p.37) from northwestern Europe. Unless a careful comparison of specimens from both regions shows these to be the same, it seems best to consider these forms distinct in view of the vagueness of Schmidt's description and in view of the southern distribution of *H. areolata*. De Laubenfels also identified the specimen from New River fishing banks as *Haliclona ?coerulescens* (Pearse & Williams 1951).

Haliclona canaliculata Hartman

Several specimens from the Cape Hatteras beach, and one (U.S.N.M. 23629) from off Portsmouth Island, south of Cape Hatteras.

This species forms encrustations 2 to 4 mm thick upon hydroid stems, mollusc shells, and similar substrates. In life, these colonies are a brownish gray in color, and softly spongy. Most of these North Carolina specimens are somewhat atypical, apparently due to a commensal association with polychaetous annelids of the family Syllidae. Numbers of these small annelids inhabit the sponge tissue, so that the exact nature of channels in the sponge tissue is uncertain.

At the surface a thin dermis is raised over an extensive subdermal space by projecting spicular tracts. Although this dermis is free of spicules, it does contain accumulations of mud and fecal matter from the annelids. These accumulations obscure much of the anatomy of this sponge. Cylindrical tubes, 400 μ in diameter and formed of a spongin membrane, perforate the surface. These probably were formed around passageways frequented by the annelids, for the oscules of this species are typically 0.8 to 1.4 mm in diameter. Pores are microscopic. Peripheral regions contain much flesh distributed over the skeleton.

The skeleton consists of branching multispicular tracts with scattered free and connecting spicules. The spicules are cemented together by varying amounts of spongin. The spicules are oxeas 105–128 × 4–6 μ that taper gradually toward their ends. Occassional malformed spicules have been observed that lack points on one or both ends.

This species has been described by Hartman (1958, p.73) from New England waters.

Haliclona loosanoffi Hartman

Many specimens (including U.S.N.M. 23631) from Hatteras Harbor, and one from Beaufort Harbor.

This species forms encrustations on submerged surfaces from which hollow, branch-like oscular chimneys may arise (Fig. 10). The figured specimen is an encrustation 73 by 64 mm and basically 3 mm thick, with tapering oscular chimneys extending to 10 mm above its surface. North Carolina specimens typically are a salmon or tan color in life. They are soft in consistency and easily torn. The surface is marked by projecting spicular tracts. A very thin dermis free of spicules occurs between these projecting tracts, but is easily lost. Oscules are 1 to 2 mm in diameter.

The skeleton consists of vertical multispicular tracts connected by horizontal individual spicules, forming a loose network. These tracts may be entirely encased in spongin or only connected by spongin. The spicules are oxeas 80–100 x 2–6 μ. Most specimens have spicules that are quite stout, nearly cylindrical to within a short distance from their points. Although Hartman (1958) described the spicules of this species as tapering gradually, all but one of those shown in his Figure 23 are this stout, abruptly-pointed type of oxea. Gemmules have been found in several North Carolina specimens.

This species was first described in 1958 by Hartman (p.62), who reported collections from Connecticut and Maryland.

This species may be distinguished from similar-appearing specimens of *Haliclona permollis* by the presence of spicular tracts and the smaller spicules.

Halicolona palmata (Ellis & Solander) Burton

One specimen from Hatteras Harbor and six others (including U.S.N.M. 23626) from the Pamlico Sound shore of Hatteras Island.

This species forms encrusting colonies on marine vegetation: several specimens were attached to blades of eelgrass (*Zostera*) (Fig. 7), and one was attached to an algal holdfast. The figured specimen is 8 cm long and contains an erect, finger-like process 3 to 4 mm in diameter. This sponge was

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softly spongy in consistency and pinkish brown in color when fresh. It has faded little in preservative.

The surface is composed of an evenly developed plush of projecting fiber ends. Oscules 1 to 3 mm in diameter are scattered irregularly over the surface, and often occur within slightly elevated rims.

The skeleton is a fibrous reticulation composed of radiating fibers 12 to 22 μ in diameter, and connecting transverse fibers 7 to 12 μ in diameter in a ladder-like arrangement. The resulting delicate network is composed of rectangular meshes. These fibers are primarily composed of spongin with only a central core of spicules. The spicules are unusually small oxeas 52–60 x 1–2 μ.

This species was first described as *Spongia palmata* by Ellis and Solander (1786, p.189), and was transferred to the genus *Halicolna* by Burton (1930b, p.511). On the Atlantic coast, it has been collected in New England (de Laubenfels 1949a).

The growth form of this species may be simulated by other species of *Haliclona—canaliculata, loosanoffi,* and *permollis,* but its extremely small oxeas serve to distinguish *H. palmata.*

Haliclona permollis (Bowerbank) de Laubenfels — Volcano sponge

Many specimens from Beaufort Harbor.

This species is basically encrusting, but it may form hollow or solid cylindrical branches that are often fused at points of contact. One specimen contains several solid branches 3 to 5 mm in diameter and bears seven oscules only slightly elevated above the sponge surface. Another (U.S.N.M. 23636) is an irregularly lobed mass 35 by 22 mm that measures about 10 mm at its thickest part; from it rises a hollow branch or oscular chimney 10 mm long.

The surface is superficially smooth with prominent oscules 2 to 3 mm in diameter often occurring at the tip of a hollow branch or surrounded by a collar 1 to 3 mm high. Microscopically the surface is minutely tuberculate, with groups or individual spicules projecting from the tubercules. The skeletal unispicular reticulation is most clearly seen at the surface, a network of individual spicules with spongin only at their tips (Fig. 5). Abundant pores 50 to 100 μ across occur at the surface, in spaces between spicules. There is no easily separable dermis, nor subdermal cavity. The unispicular reticulation is regularly developed in peripheral regions, but becomes coarser internally, where larger spaces occur. The spicules in these two specimens are oxeas 110–130 x 3–5 μ, but other Beaufort representatives of this species contain oxeas 150–170 x 6–7 μ. This difference is probably associated with age or environmental differences.

This species was first described from Great Britain as *Isodictya permollis* by Bowerbank (1866, p.278). De Laubenfels (1947) found it common in Beaufort Harbor, and assumed that the sponge described as *Reneira tubifera* by George and Wilson (1919, p.145) was the same. However, Hartman (1958, p.71) has called attention to the differences and placed the latter species in the genus *Adocia.* The two species are indeed difficult to separate—displaying similar spiculation, color, and often growth form. *Adocia tubifera,* however, differs by possessing a distinct dermis, which bears oxeas smaller than those of the interior, and few pores; an extensive subdermal space; and many fibers that run longitudinally in the branches, and that are often visible in its thin oscular chimneys.

Haliclona permollis has been collected both north and south of North Carolina in the western Atlantic.

Haliclona viridis (Duchassaing & Michelotti) de Laubenfels

One specimen (U.S.N.M. 23642) collected on the beach at Nags Head, north of Cape Hatteras.

This sponge is a branching colony 15 cm high and 30 cm long in which the branches are 15 to 25 mm in diameter (Fig. 8). Where branches came into contact, they are fused. In life this species is yellowish-green, but upon death it fades to an off-white. It is softly spongy in consistency, and easily broken and surprisingly light-weight when dry.

The surface is relatively smooth and is composed of a minute reticulation. Oscules 1 to 3 mm in diameter are abundant on the upper surfaces of branches, usually at the summit of a knob or low mound. Microscopically the surface contains closely packed tufts of spicules 80 to 120 μ apart. Under the surface, this spicular reticulation becomes coarser, individual meshes being up to 160 μ across.

The internal skeleton is composed of reticulation of multispicular tracts with little spongin, and a connecting spicular network in the peripheral region. These multispicular tracts are predominantly longitudinal. Crossing them are rings of densely packed spicules wihch are obvious in

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cross-sections. These rings probably represent earlier growth stages. The spicules are oxeas 130–186 x 3–12 μ, the majority being 150–170 x 10–12 μ.

This species was first described as *Amphimedon viridis* by Duchassaing and Michelotti (1864, p.81), and was transferred to the genus *Haliclona* by de Laubenfels (1936b, p.42). Verrill (1907, p.337) also described it as *Pachychalina micropora*. In the West Indies where it is common, it occurs as an encrusting, massive, or branching sponge. Its spicules have been reported as 100–150 x 3–9 μ at Tortugas and Bermuda. The greater size attained in this North Carolina specimen can be attributed to lower water temperatures on this coast.

Xestospongia halichondrioides (Wilson) de Laubenfels

One specimen from Ocracoke Island (U.S.N.M. 23622), and one from Beaufort Harbor.

This species is represented by a flattened massive sponge 4 by 3 cm from which low mounds rise, making the greatest thickness about 1 cm (Fig. 9). It encrusts an oyster shell that was attached to a metal wreck off Ocracoke Island. It was bright orange in life and has faded to a light buff in alcohol. It is quite firm and solid in consistency, owing to the large proportion of spicules present in this sponge. The second specimen consists of a series of upright lobes, some of which bear oscules.

The surface is superficially smooth, with abundant minute pores about 40 μ in diameter evenly distributed over the surface. At the apex of several low mounds are oscules 0.3 to 1.0 mm in diameter that may be partially closed. The surface is composed of a dense pallisade of spicules situated perpendicular to the surface. Confused masses of spicules form tracts that ascend from the interior and spread out just below the surface to form the cortical layer. The spicules are oxeas 160–260 x 4–10 μ, with occasional styles or strongyles.

This species was first described from Puerto Rico as *Petrosia halichondrioides* by Wilson (1902, p.389), and was transferred to the genus *Xestospongia* by de Laubenfels (1950a, p.51). The synonymy of this species with *Xestospongia muta* (Schmidt 1870, p.44) on the basis of color in alcohol (de Laubenfels 1953) is not accepted here. The spicules of *X. muta* are larger (340 to 420 μ in length), and its form is typically vase or cup-shaped. The presence of upright lobes in the second North Carolina specimen precludes the development of the vase or cup shape characteristic of *X. muta* or *X. calyx*.

Callyspongia vaginalis Vase sponge
(Lamarck) Duchassaing & Michelotti

Four specimens (including U.S.N.M. 23619) from the beach near Cape Hatteras, and one from Bogue Sound near Beaufort.

This species is typically composed of a series of hollow branches rising from an attached base (Fig. 12). The figured specimen is 17 cm high with the largest branch 29 mm wide. The walls of these tubular branches are about one-seventh the diameter of the branch. The sponge is lavender in life, and yellowish gray in preservatives or dry. It is toughly spongy.

The surface is roughened by large, obvious conules that project 3 to 4 mm above the surface contours. Abundant round depressions 2 mm across represent pores areas. The apical opening of the large central cavity represents the oscules in this species, and may be up to 20 mm in diameter. The dermis consists of a network of spongin fibers 30 to 180 μ in diameter with much finer fibers 7 to 16 μ in diameter forming a secondary network in the meshes of the larger fibers. An extremely thin membrane may be found across this reticulation. The internal skeleton consists of an irregular reticulation of the larger fiber. Oxeas 80–95 x 2–4 μ core the fibers.

This species was first described as *Spongia vaginalis* by Lamarck (1813, p.436), and was placed in the genus *Callyspongia* by Duchassaing and Michelotti (1864, p.56). Much of the older literature treated this species as *Spinosella sororia* (Duch. & Mich. 1864), but de Laubenfels (1950a, p.56) in reviewing this species showed that they are conspecific.

ORDER POECILOSCLERINA

The skeleton includes a reticulation of spongin fibers. Usually there is some sort of dermal skeleton, with a different type of arrangement of spicules at the surface. Microspicules are often present. This order is close to the Halichondrina in which a plumose type of fiber or spicular tract is characteristic.

Adocia tubifera (George & Wilson) Hartman

Two specimens from Beaufort, including U.S.N.M. 23610.

This sponge consists of an irregular system of cylindrical branches varying from 3 to 10 mm in

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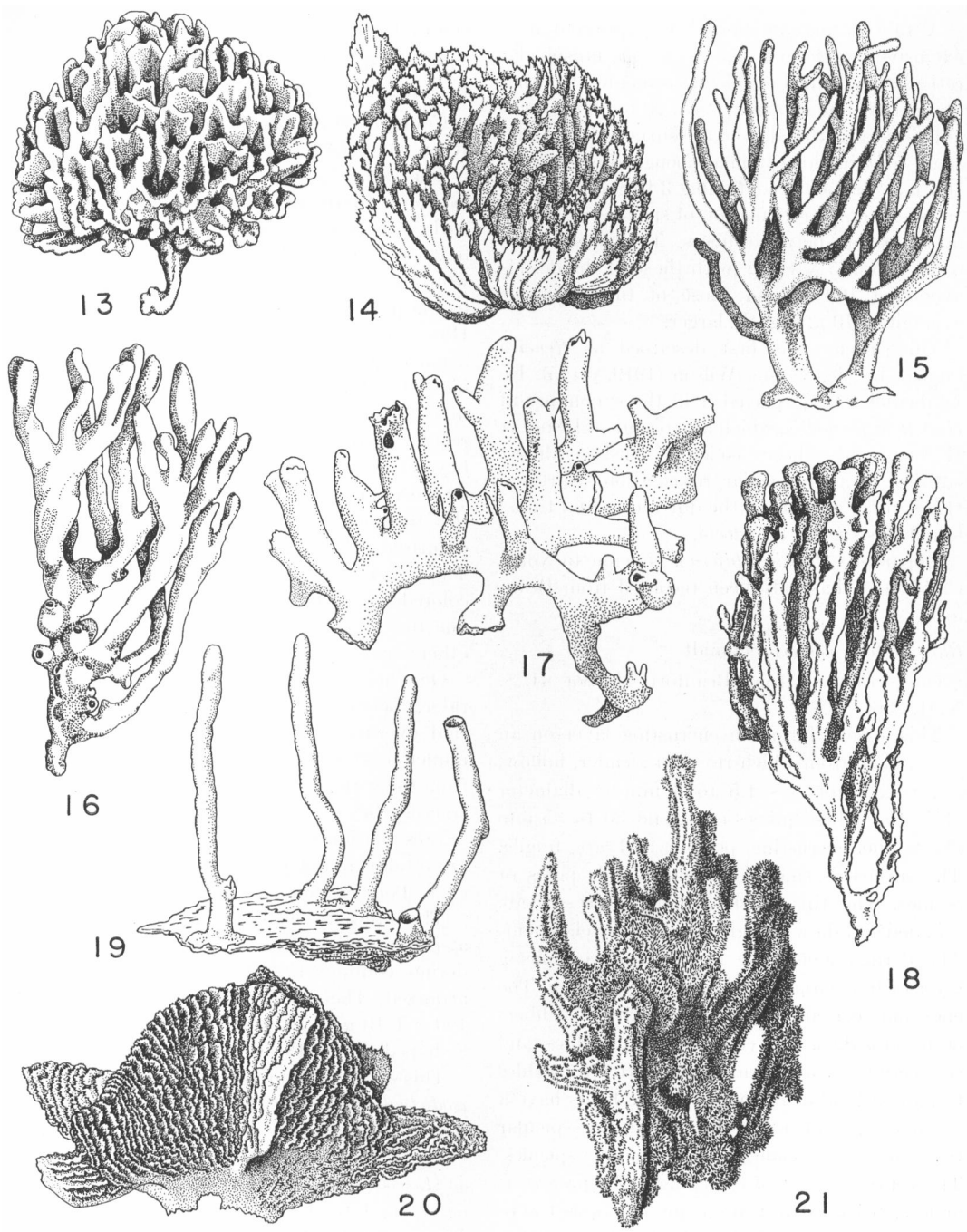

FIG. 13. *Microciona juniperina*. FIG. 14. *Hemectyon pearsei*. FIG. 15. *Endectyon tenax*. FIG. 16. *Tenaciella obliqua*. FIG. 17. *Adocia tubifera*. FIG. 18. *Microciona prolifera*. FIG. 19. *Rhizochalina oleracea*. FIG. 20. *Thalyseurypon carteri*. FIG. 21. *Dictyociona adioristica*.

diameter (Fig. 17). From these branches numerous tubes arise, 2 to 12 mm high and 2 to 4 mm wide. Their tips are thin and transparent, and surround the oscules which are 0.5 to 2.0 mm in diameter. The entire colony measures 75 mm in its greatest dimension. It is quite fragile. In life it was colored a pink or purplish tan, but this has faded to an off-white or pale yellow in alcohol.

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A thin dermal membrane is supported over extensive subdermal spaces by a unispicular reticulation formed of spicules cemented together at their tips by spongin. Pores 20 to 100 μ in diameter are scattered over the surface. The endosome contains longitudinal spongin fibers, 30 to 100 μ in diameter, containing 3 to 8 spicules per cross-section. A reticulation of spicules is present in the space between fibers. The spicules are oxeas 135–175 x 4–8 μ ,with those of the dermis averaging 160 μ, and those of the endosome averaging 170 μ, slightly larger.

This species was first described as *Reneira tubifera* by George and Wilson (1919, p.145). De Laubenfels (1947) placed it in the synonymy of *Haliclona permollis*, which also occurs in Beaufort Harbor, and whose skeleton consists almost entirely of a unispicular reticulation. Hartman (1958, p.71) recognized the differences and transferred this species to *Adocia*.

Apparently *Adocia tubifera* is endemic to North Carolina; it has only been recorded from Beaufort.

Rhizochalina oleracea Schmidt

One specimen from Beaufort Harbor (U.S. N.M. 23611).

This sponge forms an encrusting layer on an oyster shell from which rise four slender, hollow, finger-like processes 1.5 to 3 mm in diameter (Fig. 19). These processes extend 30 to 35 mm above the encrusting portion and are fragile. The surface is smooth without visible pores or oscules. The tips of the slender processes are rounded and show no sign of oscular development. The dermal membrane is thin and contains a layer of tangential spicules in a reticulation. The endosome contains a series of longitudinal fibers 30 to 80 μ thick that contain many spicules, and connecting spicular tracts and scattered spicules forming a kind of reticulation. The fibers have a a small amount of spongin, and the spicular tracts have only enough to connect the spicules. The central region of each finger-like process is hollow; adjacent to it are a ring of canals 150 to 350 μ in diameter. The spicules are oxeas 94–120 x 3–6 μ.

This species was first described by Schmidt (1870, p.35). George and Wilson (1919, p.152) describes this specimen as *Phloeodictyon nodosum*. De Laubenfels (1947, p.35) recognized its identity with *Rhizochalina oleracea*. Examination of U.S. N.M. 23611, the type specimen of *P. nodosum*, confirms his identification. *Rhizochalina oleracea* is typically a West Indian species.

Lissodendoryx isodictyalis (Carter) Topsent

Common in Beaufort and Hatteras Harbors. Represented by U.S.N.M. 23630.

This species forms encrustations that often develop into irregular colonies up to 20 cm across, with numerous vertical projections. Specimens have been collected in Hatteras Harbor in midwinter that were simply lumps of tissue enmeshed in the processes of *Microciona prolifera* colonies. However, in summer this species attains an unusual degree of development on the rock jetty opposite Hatteras Harbor, producing extensive mats that coat many of the submerged rocks. Irregular vertical processes often project 2 to 3 cm beyond the encrusting mass, in exceptional cases measuring up to 10 cm in height. By their fusion, the thickness of the colony is increased and excurrent channels may become surrounded. This species is crisp in consistency. It often is colored blue-green or yellow green, but this may be due to an alga, for whole colonies and parts of others are a pale yellow or off-white.

On the surface are many slightly elevated ridges, between which is a thin dermal membrane that overlies obvious subdermal canals. In life, numerous translucent papillae extend 1 to 3 mm from the surface, but because these are very contractile, they are often withdrawn upon collection or preservation. Oscules 0.5 to 2.5 mm in diameter are often contained at the tips of vertical processes. Pores are microscopic.

The internal skeleton is primarily composed of a spicular reticulation formed of styles, while the dermis contains tylotes radially or tangentially arranged. The spicules (Fig. 15) are styles 146–190 x 4–10 μ, tylotes 178–194 x 4–6 μ, C- and S-shaped sigmas 18–40 μ, and chelas 12–28 μ.

This species was first described as *Halichondria isodictyalis* by Carter (1882, p.285) and was transferred to the genus *Lissodendoryx* by Topsent (1897, p.456). Wilson (1911, p.11) described it as *Lissodendoryx carolinensis*; and this is the name used by George and Wilson (1919) and Miner (1950). North Carolina specimens and those to the north contain larger sigmas and smaller chelas than specimens from warmer waters to the south (Hartman 1958), but this variation has not been given taxonomic status.

Mycale cecilia de Laubenfels

Many specimens from Hatteras Harbor, including U.S.N.M. 23633.

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TABLE 1
Comparison of characters of Mycale cecilia *de L.*

Location	Panama	Hawaii	North Carolina
Author	de Laubenfels 1936a	de Laubenfels 1950c	Wells & Wells
Tylostyles	300 x 7–10 μ	240–250 x 4–6 μ	250–270 x 4–6 μ
Sigmas	30 μ	30–42 μ	50–58 μ
Larger chelas	22–25 μ	24 μ	30–36 μ
Smaller chelas	12–15 μ	15 μ	14–16 μ
Color	green, red embryos	pink and lavender, yellow embryos	yellow-green or yellowish tan, orange embryos

This species is represented by thin colonies up to 8 cm in diameter that encrust rocks, shells, and calcareous worm tubes. In life they are pale yellowish green or yellowish tan and quite soft and slimy. Specimens containing orange-colored embryos were collected in August 1959.

There is a thin dermal membrane containing spicules tangentially arranged, that extends over the ends of vertical polyspicular tracts. This dermis can be pulled off as a sheet, exposing dendritic patterns of subdermal canals. No oscules or pores are optically evident. Internally the sponge may be more or less cavernous, with abundant spaces. The skeleton consists of ascending spicular tracts 30 to 60 μ in diameter which branch and end in a brush of spicules at the dermis. In dry specimens, these tracts may extend beyond the dermis as a result of shrinkage of surrounding tissue. The spicules (Fig. 16) are tylostyles 250–270 x 4–6 μ, comprising the ascending tracts and scattered in the dermal membrane; sigmas 50–58 x 3–4 μ in which the axis is twisted 90°; and two size classes of palmate anisochelas, the larger 30–36 μ long and the smaller 14–16 μ long.

This species was first described from the Pacific coast of Panama by de Laubenfels (1936a, p.447). It has also been reported from Hawaii (de Laubenfels 1950a). The characters of these sponges are compared in Table 1. Sigmas and the larger class of chelas are somewhat larger in North Carolina specimens. Regarding the variations in color of this species, de Laubenfels has suggested that its color may change with age.

This is the first report of this species from the Atlantic Ocean. It is probably distributed in the West Indian region. Many other marine organisms are distributed on both sides of Central America, so this pattern of distribution is not unusual.

Xytopsues griseus (Schmidt) de Laubenfels

One specimen was collected at Beaufort by George and Wilson.

This species forms encrustations that may develop into thick massive colonies up to 8 cm long. The surface is relatively smooth. Small oscules, 1 mm in diameter, pass through a dermal layer 10 μ thick into meandering subdermal canals. Scattered spicules are found in the dermal membrane lying parallel to the sponge surface. Skeletal fibers of the endosome are largely composed of sand, with a greater representation of the proper spicules of this species present in the peripheral portions of these fibers. These fibers neither branch nor anastomose, but sometimes run to the surface at an oblique angle, presenting a branching appearance. Only inconspicuous amounts of spongin are present in the fiber. Specimens have been reported (de Laubenfels 1950a) in which algal filaments substituted for skeletal fibers. Spicules: (1) strongyles 160–180 x 2–3 μ, (2) sigmas 10–20 μ, and (3) isochelas 12–16 μ.

This species was first described as *Desmacidon griseum* by Schmidt (1870, p.55). It was described by George and Wilson (1919, p.154) as *Phoriospongia osburnensis*, and subsequently *osburnensis* was made the type of the genus *Xytopsues* (de Laubenfels 1936b, p.55). In 1947, de Laubenfels placed *osburnensis* in the synonymy of *Desmapsamma australis* Dendy, but later (1949a) he corrected this mistake, and synonymized it with Schmidt's species.

Xytopsues griseus is a typical West Indian form.

Microciona prolifera (Ellis & Solander) Verrill

Many specimens from Hatteras Island and Harbor, and several from Beaufort Harbor. Represented by U.S.N.M. 23618.

Colonies of this species attach to rocks, shells, pilings, algae, and alcyonarians. Initially this

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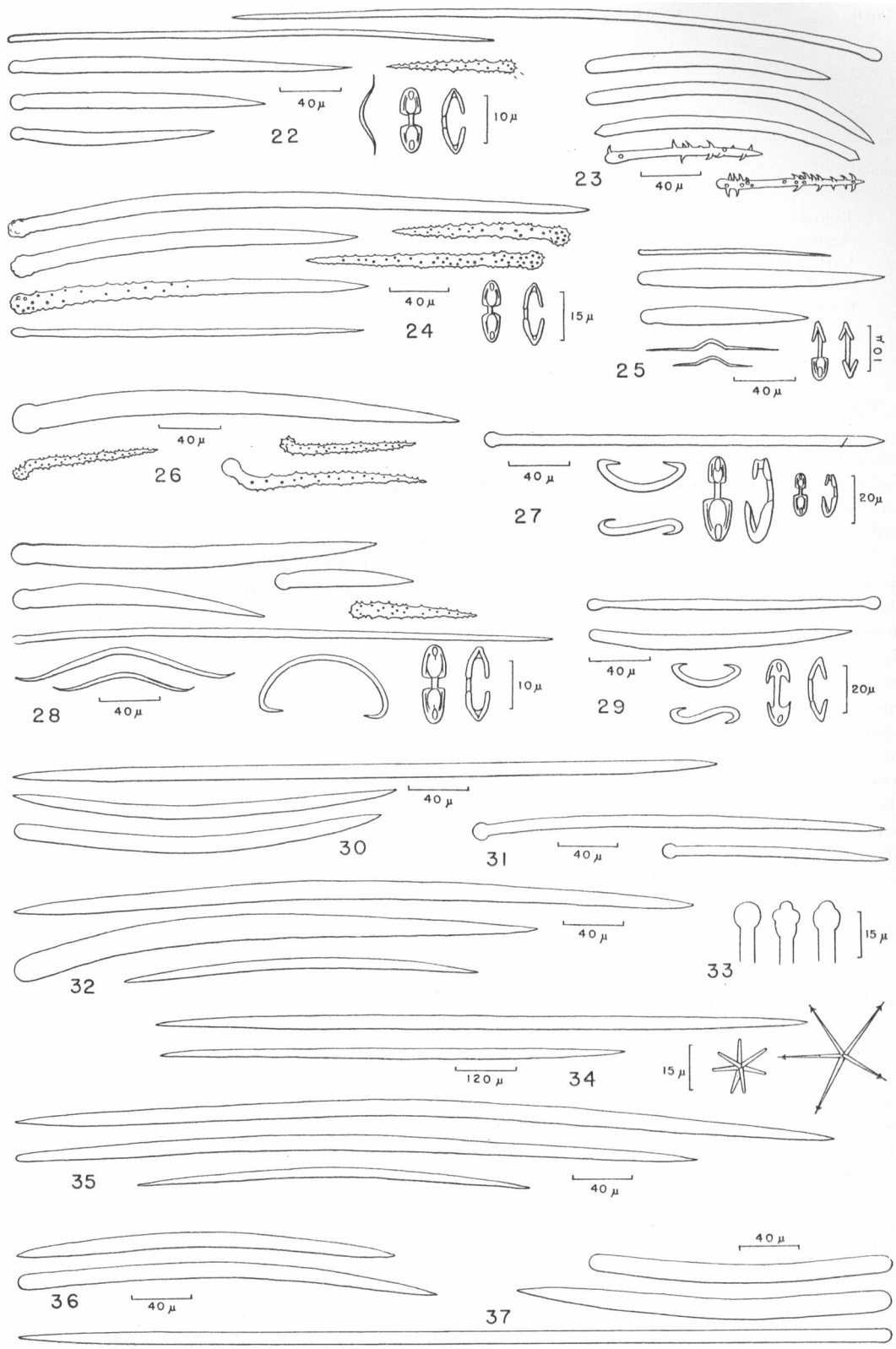

FIGS. 22–37

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species forms a thin encrustation; many specimens from exposed situations in high salinities exhibit this form. Under typical estuarine conditions however, many erect fibers develop from this nasal membrane and form by their fusion a series of erect lobes (Fig. 18). These lobes are 2 to 5 mm in diameter and up to 20 cm high and may branch and coalesce to form a head-sized mass. The tips of these lobes are sometimes swollen and often compressed. Intermediate forms have been collected on the Hatteras Harbor jetty that exhibit an upright lamella with an irregular surface, as though it had been formed by the incomplete separation of a series of adjacent lobes.

In his description of this species in his paper on sponges of the Woods Hole area, de Laubenfels (1949a) confused it with the following species, *Microciona juniperina*. His description of growth form is primarily that of two specimens dredged off Beaufort which we have examined and found to represent the latter species. In it, a honeycomb-like structure is formed by the fusion of adjacent upright septa.

This species is bright red in life, but cold damage and other adverse conditons may produce a dull brown discoloration. Its consistency is toughly spongy.

The surface appears smooth in fresh specimens, but with drying, contraction of the flesh leaves the surface irregularly conulose. Microscopically, a thin, translucent dermal membrane extends over the ends of radial spongin fibers. Individual spicules project through this membrane, extending up to 200 μ, usually only 100 μ beyond its surface. With drying or wave erosion, this membrane and much of the soft flesh is lost, and the surface exhibits a hispid, ragged appearance due to projecting fiber ends and spicules. Oscules are not evident. In encrustations, branching fibers arise from a basal plate of spongin and project independently toward the surface. In the interior of erect lobes, there is a network of spongin fibers that leads into a peripheral zone of independent radial fibers that extend to the surface. The fibers contain many spicules, often with only their heads embedded in the spongin. Spicules (Fig. 22): (1) thick styles 150–350 x 8–14 μ, (2) thin subtylostyles 100–340 x 2–5 μ, with intermediate stages present, (3) acanthostyles 80–100 x 6–8 μ, (4) toxas 10–40 μ, and (5) chelas 12–16 μ. Toxas and chelas are rare in North Carolina material, and may be virtually impossible to find in some specimens. Their discovery is made difficult by the granular nature of the protoplasm of this species. In specimens from north of Cape Cod, toxas and chelas are more abundant and the acanthostyles are larger. The shape of the larger spicules (1, 2, and 3) may vary considerably between specimens: the swollen "tylote" endings may be well developed or absent, and the spination of the acanthostyles may also be well developed or absent.

This species was first described as *Spongia prolifera* by Ellis and Solander (1786, p. 189), and transferred to the genus *Microciona* by Verrill (in Verrill & Smith 1873, p.741). De Laubenfels (1947, 1949a) placed *Esperiopsis obliqua* George & Wilson in the synonymy of this species, and suggested that the same should be done with *Acanthella corrugata*, *Axinella acanthifera*, and *Suberites undulatus*, all four described by George and Wilson from a small number of specimens. These are discussed in this paper under *Tenaciella obliqua*, *Higginsia strigilata*, *Endectyon tenas*, and *Cliona viridis*, respectively, and are regarded as separate entities. In addition, specimens identified as *Microciona prolifera* by de Laubenfels (Pearse & Williams 1951) are included in the following species—*Microciona juniperina*.

De Laubenfels (1936b, p. 111) noted that *prolifera* is intermediate in character between the genus *Thalysias* and the genus *Microciona* as he defined them, and actually would fit *Thalysias* better than *Microciona*. However, on the basis of long usage in that combination, he left *prolifera* in *Microciona*. By his definition, *Microciona* is encrusting and has little dermal specialization, while *Thalysias* branches and has distinct dermal specialization. Because these characteristics intergrade, Vosmaer (1935) and Hartman (1955) dropped *Thalysias* into the synonomy of *Microciona*. De Laubenfels' partitioning of this group

FIGS. 22–37. Sponge spicules, drawn with the aid of a camera lucida. FIG. 22. *Microciona prolifera*. FIG. 23. *Endectyon tenax*. FIG. 24. *Dictyociona adioristica*. FIG. 25. *Tenaciella obliqua*. FIG. 26. *Hemectyon pearsei*. FIG. 27. *Mycale cecilia*. FIG. 28. *Microciona juniperina*. FIG. 29. *Lissodendoryx isodictyalis*. FIG. 30. *Pseudaxinella wilsoni*. FIG. 31. *Prosuberites microsclerus*. FIG. 32. *Teichaxinella grayi*. FIG. 33. *Terpios fugax*, heads of tylostyles showing variation in form. FIG. 34. *Dorypleres carolinensis*. FIG. 35. *Ciocalapata gibbsi*. FIG. 36. *Axinella bookhouti*. FIG. 37. *Phakellia folium*.

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has merit, for it is large and widely distributed; and the existence of intermediates does not lessen the convenience of recognizing two divisions. It would appear best to recognize these two categories, using the criteria set up by de Laubenfels (1936b), but drop their rank to subgenera within the genus *Microciona*. Under this classification, *prolifera* should then be transferred to the subgenus *Thalysias*, the full designation being *Microciona* (*Thalysias*) *prolifera*.

Microciona prolifera is distributed from North Carolina northward.

Microciona juniperina (Lamarck) Hartman

Two specimens from New River fishing banks, and two specimens dredged off Beaufort Inlet. Represented by U.S.N.M. 23565.

This species produces beautiful colonies of intricate design (Fig. 13). The figured specimen is 8 cm high and 8 cm wide. From a narrow peduncle attached to a stone, arise about six branches that extend out radially and then divide and form a complicated network of branching and anastomosing septa directed toward the surface. The peduncle is 1 cm tall and 10 by 4 mm thick. The septa are 2 to 3 mm thick, and enclose cylindrical channels 5 to 10 mm in diameter that are open both above and below. Toward the periphery of the colony the development of septa is less pronounced; here, flat, lumpy branches, not yet fused with one another, present a more irregular appearance. Even in the central part of the network, the upper margins of the septa are not evenly developed.

The sponge is red, and tough in consistency. The surface is more compact and even than that of *Microciona prolifera*. There is a thin derma membrane pierced by many hispidating spicules. Minute pores are visible on the sides of septa, and stellate patterns mark the location of oscules. The thin dermal membrane is easily lost, exposing the many dermal brushes of projecting spicules. A reticulation of spongin fibers forms the interior skeleton. Spicules (Fig. 28): (1) stout subtylostyles 210–310 x 13–18 μ, characteristic of the surface hispidation and the fibers; (2) slender subtylostyles 120–405 x 2–5 μ, characteristic of the dermal membrane; (3) short subtylostyles, often with spiny heads, 74–114 x 8–14 μ, echinating the fibers; (4) toxas 50–144 x 4 μ, (5) very rare sigmas 76–110 μ, and (6) palmate chelas 16–20 μ. Apparently, the occurrence of specimens containing sigmas is unusual, for this is only the second report of their occurrence in this species, the first being that of Schmidt (1870, p.56, as *Tenacia clathrata*). As in *M. prolifera*, the spination of the short echinating spicules is variable.

On the surface of *Microciona juniperina* specimens from New River fishing banks were a number of colonial sea-anemones that have been identified as the zoanthid *Parazoanthus swiftii* (Duch. & Mich. 1861) by Dr. C. E. Cuttress of the U.S. National Museum.

The unusual form of this sponge, the striking contrast between the thickness of its stout subtylostyles and slender subtylostyles, and the large size of its toxas readily distinguish this sponge from *Microciona prolifera*.

This species was originally described by Lamarck (1813, p. 444), and redescribed by Topsent (1932a, p. 97). Hartman (1955, p. 171) has transferred it to the genus *Microciona* and given an extensive list of synonyms. De Laubenfels (1936b) established *juniperina* as the type species of *Thalysias*. In accordance with Hartman's placing this species in *Microciona*, *Thalysias* is dropped to a subgenus, and the full designation for this species becomes *Microciona* (*Thalysias*) *juniperina*.

There has been some question raised about the correct spelling of the generic name *Thalysias* Duchassaing & Michelotti, 1864 (or subgeneric name under the present classification). Carter (1882) and Hartman (1955) point out that through printer's errors four different spellings of this name appear in Duchassaing and Michelotti's paper. However, there is no question as to which is the correct spelling, for three misspellings are corrected to *Thalysias* on pages 122 and 123 of the original publication, and only that spelling remains. It seems possible that their four-page "Errata" was not bound with all copies of this publication, for it is variously listed with 115, 119, or 124 pages in the literature citations of recent toxanomic works. A copy of Duchassaing and Michelotti (1864) in the United States Library of Congress, Washington, D. C., contains an "Errata" on pages 121 to 124 bound into the volume.

In 1946, de Laubenfels dredged two specimens from 5 meters depth off Beaufort that he regarded as *Microciona prolifera* "in its most extremely proliferated form." He later described these specimens as the "extreme perfection" of *M. polifera*, in his paper on the sponges of Woods Hole (de Laubenfels 1949a). We have examined these and shown one in Fig. 13. They are typical specimens of *Microciona juniperina*. A similar situation ex-

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ists with the specimens from New River fishing banks. These specimens, which had been labeled by de Laubenfels as "abnormal, dubious *Microciona prolifera*", and which were recorded by Pearse and Williams (1951), are also *M. juniperina*.

This species is typical of the West Indian region.

Thalyseurypon carteri (Topsent) de Laubenfels

Two specimens from New River fishing banks, represented by U.S. N.M. 23656.

This species forms this fan-like laminae whose surfaces are corrugated by ridges (Fig. 20). The figured specimen is 55 mm long and 40 mm high, and the main lamina is 3 to 10 mm thick. Lateral laminae project from the main lamina like buttresses. In alcohol this species is brownish gray and spongy. The surface is prominently marked by thin ridges that extend across the main axis of the sponge. At the surface, these ridges form a divergent, branching pattern. Between these ridges, a depressed, fleshy dermis extends across the intervening valleys which contain oscules 0.5 to 1.0 mm in diameter. The protruding ridges are made hispid by brushes or projecting spicules.

Internally, the skeleton consists of a reticulation of radial multispicular spongin fibers 30 to 80 μ in diameter and connecting transverse fibers, usually containing only one spicule. The radial fibers may be surrounded by abundant spicules that have their heads embedded in spongin. Spicules: abundant acanthotylostyles 150–350 x 8–15 μ with very small spines, characteristic of the interior tracts; and smooth tylostyles 250–900 x 10–14 μ, characteristic of the surface brushes.

This species was first described as *Clathria carteri* by Topsent (1889, p. 38), and transferred to the genus *Thalyseurypon* by de Laubenfels (1936b, p. 107). The latter author noted that this species is identical with *C. foliacea* described by Topsent on the next page, and he used *foliacea* as the specific name. Because *carteri* was applied to the species first, *Thalyseurypon carteri* is the valid name for this species, and *foliacea* falls to its synonymy. This species was identified as *Thalyseurypon foliacea* in the New River collection and reported that way by Pearse and Williams (1951). An examination of the specimens from the New River collection that were labeled *Thalyseurypon carteri* shows that they are actually *Homaxinella waltonsmithi*.

This is typically a West Indian species.

Eurypon clavata (Bowerbank) Gray

One specimen from off Ocracoke Inlet, U.S. N.M. 23632.

This species is represented by a thin encrustation of less than 1 cm^2 in area that was attached to a conglomerate rock dredged from 10 meters. It was orange and fleshy in life. The surface is marked by a projecting hispidation of scattered individual spicules. No oscules or pores can be observed. The entire sponge is less than 1 mm in thickness. Its spicules are extremely long tylostyles 1000–2000 x 15–16 μ and abundant short acanthotylostyles 70–205 x 5–11 μ. The tylostyles stand erect upon the substrate and are echinated by the smaller spiny spicules, as though they were the spongin fibers of other sponges in this family. The spines on the acanthotylostyles may be quite obvious.

This species was first described as *Hymeraphia clavata* by Bowerbank (1866, p. 143), and transferred to the genus *Eurypon* by Gray (1867, p. 521). It is common on the coast of Europe and has been recorded at Bermuda (de Laubenfels 1950a).

Dictyociona adioristica de Laubenfels

Many specimens collected on Cape Hatteras beach, represented by U.S.N.M. 23623, and one specimen from Beaufort Harbor.

This sponge attaches to hard substrates such as shells, alcyonarian colonies, conglomerate rock, and calcareous worm tubes. Its colonies are composed of a series of irregularly shaped upright processes that often branch and coalesce (Fig. 21). The figured specimen is 7 cm high. Individual branches range from 3 to 10 mm in width. When fresh, this species was bluish gray and toughly spongy.

The surface contains a thin dermal membrane that is easily lost. No oscules or pores are visible. The internal skeleton includes a reticulation of spongin fibers that give rise to a zone of loosely matted, branching radial fibers. The spongin of these fibers is unusually firm and resistant to bases. At the surfaces, these fibers branch at wide angles and end in brushes of erect spicules. Where the dermis has been lost, these spicular brushes give this sponge a fuzzy appearance. Spicules (Fig. 24): (1) subtylostyles with spiny or lumpy heads 150–350 x 8–14 μ common in fibers and surface brushes, (2) acanthotylostyles 150–200 x 6–8 μ in fibers, (3) acanthotylostyles 70–100 x 3–6 μ echinating the fibers, (4) slender

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tylostyles 210–250 x 2–4 μ in the dermis, and (5) chelas 16–20 μ.

This species was first described from Florida by de Laubenfels (1953, p. 526).

Endectyon tenax (Schmidt) Topsent

Many specimens from the Hatteras area including U.S.N.M. 23616, and two specimens from New River fishing banks.

This species usually forms erect colonies up to 16 cm high that produce many slender branches (Fig. 15), although colonies may occur with flattened lobes. The figured specimen is 9 cm high. The basal stalk may be up to 17 mm wide, but the many branches that it gives rise to are only 2 to 4 mm in diameter. The pattern of branching may be palmate or trichotomous, as well as dichotomous; commonly branches fuse where they come into contact. One specimen from the New River collection has several flattened lobes 1.5 to 3 mm in thickness arising from a narrow attachment. This species is red colored in life, and yellowish gray in dried specimens. It is quite stiff and will break when dry rather than bend.

The surface is optically smooth, with stellate patterns of narrow radiating grooves marking the location of oscules. Pores and oscules are microscopic. Under a lens the surface is hispid and punctate. Internally, there is a firm axial core that contains longitudinal spongin fibers. The peripheral zone contains radial fibers (1 or 2 spicules per cross-section). At the ends of radial fibers several spicules stand erect, points directed outward. Spicules (Fig. 23): (1) numerous styles 118–230 x 4–14 μ, (2) thin subtylostyles 170–400 x 4–8 μ, and (3) acanthostyles 85–130 x 3–10 μ with recurved spines 3 to 8 μ long. One New River specimen contains many abnormal spicules that have enlarged central canals and step-wise ends. There were also some abnormal spicules with step-wise points at each end, oxeas 130–190 x 6–10 μ, one of which is shown in Figure 26.

George and Wilson (1919, p. 159) described a specimen of this species from the Beaufort area as *Axinella acanthifera*, and it is treated by Miner (1950) under that name. That sponge contained flattened lobes 2 to 3 mm thick, resembling one of the New River specimens. De Laubenfels (1947, 1949a) suggested that it was a malformation of *Microciona prolifera*, but the spiculation easily sets this species apart from that and other species.

This species was first described as *Phakellia tenax* by Schmidt (1870, p. 62), and was transferred to the genus *Endectyon* by Topsent (1920, p. 308). It is a West Indian species.

Hemectyon pearsei, new species

One specimen (type: U.S.N.M. 23651) dredged from 5 meters depth off Beaufort.

This sponge is a small ellipsoidal mass 30 mm long and 20 mm high composed of many compressed, vertically elongated units (Fig. 14). It was attached to a piece of conglomerate rock. Its consistency is stiffly spongy. The surface is marked by many upright ridges 1 to 1.5 mm apart from which spicules project. Between these ridges, a smooth dermal membrane covers deep subdermal spaces. This membrane is pierced by many circular openings 150 to 600 μ in diameter and several accidental tears. Presumably the larger openings are oscules, and the smaller ones pores, though separation into two size classes is difficult. The interior skeleton consists of a reticulation of vertical spongin fibers and radial fibers. The spicules (Fig. 26) are smooth subtylostyles 190–340 x 10–14 μ, characteristic of the dermal brushes and fibers, and small acanthostyles 85–115 x 3–7 μ that are sharply bent near their heads.

This species is named in honor of the late Dr. A. S. Pearse, founder of the Duke University Marine Laboratory at Beaufort.

This specimen was one of two similar sponges collected by de Laubenfels in 1946, and identified as *Higginsia coralloides*, now known as *Higginsia strigilata*. The second sponge was correctly identified. Although there is much similarity in the growth form of the two sponges, the presence of spiny tylostyles in *Hemectyon* and spiny oxeas in *Higginsia* serve to distinguish them.

The growth form of this species resembles that of *Hemectyon hyle* de Laubenfels (1930, p. 28) of the Pacific Coast, as pictured by Dickinson (1945, Fig. 64), but the echinating acanthostyles of that species are much larger (180 to 320 μ long vs. 85 to 115 in *pearsei*). This species is separated from *Hemectyon hamata* (Schmidt 1870, p. 62) of the West Indies, by a similar difference in size of the acanthostyles and other features of its spiculation.

Tenaciella obliqua (George & Wilson), new combination

Many specimens from Cape Hatteras beach, two from Beaufort area, and one from New River fishing banks. Represented by U.S.N.M. 23635, 23613, and 23658.

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This species begins as an encrustation on submerged objects such as alcyonarian colonies, pelecypod shells, or algae. It later develops a series of erect finger-like lobes that often extend 4 to 9 cm, rarely up to 15 cm, beyond its attachment. The majority of specimens from Hatteras encrust colonies of the alcyonarian *Telesto*, leaving obvious openings up to 1.3 mm at the tips of the alcyonarian branches, through which the polyps would extend in life (Fig. 16). The alcyonarian skeleton may often be seen through these openings. Above this encrusting base rise finger-like lobes 3 to 5 mm in diameter that may branch or be somewhat lumpy.

In life, this species is orangish red or bright red, but this color quickly fades with death, passing through a light orange stage, to an eventual yellowish gray in dried specimens. Beach specimens may bleach to off-white. The consistency is typically spongy-flexible and compressible.

The surface is even and finely punctate, with minute pores penetrating the thin dermal membrane. Oscules about 1 mm in diameter may be scattered over the surface. The interior skeleton consists of obliquely radial spicular fibers joined by connecting fibers. The spicules are contained within the spongin of these fibers. Spicules (Fig. 25): (1) abundant styles 110–150 x 6–10 μ tapering at both ends and sometimes spiny, (2) thin tylostyles 120–140 x 2–4 μ. (3) toxas 20–60 μ, and (4) chelas 9–11 μ with a twisted axis. The toxas and chelas may be rare in some specimens.

After storms, hundreds of specimens of this species have been collected on beaches in the Cape Hatteras area. Many of these have been fresh specimens. These have been compared with specimens collected by George and Wilson in the Beaufort area, including the type specimen (U.S. N.M. 23612), and they agree in every detail. They are evidently common on hard bottoms offshore.

This species was first described by George and Wilson (1919, p. 148) as *Esperiopsis obliqua*, and is treated by Miner (1950) under that name. The fact that the spicules of *obliqua* are enclosed in the spongin fibers and not in an echinating position places this species in the genus *Tenaciella* of the family Amphilectidae rather than in the genus *Esperiopsis* of the Ophlitaspongiidae, as defined by de Laubenfels (1936b). De Laubenfels (1947, 1949a) placed this species in synonymy with *Microciona prolifera*. In the collection of sponges from New River fishing bank is a specimen of this species identified by de Laubenfels as *Haliclona oculata* which is the basis of that record published by Pearse and Williams (1951). It bears a superficial resemblance to southern representatives of that species (see Hartman 1958) as do most colonies of *Tenaciella obliqua*. An examination of its spiculation shows the presence of styles rather than the oxeas typical of *Haliclona oculata*. It seems likely that the records of *Haliclona oculata* listed for North Carolina by Hartman (1958) probably are of *Tenaciella obliqua*. These are Fort Macon, by Coues and Yarrow (1879, p. 312, as *Chalina arbuscula*), and North Carolina, by Verrill (in Verrill & Smith 1873, p. 743, as *Chalina arbuscula*).

Tenaciella obliqua is distributed from North Carolina southward.

ORDER HALICHONDRINA

The sponges in this order are either marked by a distinctive, plumose architecture (as contrasted with the reticulate pattern found in the Poecilosclerina) or the development of a dermis that contains many tangential spicules. The spicules are usually oxeas, styles, or strongyles. Tylostyles and spiny spicules are absent in the forms represented, except the occurrence of spiny oxeas in *Higginsia*. Microspicules are rare, being represented by raphids in a few forms and the spiny oxeas of *Higginsia*. Because the two orders are very close, the separation of the Halichondrina from the Poecilosclerina has been questioned by de Laubenfels (1953).

Axinella bookhouti, new species

One specimen (type: U.S.N.M. 23659) from New River fishing banks.

This sponge consists of a series of upright lobes rising from a hard substrate (Fig. 39). Each lobe produces flattened branches that fuse with adjacent branches from other lobes, forming poorly defined lamellae. The entire colony is 5 cm high and 6 cm wide, with individual upright lobes being 6 to 10 mm wide, and oval rather than circular in cross-section. The lamella formed by the fusion of branches is about 3 mm thick near its margin. This sponge is light brown and stiffly spongy in alcohol.

The surface is finely punctate and microscopically hispid from projecting spicules. Stellate patterns of radiating grooves mark the location of oscules. These grooves are normally covered by a thin dermal membrane that is easily lost, the oscules being the openings 0.7 to 1.3 mm in diameter in this dermal membrane at the center of the radiating pattern. The subdermal grooves

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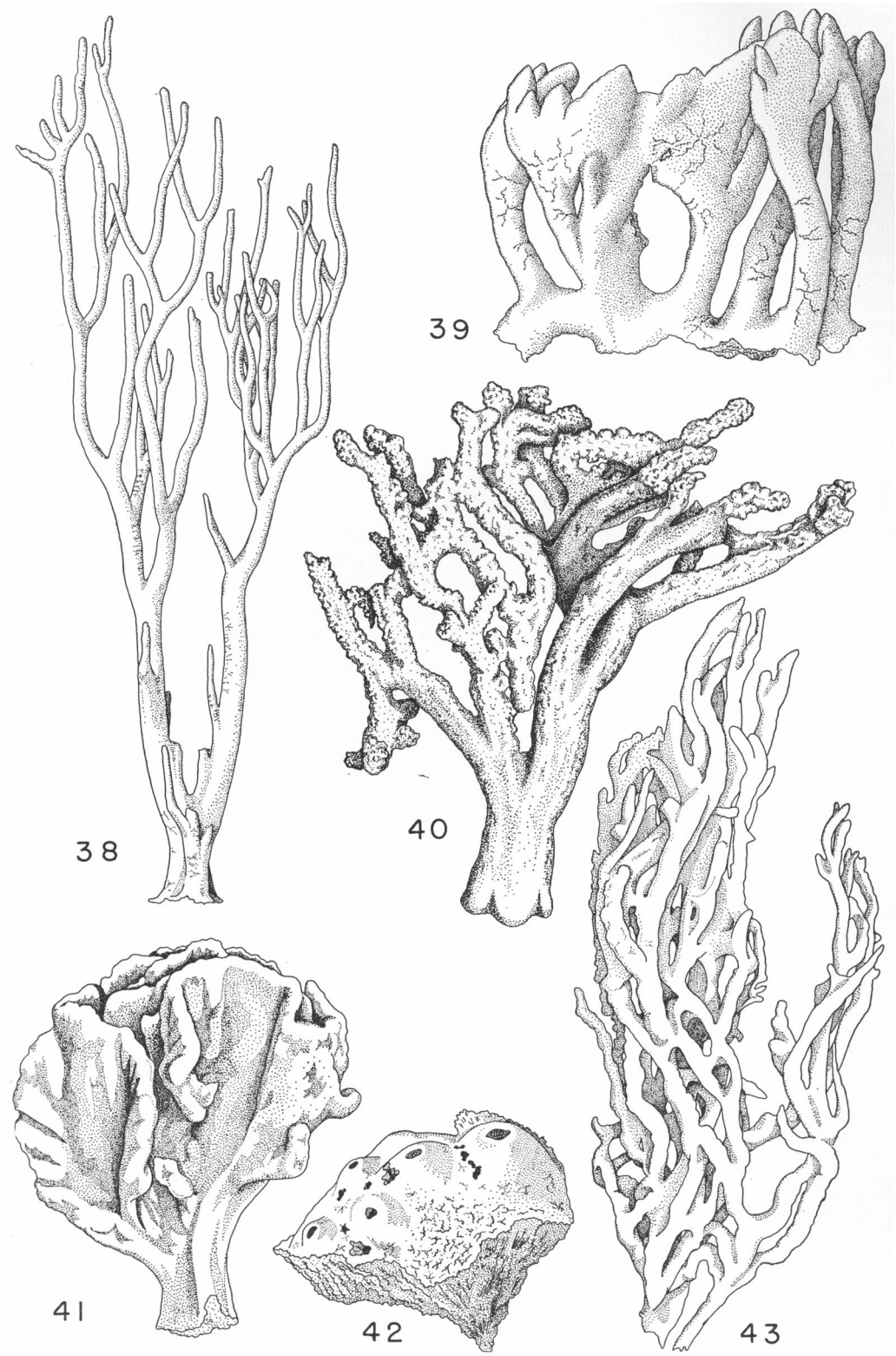

FIG. 38. *Homaxinella rudis*. FIG. 39. *Axinella bookhouti*. FIG. 40. *Axinella reticulata*. FIG. 41. *Homaxinella waltonsmithi*. FIG. 42. *Pseudaxinella rosacea*. FIG. 43. *Axinella polycapella*.

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average about 0.8 mm in width. The internal skeleton includes a stiff central core that consists of closely packed vertical fibers. In the peripheral zone are radial spicular tracts 50 to 80 μ wide, containing considerable spongin as well as spicules projecting at all angles. At the surface, these tracts widen, are joined by connectives, and end in a few projecting spicules. The spicules (Fig. 36) are all somewhat curved: (1) stout styles 190–280 x 8–12 μ, comprising the bulk of the spiculation; (2) thin styles 280–480 x 5–9 μ, characteristic of the dermal hispidation; and (3) less abundant oxeas 220–240 x 9–12 μ, more common in the interior.

This specimen bore de Laubenfel's label marked *"Ophlitaspongia species novum,"* but the presence of oxeas and the absence of toxas exclude it from that genus. Instead, its features place this sponge in the genus *Axinella*.

This species is named in honor of Dr. C. G. Bookhout, director of the Duke Marine Laboratory.

Of the species of *Axinella* from the West Indian region, *A. clava* Schmidt possesses a different growth form and *A. walpersii* (Duchassaing & Michelotti), different surface features. Both are very inadequately described. The spiculation of *A. nanaspiculata* Hartman and *A. polycapella* de Laubenfels consists principally of oxeas with very few styles, whereas *bookhouti* contains abundant styles. *Axinella reticulata* Ridley & Dendy possesses very different surface characteristics; and in addition, most of these species have significantly different spicule sizes and different forms.

Axinella polycapella de Laubenfels

One specimen from Beaufort and four from the Hatteras area, including U.S.N.M. 23621.

This species forms tall, irregularly branching colonies (Fig. 43). The figured specimen is 70 cm high. The branches are 18 to 25 mm with a hard central core 5 to 14 mm in diameter. The base of a colony may be 50 mm in its greatest dimension, and although the main stalk and major branches taper gradually, the branch tips are still 12 to 18 mm across and stubby. The cortical regions of two beach-worn specimens have been eroded, presenting a very different appearance; only the central core remains, in which the tips of the branches are pointed. This species is reddish in color and stiffly spongy in consistency.

The surface is coarsely punctate, with scattered oscules 1 to 2 mm across, and many pores about 1 mm in diameter. The internal skeleton includes a dense central core containing longitudinal fibers and obliquely radial spicular tracts 40 to 80 μ across, which branch and form an irregular reticulation with many connectives near the surface. Spicules often project from these tracts at a variety of angles. The spicules are oxeas 180–250 x 5–10 μ, occasional ones as large as 320 x 12 μ. Occasional spicules occur with one or both ends rounded.

This species was first described from Florida by de Laubenfels (1953, p. 530).

Axinella reticulata Ridley & Dendy

One specimen (U.S.N.M. 23625) dredged off Cape Hatteras, and two from the Cape Hatteras beach.

This species forms erect, branching colonies in which the branches may fuse where they come into contact (Fig. 40). The figured specimen is 33 cm high, and its base is 5 cm wide. The branches narrow to a diameter of about 12 mm. It was red-orange in color and stiffly spongy in life.

The surface has a coarsely irregular reticulation and scattered spicules in the dermal membrane, plus many depressions. Oscules lead into deep canals 1.7 to 1.0 mm in diameter, and abundant pores 400 to 900 μ perforate the dermal membrane. The thin dermal membrane forms small conules over projecting fiber ends, but is easily destroyed. Internally, there is a dense axial core of closely packed longitudinal fibers from which plumose polyspicular tracts 50 to 80 μ radiate obliquely toward the surface. There are many connectives and scattered spicules. Spicules: oxeas 280–380 x 8–22 μ bent at their midpoint, and less abundant styles 240–300 x 14–18 μ.

This species was first described by Ridley and Dendy (1887, p. 184). It is found in the West Indian region.

Homaxinella rudis (Verrill) de Laubenfels

Many specimens from the Cape Hatteras beach, including U.S.N.M. 23620, and one specimen from Fort Macon beach in the Beaufort area.

This species produces graceful branching colonies up to 70 cm high, with gradually tapering branches 5 to 14 mm in diameter (Fig. 38). The figured specimen is 50 cm high and has a basal stalk 3 cm in diameter that was attached to rock. Fresh specimens are reddish and moderately flexible. The surface is superficially smooth, but close examination reveals many small pores evenly dis-

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tributed over the surface. A stellate pattern of grooves radiates from each oscule, which is less than 1 mm in diameter. The thin dermis is easily lost, exposing projecting spicules and fiber ends that make the underlying layer microscopically hispid. The internal skeleton contains a dense central axis in which fibers containing much spongin run vertically. In the peripheral zone, plumose spicular tracts 30 to 50 μ in diameter radiate to the surface. Unispicular connective fibers may join these radial tracts. The spicules are curved styles 200–300 x 5–10 μ.

This species was first described from Bermuda as *Axinella rudis* Verrill (1907, p. 341), and was transferred to the genus *Homaxinella* by de Laubenfels (1950a, p. 87). In 1950, de Laubenfels also placed *Axinella apressa* Verrill (1907, p. 340) in synonymy with this species; but this is questionable.

In both Verrill's description and de Laubenfel's description of specimens from Bermuda (1950a), a peculiarly roughened surface was noted on the branches. However, these North Carolina specimens and Florida specimens described by de Laubenfels (1953) possess a smooth surface. This difference can be attributed to differences in water movement in the natural habitat. At Bermuda, de Laubenfels found this species only in enclosed bodies of water, and it can be assumed that Verrill's specimens came from the same area, where the species is abundant. In contrast, North Carolina and Florida specimens came from open, coastal areas with a greater degree of water movement. This correlation fits the generalization that oscules and oscular chimneys are better developed where there is less water movement.

This species is distributed from North Carolina southward.

Homaxinella waltonsmithi de Laubenfels

Two specimens from New River fishing banks, represented by U.S.N.M. 23660.

This species forms beautiful colonies composed of intricate, branching folds of sponge tissue that arise from a stout basal stalk (Fig. 41). The figured specimen is 9 cm high and 7.5 cm wide. Its basal stalk is 1 to 2 cm in diameter and the blade is 3 to 6 mm thick. This species is bright orange-red in life, and spongy in consistency.

Although optically smooth, the surface is slightly hispid and bears many microscopic tubercles which are formed of the enlarged ends of radial spicular tracts. Small, evenly-distributed pores penetrate this surface plush. Over grooves between the folds, oscules 0.5 to 1 mm occur in the dermal membrane, leading to vertical subdermal canals. Oscules also occur at the upper margin of the fold, often marked by a few radiating grooves that extend from the blade surface. Internally, there is a firm axial region that contains longitudinal spicular tracts, and a peripheral zone in which the tracts are perpendicular to the surface. These radial tracts contain much flesh and spongin and are joined by many connectives. They become thicker near the surface. The spicules are styles 210–340 x 9–16 μ, many sharply bent.

This species was originally described by de Laubenfels (1953, p. 533) from a single specimen collected in the Gulf of Mexico off Florida. His specimen differed from these in having no visible pores or oscules; presumably they had contracted at the time of collection. These specimens from the New River fishing banks had been labelled by de Laubenfels as *Thalyseurypon carteri* and were recorded as such by Pearse and Williams (1951).

Pseudaxinella rosacea (Verrill) de Laubenfels

Two specimens from New River fishing banks, represented by U.S.N.M. 23661.

This species may exhibit either of two growth forms: a semi-encrusting mass up to 5 cm thick (Fig. 42) or an upright, irregularly lobate cylinder up to 7 cm high. Both forms are represented. In life, this species is orange-red and spongy in consistency.

The surface is composed of a plush of many narrow, obliquely radial columns that end at the surface with a tuft of erect spicules. Many small pores are evenly distributed over the surface between columns. Much of the surface is coarsely roughened by these columns, but they are more closely packed at the tips of lobes and around oscules. Oscules are often conspicuous, 3 to 4 mm in diameter, and usually located on slight elevations. Internally, there is no axial specialization. The columns contain confused masses of spicules: oxeas 300–400 x 5–8 μ in the core, and curved styles 220–400 x 8–11 μ projecting from their sides.

This species was first described as *Axinella rosacea* by Verrill (1907, p. 341), and was transferred to the genus *Pseudaxinella* by de Laubenfels (1949b). It is distributed from North Carolina southward.

Pseudaxinella wilsoni, new species

Two specimens from New River fishing banks, including the type: U.S.N.M. 23662.

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The type specimen consists of an upright, hand-shaped plate rising from a narrow basal stalk (Fig. 48). Evidently this plate is the result of fusion or incomplete separation of a series of vertical processes, for individual lobes are still discernible at the margin of the colony. It is 7 cm high and 4.5 cm wide; the plate is 3 to 5 mm thick. It is reddish in color and toughly spongy in alcohol. The surface is minutely punctate and hispid with projecting spicules. Deeply incised grooves 2 to 4 mm long form a pattern that radiates from the basal attachment; they probably represent oscules. In the not-yet-fused upright lobes, stellate patterns of radiating grooves mark the location of oscules. The interior is composed of closely packed plumose spicular tracts. There is no axial specialization. The spicules (Fig. 30) are styles 180–230 x 7–10 μ and oxeas 210–360 x 6–8 μ.

This species is named in honor of the late Dr. H. V. Wilson, who pioneered in the study of North Carolina marine sponges.

The absence of a firm axial core in *wilsoni* places this species in the genus *Pseudaxinella*. The unusual growth form of this species and differences in oscules and other surface features separate *wilsoni* from *Pseudaxinella rosacea*.

Teichaxinella grayi, new species

Four specimens from New River fishing banks, including the type: U.S.N.M. 23663.

This species forms semi-encrusting masses whose surface is strikingly marked by deep grooves. The type specimen (Fig. 45) is 5 cm long, 3 cm wide, and 1.5 cm thick. In alcohol, it is pale straw-colored and stiffly spongy. The surface is coarsely porous. Stellate patterns of deep grooves radiate from oscules, dividing the surface into polygonal areas where one system of grooves meets another. The grooves may be 2 to 3 mm deep and 1 to 2 mm wide; the oscules, about 1 mm in diameter, are found in the deepest part of the grooves. The interior is composed of plumose spicular tracts that form radial columns at the surface. These columnar units are unconnected beyond a point 1.5 to 3 mm from the surface. At the surface the columns end in a group of projecting spicules. There is no axial specialization. The spicules (Fig. 32) are abundant styles 240–300 x 9–15 μ, oxeas 240–300 x 11–14 μ, and oxeas 360–460 x 5–10 μ.

This species is named in honor of Dr. I. E. Gray, Professor of Zoology, Duke University. It is placed in the genus *Teichaxinella* as defined by de Laubenfels (1936b), because this genus contains sponges in which the growth form precludes the possibility of the axial specialization typical of the Axinellidae. The other species placed in this genus by de Laubenfels possess a thin lamellate shape. The type species, *T. shoemakeri* de Laubenfels (1936b, p. 129), posesses much longer styles, about 500 to at least 1200 μ long, as well as an erect lamellate form.

Phakellia folium Schmidt

Two specimens from New River fishing banks, represented by U.S.N.M. 23664.

This species forms beautiful fan-shaped colonies arising from a short, stout base (Fig. 44). The figured specimen is 12 cm high and 11 cm wide, with a base about 2 cm in diameter. The compressed blade is 2 to 3 mm in thickness and supported by several radiating ribs that are similarly compressed. The margin is undulating and somewhat lobed. In alcohol, this species is chocolate brown, its consistency is stiffly spongy.

The surface is minutely hispid. Pores about 100 μ in diameter are evenly distributed in the dermal membrane. On the stalk and on the margins of the blade and supporting ribs, dendritic patterns of radiating grooves mark the location of oscules about 300 μ in diameter. Internally, the skeleton contains closely packed vertical fibers that give rise to tracts that arch out toward the surface, branch, and are joined by many connectives. Spicules (Fig. 37): (1) very abundant styles 200–320 x 8–13 μ, bent about one-third the distance from their head end, (2) rare strongyles 148–195 x 5–8 μ, and (3) long styles 400–600 x 7–8 μ, characteristic of the surface hispidation.

This species was first described by Schmidt (1870, p. 62) from Florida. The original description left much to be desired (once de Laubenfels regarded it as "unrecognizable"), and no further description has been published. The collection of these specimens by Pearse and Williams (1951) has permitted us to illustrate the spicules and the distinctive growth form of this species, and provide a more complete description.

Higginsia strigilata (Lamarck) de Laubenfels

Two specimens from Hatteras Island, one from off Beaufort Inlet, and one from New River fishing banks (U.S.N.M. 23665).

Colonies of this species produce broad, curving lobes that rise from a narrowed base (Fig. 52). These lobed processes may fuse with one another producing a curved or folded lamella with radial

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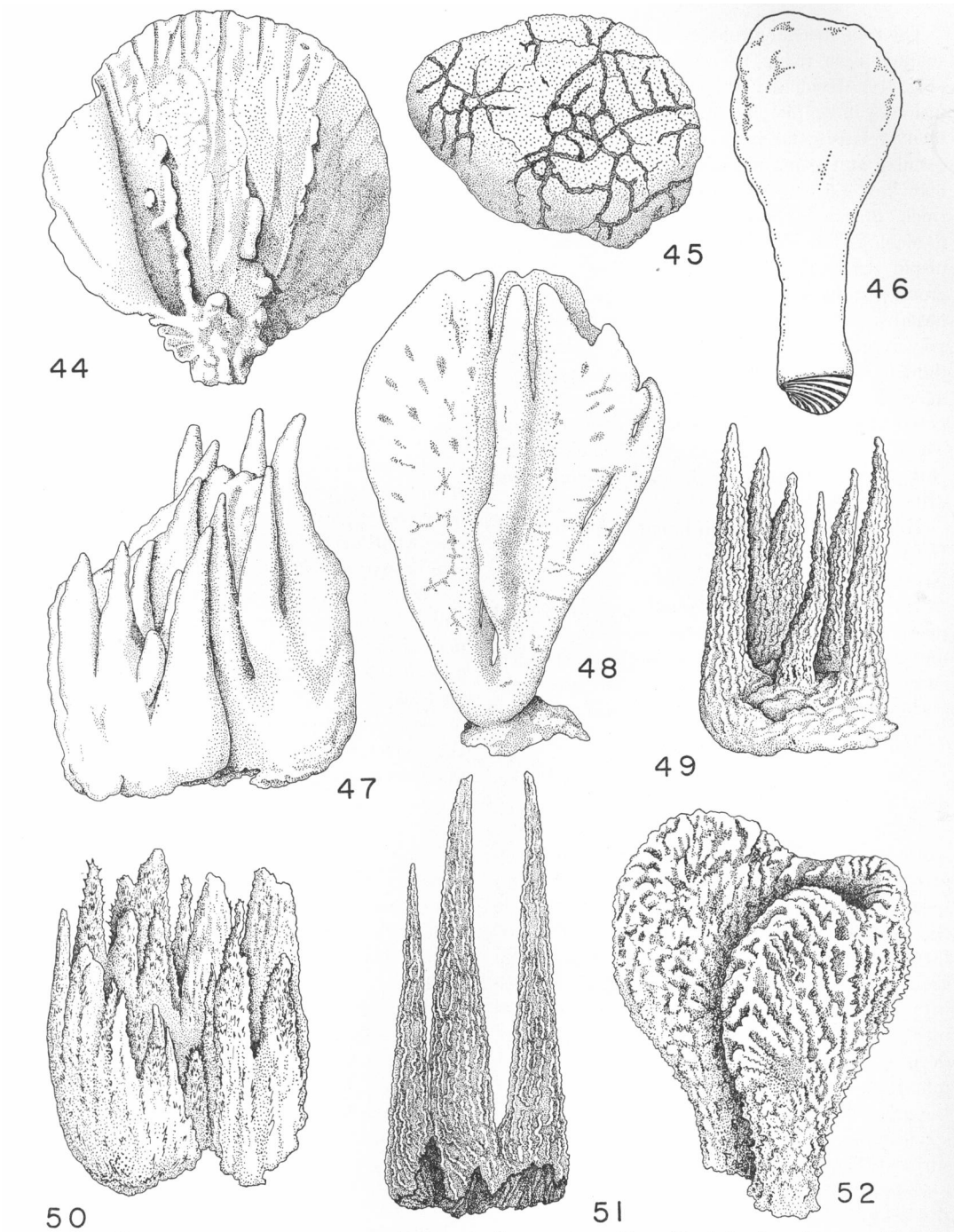

FIG. 44. *Phakellia folium.* FIG. 45. *Teichaxinella grayi.* FIG. 46. *Suberites ficus.* FIG. 47. *Ciocalapata gibbsi.* FIG. 48. *Pseudaxinella wilsoni.* FIG. 49. *Ciocalypta penicillus.* FIG. 50. *Hymeniacidon heliophila.* FIG. 51. *Oxeostilon burtoni.* FIG. 52. *Higginsia strigilata.*

corrugations on their faces. Radial ridges run across the margin of the lamella, giving rise to rows of tufts or elongated conules of tissue, 2 to 3 mm long. The lamella plus its corrugations may be up to 15 mm in thickness. This species is orange-red in life, but fades to a yellowish gray upon drying. It is stout or firm in consistency.

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A dermal membrane about 30 μ thick overlies many of the interconular valleys, with irregular apertures leading into subdermal spaces up to 4 mm deep. The surface of the fleshy tufts is hispid with projecting spicules. In the interior is a system of branching and anastomosing vertical fibers that contain much spongin. In peripheral regions, oblique radial spicular bundles widen and extend to the surface where they form the surface tufts of oscules. The spicules are (1) abundant oxeas 400–600 x 16–28 μ, bent at the mid-point, (2) less abundant styles and strongyle modifications 250–470 x 20–25 μ, (3) smaller oxeas 300–500 x 4–8 μ, possibly growth stages of (1), (4) long narrow styles 640–960 x 8–15 μ characteristic of the surface hispidation, and (5) acanthoxeas 70–160 x 3–4 μ with spines up to 3 μ long, echinating the fibers and filling much of the surface tufts.

This species was first described as *Spongia strigilata* by Lamarck (1813, p. 450) and was transferred to the genus *Higginsia* by de Laubenfels (1953, p. 534). George and Wilson (1919, p. 161) described a sponge from Beaufort as *Acanthella corrugata*. In 1936, de Laubenfels transferred *corrugata* to the genus *Dragmaxia*; then he later (1947, 1949a) suggested that *corrugata* might be a malformation of *Microciona prolifera*. Except for the omission of acanthoxeas, their description of *corrugata* resembles one of these Hatteras specimens. It is well recognized that microspicules may not be present or may be very rare in specimens of a species that typically possesses them. It seems most likely that George and Wilson had a specimen of *H. strigilata* that lacked acanthoxeas. De Laubenfels (1947) reported this species from Beaufort as *Higginsia coralloides* Higgin 1877, and that name has been used in much of the older taxonomic literature. De Laubenfels also identified a specimen from New River fishing banks as *Myrmekioderma* n. sp. (Pearse & Williams 1951). This species is typical of the West Indian region.

Halichondria bowerbanki Burton

Many specimens from Hatteras and Ocracoke Harbors, several on Cape Point, and two from Beaufort, including U.S.N.M. 22724.

Colonies of this sponge assume a variety of shapes, starting as low encrustations, and often developing into a mass of erect lamellate ridges, or occasionally a series of rounded anastomosing branches. The largest colony observed was 30 cm wide. The sponge is typically a straw-yellow or beige color, sometimes a pale orange. It is soft and easily torn. Dried specimens are white and stiff.

The surface is irregular, with low ridges and conules extending above a thin dermis. This dermis contains narrow spicular tracts and individual spicules, and is perforated by widely-spaced pores. The dermis is supported over extensive subdermal spaces by spicular tracts that approach the surface diagonally and extend some distance under it. The internal skeleton is composed of many spicular tracts and individual spicules scattered in confusion. The spicules are oxeas 210–380 x 3–9 μ.

Colonies of this species might be confused with colonies of *Hymeniacidon heliophila* of a similar appearance and coloration. The difference in spiculation is distinctive.

This species is attributed to Burton (1930a, p. 489), who discussed the taxonomy of this species. It had often been referred to *Halichondria coalita* Johnston in sponge literature. Hartman (1958) discusses collections from New England and Europe. This species was also described from Beaufort by de Laubenfels (1947, p. 36) as *Calyx poa*, and subsequently was made the type of a new genus *Calyxabra* (de Laubenfels 1949a, p. 49). A study of the type specimen of *C. poa* (U.S.N.M. 22724) shows that *poa* falls to the synonomy of *Halichondria bowerbanki*. This species is distributed from North Carolina northward.

Halichondria melanadocia de Laubenfels

One specimen from off Ocracoke Island (U.S.N.M. 23637), and one fragment from New River fishing banks.

This species is represented by a thin encrustation less than 3 mm thick that covers an area 2 cm square on an oyster shell that was attached to rock. It bears much resemblance to keratose sponges in possessing a conulose surface and a fleshy consistency. It is brown when fresh and in alcohol. The fleshy surface membrane, up to 40 μ thick, bears tangentially placed spicules. It is raised by projecting fibers into large, obvious conules. Extensive subdermal spaces lie between the conules. Large windows in this membrane, up to 2 mm across, probably represent oscules. The pores are microscopic. The interior is fleshy and contains many spaces and a network of multispicular tracts and scattered spicules. Where these tracts extend to the surface, they push the surface membrane out into conules,

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and extend beyond their apex as a fiber 60 to 80 μ wide. The spicules are oxeas 180–320 x 3–11 μ.

This species was first described from Tortugas by de Laubenfels (1936b, p. 133). It is primarily West Indian in distribution.

Ciocalypta penicillus Bowerbank

Ten specimens from the Hatteras area, including U.S.N.M. 23624, and one from Beaufort.

This species forms tapering finger-like processes marked by vertical rows of small conules (Fig. 49). Usually a number of such processes are contained in one sponge colony. The figured specimen is 40 mm in height and about 29 mm in diameter. In other specimens, tapering processes are up to 10 cm tall, and by the fusion of several units, the bases measure up to 3.5 cm wide. In life, this species is light gray in color and toughly spongy.

The surface is raised into vertical ridges 1.5 to 2 mm apart which are further produced in low conules less than 1 mm apart. The dermis averages about 75 μ in thickness, but varies according to the quantity of tangentially-placed spicules included. In places, narrow spicular tracts can be seen crossing a transparent membrane, and in others, the dermis is simply a crust of tangential spicules. Large and extensive subdermal spaces are present, through which spicular columns extend to the surface, supporting the dermis. A few pores 200 to 250 μ in diameter occur in the membrane; oscules are apparently represented by gaps in the dermis between ridges. Internally, the skeleton contains a loose arrangement of branching and anastomosing vertical fibers 50 to 100 μ in diameter with many scattered spicules. Stout horizontal fibers 150 to 400 μ in diameter project laterally up to 4 mm beyond the longitudinal skeleton, providing support for the conules. Where the dermis is lost in beach-worn specimens, these projecting fibers give the sponge a peculiar, fuzzy appearance. These fibers are literally filled with spicules. The spicules are styles of two size classes: long styles 375–500 x 5–12 μ, and short styles 260–290 x 3–7 μ.

This species was described by Bowerbank (1862, p. 1105). It is widely distributed in the eastern hemisphere.

Ciocalapata gibbsi, new species

One specimen (type: U.S.N.M. 23666) from New River fishing banks.

The type specimen (Fig. 47) is composed of a series of fingerlike processes whose bases are fused into an encrusting mass about 3 cm in diameter. The whole colony is about 3 cm high. In alcohol, the sponge is colorless and stiff, although the tips of several processes are bent as if they were soft at the time of collection. At the surface is a smooth dermis about 40 μ thick with no evident oscules or pores. The dermis is supported by columns over an extensive subdermal space approximately 600 μ high. These columns are stout, 160 to 260 μ in diameter, and contain many spicules. Where they reach the surface, narrow tracts of spicules radiate in all directions, supporting the dermal membrane. The interior skeleton is a confused mass of spicules. The spicules (Fig. 35) are (1) fusiform styles 360–660 x 10–14 μ, (2) equally abundant long oxeas 360–630 x 8–12 μ, and (3) short oxeas 140–290 x 3–7 μ.

This species is named in honor of Mr. Robert F. Gibbs, Superintendent of the Cape Hatteras National Seashore, National Park Service.

The occurrence of both oxeas and styles in its spiculation places *gibbsi* in the genus *Ciocalapata* as defined by de Laubenfels (1936b). It differs from *C. sacciformis* (Thiele), from the Indo-Pacific region, by possessing large styles rather than small ones, and two classes of oxeas rather than one.

Hymeniacidon heliophila (Parker) de Laubenfels

Many specimens from off Ocracoke Island, and many from Beaufort Harbor, including U.S.N.M. 23627.

This species produces encrusting masses from which finger-like processes 20 to 40 mm high may develop (Fig. 50). Theses processes may fuse laterally and contribute to enlarging the main body of the sponge. This species is pale yellow-orange or bright orange-red. The tissue is soft and easily torn, or fleshy in consistency. The surface is minutely conulose, and hispid with projecting spicules. Oscules 1 to 5 mm in diameter are located at the ends of long canals that are often situated at the tips of processes. The dermal membrane contains many spicules, some placed tangentially and others projecting radially with their points directed outward. The superficial layer may contain many tufts or brush-like masses of spicules and protoplasm that contribute to the conulose appearance. Systems of large subdermal channels up to 2 mm in diameter can often be seen through the dermis. In the interior, spicules are arranged in

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tracts, or scattered without order. The spicules are styles 130–320 x 3–8 μ, slightly curved or straight.

Specimens from off Ocracoke Island have a more fleshy consistency and do not exhibit the erect processes that typically bear oscules in Beaufort specimens. Probably both these features are due to environmental influences, for the Ocracoke specimens are exposed to the circulation and wave action of the open ocean, while the Beaufort colonies grow in more protected locations.

Some specimens of this species may be confused with *Halichondria bowerbanki* in the field. However, spiculation quickly distinguishes the two, for the latter species possesses oxeas rather than styles.

This species was first described as *Stylotella heliophila* by Parker (1910, p. 766). George and Wilson (1919) and Miner (1950) have treated it as *Stylotella heliophila* Wilson. It was transferred to the genus *Hymenacidon* by de Laubenfels (1947, p. 34). The record of this species from New River fishing banks (Pearse and Williams 1951) should be transferred to *Oxeostilon burtoni*. We have examined the specimen (U.S.N.M. 23288) recorded as *Hymeniacidon heliophila* for northwest Greenland (de Laubenfels 1942) and found that it is not *H. heliophila*. We have also examined a specimen from Virginia (U.S.N.M. 23341) that was identified by de Laubenfels as this species; it is not *Hymeniacidon heliophila*. This species was included in the paper on Woods Hole sponges (de Laubenfels 1949a) on the surmise that it would be found there, not on the basis of an actual collection.

This species is distributed from North Carolina southward.

Oxeostilon burtoni de Laubenfels

Three specimens from New River fishing banks, including U.S.N.M. 23667.

This species forms very slender, tapering processes arising from an encrusting base (Fig. 51). The figured specimen is 6 cm high. It is orange in life and toughly spongy. The surface is raised into low vertical ridges about 1.5 mm apart. No pores or oscules are evident; the tips of the processes are closed. Microscopically, the surface is hispid with projecting individual spicules. The dermis, 35 to 50 μ in thickness, contains many tangentially placed spicules, with vague tracts running vertically under the crests of the ridges. In the valleys, the dermis is perforated by many evenly distributed pores 90 to 100 μ in diameter. This dermis is supported over extensive subdermal spaces 0.6 to 2 mm high by stout multispicular columns 300 to 400 μ in diameter. The interior region is filled with a fleshy mass of spicules packed without order. The spicules are oxeas 300–500 x 6–10 μ, and styles 300–400 x 5–9 μ, both with points that taper in a series of step-wise stages.

This species was first described by de Laubenfels (1934, p. 15) from off Puerto Rico. In form, *Oxeostilon burtoni* resembles *Ciocalypta penicillus*, but the orange color and spiculation of both styles and oxeas clearly distinguish *O. burtoni* from *C. penicillus*, which is light gray and possesses only styles. *Oxeostilon burtoni* is distributed from North Carolina southward.

ORDER HADROMERINA

The sponges in this order usually contain tylostyles, spicules with an enlarged ball at one end and a point at the other. They may have microspicules in which many rays or spines diverge from an axis or point. The sponge tissues typically have a radiate organization.

Spheciospongia vesparia (Lamarck) Marshall

Several specimens have been collected from the fishing banks off Beaufort Inlet, represented by U.S.N.M. 9016.

This species forms massive cake-shaped or hassock-shaped colonies over 1 meter in diameter. The largest sponges known to science are specimens of this species. The surface is dark brown in color and the interior is a light drab, sometimes with a yellow tint. The tissue has the consistency of cork or wood. The surface is smooth. The upper surface is marked by a series of large excurrent apertures up to 8 or 9 mm in diameter usually grouped in a central depression. The lateral surfaces are marked by clusters of pores 1 to 2 mm in diameter. Each cluster leads through a sieve into a large canal, 1 cm or more in diameter, that in turn leads to many branches in the sponge interior. There is a dense dermis 2 to 5 mm thick in which the spicules are radially arranged. Internally, spicules are found in spicular tracts and packed in confusion.

The spicules are tylostyles 445–600 x 9–10 μ and spirasters 12–15 x 2–4 μ with one to four bends in their shaft. Spirasters are found only lining canals and on the surface, and may be quite rare.

This species was first described as *Alcyonium*

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vesparium by Lamarck (1815, p. 78), and transferred to the genus *Spheciospongia* by Marshall (1892, p. 32). It was reported from the Beaufort area by George and Wilson (1919) as *Spirastrella andrewsii*, and as *Poterion atlantica*. This species has been thoroughly redescribed and compared with similar forms by de Laubenfels (1936b, 1950a). We have examined representatives of George and Wilson's species in the National Museum (e.g. U.S.N.M. 9016, 9020, and others), and have confirmed de Laubenfels' identification as *Spheciospongia vesparia*. Miner (1950) treats this species as *Spirastrella andrewsii*.

This species is distributed from North Carolina southward.

Spirastrella coccinea (Duchassaing & Michelotti) de Laubenfels

Two specimens from off Ocracoke Island.

This species is represented by extremely thin colonies encrusting shell and rock dredged from 10 meters depth. The encrustation is less than 1 mm in thickness and slightly less than 4 cm^2 in area. They were colored red in life, and are dark red-brown in alcohol. The surface is optically smooth with only microscopic openings. It contains many microspicules. The interior is microcavernous with confused masses of tylostyles between the spaces. The spicules are tylostyles 250–300 x 6–8 μ with elongate heads, and abnormal, rod-shaped spirasters about 10 μ long with reduced spines, common in the dermis.

This species was first described as *Thalysias coccinea* by Duchassaing and Michelotti (1864, p. 84), and was transferred to the genus *Spirastrella* by de Laubenfels (1936b, p. 143). Typically this species possesses spirasters with well developed spines. However, Topsent (1932b, p. 558) has described and pictured similar, abnormal spirasters in a specimen of *Cliona vastifica* from the coast of Tunis. They do not warrant taxonomic recognition.

Spirastrella coccinea is widely distributed in the West Indian region.

Anthosigmella varians (Duchassaing & Michelotti) de Laubenfels

Several specimens from off Ocracoke Island.

This species forms thin encrustations on shells and rock. The sponge is usually about 350 μ thick, little more than the length of its spicules. These colonies are less than 1 cm^2 in area. In its thinnest parts, this species appeared pale orange, almost colorless; but with death, it became a dark red-brown. The surface is hispid with many erect spicules, made more obvious in dead sponges by their contrast with the darkly colored flesh. The extreme thinness obscures other anatomical features. There are no evident oscules or pores. The spicules are tylostyles 210–340 x 6–7 μ in which the heads are pronounced (8 or 9 μ across) and usually subterminal.

This species was first described as *Thalysias varians* by Duchassaing and Michelotti (1864, p. 86), and was transferred to the genus *Anthosigmella* by de Laubenfels (1936b, p. 143). Ordinarily this species possesses spirasters about 24 μ long, but de Laubenfels (1953) has shown that their abundance in this species is variable, and that specimens totally lacking spirasters occur and have often been named as a separate species.

Anthosigmella varians is distributed from North Carolina southward.

Suberites ficus (Johnston) Schmidt

Fig sponge

Two specimens, including U.S.N.M. 23617, dredged from 60 meters depth near the North Carolina-Virginia border, in the Cape Hatteras region.

This species forms flat lobate colonies that grow on sandy bottoms often attached to bivalve shells (Fig. 46). The figured specimen is 13 cm by 5 cm with a maximum thickness of 2 cm near the top. It is straw-yellow in color and firmly spongy in consistency. The surface is smooth and relatively featureless. Several closed oscules can be found that probably measured 2 mm in greatest diameter. The pores are microscopic. The dermis contains many closely packed microspicules. The interior is very compact, containing tracts and vertically arranged columns of macrospicules. The spicules are tylostyles 160–360 x 4–9 μ and centrotylote acanthostrongyles 14–40 x 2–4 μ.

Hartman (1958) discusses the taxonomy of this species. It was first described adequately by Johnston (1842) as *Halichondria virgultosa* (p. 137), *H. suberea* (p. 139), and *H. ficus* (p. 144). The first has priority, but because *ficus* is so well established, Hartman has suggested that the International Commission on Zoological Nomenclature be asked to conserve it. In the meantime, we have followed his example in retaining the commonly used name. This species was transferred to the genus *Suberites* by Schmidt

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(1870, p. 76). De Laubenfels (1949a) treated this species as *Choanites ficus*.

This species is distributed from North Carolina northward.

Pseudosuberites sulphureus (Bowerbank) Topsent

Eight specimens from off Ocracoke Island.

This species is represented by encrustations that are about 500 microns thick and as much as 1 cm² in area. They were attached to shells 2 to 3 meters deep. The sponge is fleshy in consistency. In life it is pale orange, and in alcohol it is orangish brown.

The surface is moderately roughened and only slightly hispid. This hispid effect is due to scattered individual spicules projecting slightly beyond the surface. There is a distinct dermal layer about 60 μ thick that contains spicules, most of which are tangentially arranged. A limited number of spicules stand with their tips outward. No pores or oscules are visible, but microscopic pores 40 to 70 μ in diameter were found in sections. The dermis is supported by spicular columns which spread out under the dermal layer. Extensive subdermal cavities occupy a zone 80 to 100 μ thick. The interior contains confused spicule masses, chiefly in the walls of cavities and channels. The spicules are tylostyles 140–320 x 4–5 μ with broad heads.

This species was first described as *Hymeniacidon sulphurea* by Bowerbank (1866, p. 208), and was transferred to the genus *Pseudosuberites* by Topsent (1896, p. 125). In view of its distribution in the eastern Atlantic from Iceland to the Mediterranean, this species appears to be of northern affinities.

Prosuberites microsclerus de Laubenfels

Many specimens from Hatteras Harbor, including U.S.N.M. 23645, and several others from Beaufort.

This species forms thin encrustations on a variety of substrates including rocks, shells, and algae. Most specimens measure about 1 mm in thickness, but by lateral growth they may attain 13 cm in length. The surface is hispid with many erect, projecting spicules. This species is marked by a distinctive chrome-yellow color, which fades somewhat in dried specimens. Dendritic patterns of subdermal canals show on the surface of many larger colonies. However, the oscules must be contractile, for they are not visible. Pores are microscopic. The spicules (Fig. 31) are tylostyles 125–360 x 3–8 μ, with very large heads.

This species was described by de Laubenfels (1936b, p. 149) from Tortugas. However, in 1950 that author placed *microsclerus* in synonymy with *Terpios fugax*. Our rediscovery of this species has permitted us to supplement the original description and to affirm its distinctness. Many features, among them color, surface hispidation, and spicule size serve to distinguish this species from *T. fugax*.

Prosuberites microsclerus is distributed from North Carolina southward.

Terpios fugax Duchassaing & Michelotti

Three specimens from off Ocracoke Island, including U.S.N.M. 23646.

This species forms smooth encrusting or massive colonies that attach to hard substrates. These specimens were attached to a conglomerate rock dredged at 10 meters. The largest formed a very thin encrustation that covered an area equal to 2 cm². When first collected, this sponge presented a shiny black appearance like that of shoe-polish or heavy grease. This color quickly faded through a deep blue, to a beautiful blue-green color in alcohol. It is fleshy in consistency. The surface is optically smooth without detectable openings. Microscopically, individual spicules project well beyond the surface, producing a long hispidation. The internal skeleton is composed of spicules clustered in confused masses. The spicules are tylostyles 160–360 x 2–6 μ. The heads of these tylostyles are typically enlarged and often double or lobate. Three common forms of tylostyle heads are outlined in Figure 33.

The color changes shown by these specimens suggest that color differences which have been utilized as specific distinctions within this genus (see review by de Laubenfels 1950a) may only be transitory states in the death of this species.

This species was first described by Duchassaing and Michelotti (1864, p. 102). De Laubenfels (1950a) placed *Prosuberites microsclerus* in synonymy with this species; however, our study of both forms indicates that they are valid species. The bright chrome-yellow color of *P. microsclerus* is a useful criterion for field recognition. In *P. microsclerus* the spicules are erect upon the substratum, while in *Terpios fugax* many may be tangentially placed, and the colony may become massive.

This species is distributed from North Carolina southward.

Polymastia robusta Bowerbank

One specimen from off Ocracoke Inlet.

This species is represented by a small, convex

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encrustation less than 2 cm in diameter, that was attached to conglomerate rock dredged from 10 meters depth. Its color is brownish gray in preservative. The surface is conulose and obviously hispid. Tufts of spicules project about 450 μ beyond the apices of the conules. The conules are spaced about 1 mm apart from one another. No oscules or pores are visible. The spicules are subtylostyles and styles of two size ranges: 200–230 x 2 μ, and 320–864 x 5–12 μ, most being near 500 μ in length.

This species was first described by Bowerbank (1862, p. 822) from the British Isles. It has been reported as extending to North Carolina by Pratt (1935). Typical colonies of this species develop a series of erect, finger-like fistules, but this North Carolina specimen was apparently still too small to produce such processes. Lambe (1896) also recorded only two size classes of spicules in this species, but Proctor (1933) has reported a still larger group of spicules 1080–1360 x 16–24 μ, as well as the two recorded for this juvenile North Carolina specimen.

This species is distributed from North Carolina northward.

Cliona caribboea Carter

One specimen from off Diamond Shoals, one from off Ocracoke Island, and two from New River fishing banks, including U.S.N.M. 23638.

This species is represented by large masses of sponge tissue that do not show the boring habit characteristic of the genus *Cliona*. Certain species of this genus may pass through three stages of development: typical boring colonies that perforate calcareous materials such as coral, shells, or limestone rock, termed the *alpha* stage; colonies that encrust the object they have eroded, termed the *beta* stage; and apparently free-living colonies that have destroyed the object they excavated and have left no trace of their boring habit, termed the *gamma* stage. These specimens fit the last stage in this sequence. The largest specimen was 25 cm by 15 cm and 3 cm thick; Figure 60 shows part of it with the internal structure exposed. It was firm but compressible (cartilaginous) in consistency and was a bright orange-yellow in life. With preservation, its color has changed to dark brown.

The undulating surface is superficially smooth and exhibits many prominent circular areas about 5 mm in diameter. These probably represent low papillae that have contracted. Oscules are visible in the center of some. Pores are microscopic. In the space between these circular areas, fragments of calcareous material may be common. Under the round areas is a tough cortical layer 0.6 to 1.2 mm thick containing spicules packed in confusion. In much of the surface, spicules are closely packed with their points out. In the interior of the sponge are confused masses of spicules and vague tracts in vertical arrangement. Through this internal region large canals up to 6 mm in diameter run vertically and terminate below the circular areas of the surface. Their walls resemble the outer surface in smoothness. The spicules are tylostyles 240–440 x 6–14 μ.

When boring, this species excavates very wide galleries 5 to 6 mm in diameter which the sponge does not completely occupy. A canal remains with a central lumen 2 to 3 mm in diameter.

This species was first described by Carter (1882, p. 346). It is typical of the West Indian region. De Laubenfels identified a specimen of this species from New River fishing banks as *Pseudosuberites melanos* (Pearse & Williams 1951). While that species has a similar form, it has smaller spicules (125–285 x 3–6 μ) and a very different color (slate black). In view of the remarkable color change with death in *Cliona caribboea*, it seems likely that de Laubenfels was misled by the dark brown color of the preserved specimen.

Cliona celata Grant

Many specimens from Hatteras and Beaufort Harbors, including U.S.N.M. 23648.

Like *C. caribboea*, this species can be found boring into calcareous shells, in an encrusting state, or in a massive, free-living form showing little trace of its boring nature. Perforations produced in shells by this species are obvious, measuring 1.5 to 3.0 mm for oscular openings and 0.8 to 1.1 mm for pore openings. Under the surface, connecting galleries may be so extensive that only calcareous pillars connect the outer shell layers. In life, yellow or greenish papillae extend from the perforations, the larger papillae bearing oscules 1 to 1.5 mm in diameter and the smaller ones bearing a cluster of microscopic pores. The galleries contain confused masses of spicules—tylostyles 200–400 x 4–10 μ. Although spirasters have been recorded from European specimens (see Hartman 1958), they have not been observed in North Carolina material.

Most commonly, this species is represented by its boring form, but we have also found sheets

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of this species lining the interior of dead barnacle shells and small oyster "boxes". In its massive, freeliving stage, this species possesses a smooth surface marked by many small papillae 2 mm apart. The yellow or yellow-orange color turns dark brown with death.

This species is the most common species of *Cliona* in North Carolina. It can be recognized from the other *Cliona* species by the size of its shell perforations and by its spiculation. All the other species but *C. caribboea* possess spirasters or spirasters and oxeas in addition to tylostyles.

This species was first described by Grant (1826, p. 79). Being a cosmopolitan species, it is distributed both north and south of North Carolina.

Cliona lobata Hancock

Several specimens from Pamlico Sound and Newport River, represented by U.S.N.M. 23639.

This boring sponge is represented only by colonies that have penetrated oyster shells. At the surface, its perforations in the shell fit into two obvious size classes: the larger perforations, 400–600 μ in diameter, are excurrent openings, while the smaller perforations, 150–350 μ in diameter, are incurrent openings. These perforations may be arranged in a dendritic pattern or in a closely-spaced group. The sponge occupying these perforations was pale yellow in color. Its spicules are slender tylostyles 170–210 x 1.5–4 μ, and two sizes of spirasters: those 25–50 x 4 μ with prominent spines spirally arranged, and those 8–25 x 2–3 μ with evenly distributed inconspicuous spines. Both types of spirasters are typically multiply bent or zig-zagged. The larger spirasters and the absence of oxeas distinguish this species from most other North Carolina boring sponges.

Cliona lobata was first described by Hancock (1849, p. 341). It has been collected both north and south of North Carolina.

Cliona robusta Old

Old (1941, p. 9) described this species from three specimens collected in Beaufort Harbor. Only one specimen has been reported since the original discovery, that from South Carolina (Hopkins 1946).

The shell perforations made by this species are small (presumably 0.5 to 1.5 mm in diameter). The live sponge tissue is yellow to orange. The spicules are (1) slender tylostyles 160–200 x 2–4 μ; (2) stout, finely microspined centrotylote oxeas 40–130 x 4–12 μ (the spination or central swelling may be missing); and (3) small, microspined spirasters 8–16 x 1–2 μ. The unusual width of the oxeas serves to distinguish this species of *Cliona*.

Cliona spirilla Old

One specimen (U.S.N.M. 23644) from off Portsmouth Island, and several from Beaufort Harbor.

This boring sponge makes perforations in shells 0.5 to 1.5 mm in diameter. The sponge tissue is light yellow in color. The spicules are (1) relatively rare slender tylostyles 160–260 x 2–5 μ; (2) very abundant large, microspined oxeas 90–200 x 3–8 μ, often somewhat curved and occasionally with a central swelling; and (3) relatively rare microspined or smooth twisted spirasters 9–22 x 1–2 μ.

This species was first described by Old (1941, p. 10) from the Beaufort area.

Because he had difficulty in separating this species from *Cliona vastifica*, Hopkins (1956) treated specimens that fitted this description as

TABLE 2

Spicule dimensions for North Carolina specimens of Cliona *species. (All dimensions in microns.)*

Species	Tylostyles	Oxeas	Spirasters
Cliona caribboea	240–440 x 6–14	—	—
Cliona celata	200–400 x 4–10	—	—
Cliona lobata	170–210 x 1.5–4	—	8–25 x 2–3, 25–50 x 4
Cliona robusta	160–200 x 2–4	40–130 x 4–12	8–16 x 1–2
Cliona spirilla	160–260 x 2–5	90–200 x 3–8	9–22 x 1–2
Cliona truitti	170–230 x 2.5–4	75–130 x 2–5	7–14 x 0.5–2
Cliona vastifica	260–330 x 3–6	50–130 x 2.5–4	6–15 x 1–3
Cliona viridis	200–460 x 3–10	—	10–18 x 0.5–2

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the latter species. Wells (1959) experienced a similar difficulty in distinguishing these forms. The possibility arises that *C. spirilla* is only an ecophenotype of *C. vastifica*, but it seems more likely that they are distinct species. Wells found different distribution patterns for the two forms in the Beaufort area, which overlapped in higher salinities. In the Cape Hatteras area, both forms have been collected from shells attached to hard substrates in the open ocean. Their collection from areas of similar salinity casts doubt on any interpretation that one is only a brackish-water form of the other species. The large oxeas of *C. spirilla* almost equal the tylostyles in length and often exceed them in width, while in *C. vastifica* the tylostyles are much longer than the oxeas. Spicule dimensions are compared in Table 2 for these and other *Cliona* species.

Cliona spirilla has been collected in North and South Carolina.

Cliona truitti Old

Several specimens from Beaufort Harbor, and many specimens from Hatteras Harbor, including U.S.N.M. 23640.

This boring sponge produces perforations in shell about 0.5 mm in diameter. The sponge tissue within the galleries may be colored yellow to orange-red. Gemmules can frequently be found in this species. The spicules are (1) slender, often curved tylostyles 170–230 x 2.5–4 μ; (2) slender, smooth or microspined oxeas 75–130 x 2–5 μ, occasionally with a central swelling; and (3) nearly straight microspined spirasters 7–14 x 0.5–2 μ.

Cliona truitti was first described from Maryland waters by Old (1941, p. 10), and was first recorded from North Carolina waters by Wells (1959). It is distributed both north and south of North Carolina.

Cliona vastifica Hancock

One specimen (U.S.N.M. 23643) from off Hatteras Island, many specimens from Pamlico Sound, and several from Beaufort Harbor.

This species produces perforations 0.5 to 1.5 mm in diameter in the shells of oysters and scallops. The perforations may form dendritic patterns on shell surfaces, or they may be distributed apparently at random. The sponge tissue is yellow or orange in life. Often gemmules are found in its tissues. The spicules are (1) abundant slender tylostyles 260–330 x 3–6 μ; (2) slender microspined or smooth oxeas 50–130 x 2.5–4 μ; and (3) zig-zag microspined spirasters 6–15 x 1–3 μ, in which the spines are more prominent at the angles.

This species was first described by Hancock (1849, p. 343). Hopkins (1956) included specimens of *C. spirilla* in his treatment of the distribution of this species. Although the spiculation of these two species is similar, they may be separated on the basis of relative sizes of the spicules (Table 2). *Cliona vastifica* is distributed both north and south of North Carolina.

Cliona viridis (Schmidt) Gray

One specimen (U.S.N.M. 23614) from Beaufort Harbor.

Like *Cliona caribboea* and *C. celata*, this species may form upright massive sponges as well as colonies that bore into shell. This North Carolina specimen combines the features of both growth forms. Its base occupies galleries in an oyster shell while a large mass of ascending lobes 7.5 cm by 9 cm rises to a height of 6 cm above the shell. Perforations in the oyster shell measure 0.4 to 1.6 mm in diameter and occur in a dendritic pattern at the edge of the shell. The basal portion of the sponge mass incorporates a few pieces of shell. The erect part of the body is divided into many firm narrow upright lobes that fuse freely. The lobes end in soft hollow papillae 2 to 8 mm in diameter and up to 15 mm high. The upper edges of these papillae are somewhat thickened. This specimen is light gray in alcohol, and of a fairly firm consistency. The color of this species in life is typically yellow, green, or brownish.

The surface is minutely roughened and contains many projecting spicules. The dermis is perforated by oscules about 1 mm in diameter on the upper margin of the lobes. The interior contains tracts of spicules with many canals 100 to 300 μ in diameter. The spicules are tylostyles 200–460 x 6–10 μ, with heads quite swollen and exhibiting a variety of forms, and small spirasters about 10–18 x 0.5–2 μ, found only in the basal part of the sponge. Spirasters are particularly abundant in papillae that project through the shell perforations.

This species was first described as *Vioa viridis* by Schmidt (1862, p. 77), and was transferred to the genus *Cliona* by Gray (1867, p. 525). This specimen was described by George and Wilson (1919, p. 140) as *Suberites undulatus*, and Miner (1950) treats it under that name. De Laubenfels (1947) suggested that the forms described by

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George and Wilson were unusual specimens of *Microciona prolifera*. The scarcity of spirasters in erect portions of this sponge makes its correct identification difficult.

In summary, the spiculation of the species of *Cliona* collected in North Carolina is compared in Table 2.

ORDER EPIPOLASIDA

Sponges of this order possess a radiate architecture with a well-developed fibrous cortex. They contain oxeas as principal spicules and never have tylostyles. North Carolina representatives possess asters of various kinds as microspicules. They lack the four-rayed spicules characteristic of the next order, Choristida.

Dorypleres carolinensis, new species

One specimen from New River fishing banks (type: U.S.N.M. 23668).

The type specimen (Fig. 58) is a cushion-shaped mass 5 cm in diameter and 3 cm thick that was attached to a rock. It is firm in consistency and pink-colored in alcohol. While the upper surface is smooth, the lateral surfaces are somewhat coarsely roughened. Microscopically, the entire surface is hispid with projecting spicules. Oscules 1 to 2 mm in diameter are visible in lateral regions, lying between slightly elevated ridges. Pores are microscopic. The stout cartilaginous cortex contains a pallisade of erect spicules. The interior region is a pulpy mass of spicules arranged in radiating bundles. The spicules (Fig. 34) are (1) oxeas 380–1500 x 7–20 μ, (2) euasters about 20 μ in diameter, having six to eight tapering rays with blunt ends (sometimes with lumpy rays), and (3) characteristic delicate euasters 30–70 μ in diameter with five to eight very thin rays that bear minute recurved hooks near their ends.

This species fits into the genus *Dorypleres* as defined by de Laubenfels (1936b) on the basis of its possession of two classes of astrose microspicules. It differs from *D. serpentina* (Wilson) from the Philippines in not possessing the irregular, sinuous spicules for which that species was named, and in other details of spiculation and form. *Dorypleres splendens* de Laubenfels from the western Pacific possesses smaller oxeas (150–610 x 4–10 μ), smaller asters (7–8 μ, 15 μ, and 18 μ), and no spicules resembling the unusual asters characteristic of *D. carolinensis*.

Trachygellius cinachyra de Laubenfels

Three specimens from New River fishing banks, including U.S.N.M. 23669.

This species forms subspherical colonies marked by prominent apertures (Fig. 53). The figured specimen is 6 cm in diameter; the largest specimen, 9 cm in diameter. This species is colored ochre-yellow in life, and dull drab in alcohol. It has a firm, cartilaginous consistency. There is a very thin dermis. On the lateral surfaces there are prominent openings 1 to 3.5 mm in diameter, often with a thickened spicular collar 2 mm high surrounding the opening. A large contractile opening (2 to 3 mm across in one incompletely closed example) is present in the center of the upper surface, often in a slight depression. The spicules are oxeas 2–4 mm long and 4–40 μ wide, and abundant microspined sigmas 6–11 μ long.

Trachygellius cinachyra was first described by de Laubenfels (1936b, p. 158) from Tortugas. De Laubenfels identified these specimens as *Craniella crania*, that record from New River fishing banks (Pearse & Williams 1951) should be transferred to this species. Judging from the similarity of the photograph published of *Cinachyra cavernosa* in de Laubenfels' paper on Bermuda sponges (1950a, fig. 7, upper left), the authors suspect that *Trachygellius cinachyra* has also been collected at Bermuda and confused with specimens of *Cinachyra cavernosa*. The fact that the present specimens were mistakenly identified as *Craniella crania* makes a similar misidentification credible. Both *Craniella* and *Cinachyra* possess the four-rayed spicules typical of the Choristida, which are absent in the Epipolasida. Only a brief check on spiculation is needed to separate *Trachygellius cinachyra* from them.

ORDER CHORISTIDA

The sponges of this order are marked by the possession of four-rayed "triaene" spicules among the macrospicules. Like the preceding order, they exhibit a radiate architecture with a well-developed fibrous cortex, and possess asters of various kinds as microspicules.

Myriastra fibrosa (Schmidt) de Laubenfels

One specimen from New River fishing banks, U.S.N.M. 23670.

This sponge is a semi-encrusting, flattened mass 5 cm long, attached to an oyster shell. In alcohol, it is pale brown and firm in consistency.

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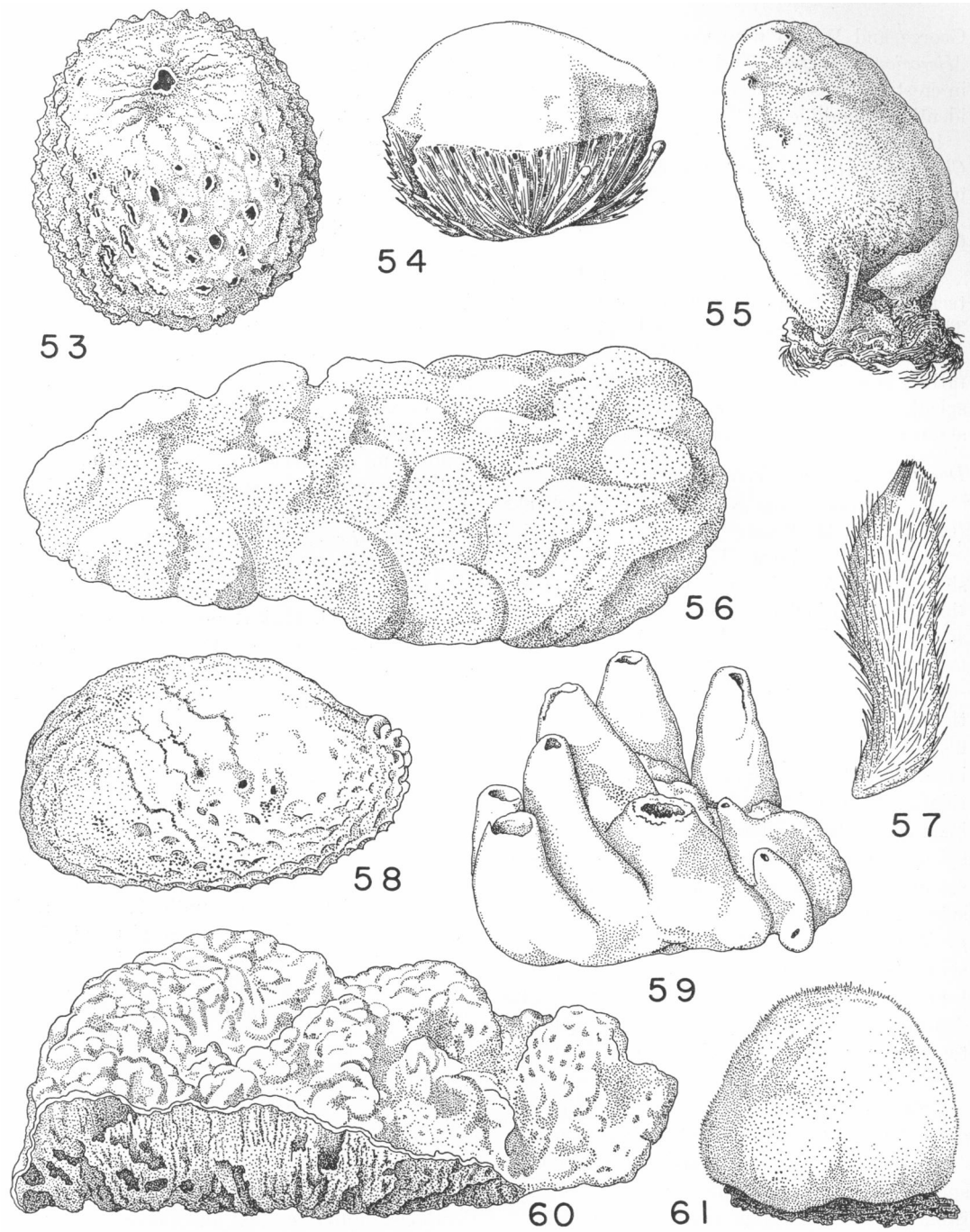

FIG. 53. *Trachygellius cinachyra.* FIG. 54. *Cinachyra cavernosa.* FIG. 55. *Craniella laminaris.* FIG. 56. *Geodia gibberosa.* FIG. 57. *Scypha barbadensis.* FIG. 58. *Dorypleres carolinensis.* FIG. 59. *Leucetta floridana.* FIG. 60. *Cliona caribboea.* FIG. 61. *Craniella crania.*

Many worm tubes, bryozoans, shell fragments, and sand grains are incorporated into the stout cortex which is 700 μ thick. The surface is smoothly porous, or may be punctate and irregular. The two oscules are 2 mm in diameter and ringed by a smooth border. Under the dermal cortex is a layer of subdermal spaces. The spicules are (1) orthotriaenes with one long ray

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640–800 x 12–24 μ, and three short rays 20–60 μ long, diverging at right angles; (2) anatriaenes with the long ray 720–1000 x 12–20 μ, and recurved short rays 20–50 μ long; (3) oxeas 700–950 x 12–18 μ, primarily in the interior; (4) slightly curved oxeas 168–230 x 6–8 μ, radially arranged in the cortex; and (5) euasters 10–16 μ in diameter, with 8 to 12 rays, in the cortex.

This species was first described as *Ancorina fibrosa* by Schmidt (1870, p. 67). Wilson (1902, p. 384) treated it as *Pilochrota variabilis*. De Laubenfels (1936b, p. 169) transferred this species to the genus *Myriastra*. It is typical of the West Indian region.

Geodia gibberosa Lamarck

Three specimens from the Hatteras area, and one from New River fishing banks (U.S.N.M. 23671).

This species forms large, massive colonies that resemble rounded calcareous rocks (Fig. 56). The figured specimen measures 23 cm by 16 cm and 5 cm at its greatest thickness. It is chalky white with a tint of greenish yellow. It is stony in consistency, due to the great quantity of spherical spicules in the cortex. The surface is an undulating, superficially smooth crust. Oscules 0.5 to 1 mm in diameter occur in groups that occupy slight depressions up to 10 cm^2 in area. Much smaller pores are evenly distributed over most of the surface. The dermal cortex, about 1 mm thick, is a solid crust composed of many closely packed sterrasters. Extending inward from the cortex are many radially arranged macrospicules. The interior is a confused mass of spicules. The spicules are (1) oxeas 900–1800 x 20–27 μ; (2) orthotriaenes with long ray 1100–1300 x 20–32 μ and short rays 140–200 μ long diverging at right angles; (3) sterrasters 50–65 μ in diameter, typical of the cortical region; and (4) euasters 12–22 μ in diameter, with rays tapering to slender points, characteristic of the interior.

Geodia gibberosa was first described by Lamarck (1815, p. 333). It is a West Indian species.

Cinachyra cavernosa (Lamarck) Topsent.

Two specimens from New River fishing banks, including U.S.N.M. 23672.

This species is represented by two ovoid specimens that were attached to a rock. The figured specimen (Fig. 54) is 25 mm long, 20 mm wide, and 20 mm high. The living sponge is yellow-orange and hard in consistency; in alcohol the color is dull drab and the projecting spicules upon its surface form dark gray patches. The upper surface is hispid with projecting spicules. There is a contractile fibrous cortex. Abundant elliptical openings, 200–300 μ in diameter are found around and slightly above the equatorial zone. A larger opening 3 mm in diameter was found at the more pointed end of one specimen. According to de Laubenfels (1950a), this opening is the incurrent aperture, and the former openings are oscules. The interior of this sponge is radiate, with large, obvious bundles of spicules perpendicular to the surface. The spicules are (1) abundant oxeas 3500–4000 x 35–35 μ; (2) anatriaenes and (3) protriaenes, long rays up to 3000 x 8–20 μ, short rays 50–300 μ long, in the surface plush; (4) many slender growth stages of (1), (2), and (3); and (5) sigmoid spirasters 10 μ long.

This species was first described as *Tethya cavernosa* by Lamarck (1815, p. 70), and was transferred to the genus *Cinachyra* by Topsent (1931, p. 5). It is circumtropical in distribution.

Craniella crania (Müller) Schmidt

Fragments of a specimen from off Beaufort Inlet, and one specimen from Cape Hatteras beach.

This species forms compact, erect ovoid or spheroid colonies up to 5 cm in height that attach to a hard substrate (Fig. 61). The colonies are stony in consistency and light gray-green in color. The surface is strongly hispid and without obvious oscules or pores. There is a thin cortical layer. Internally, bundles of spicules radiate from the center of the sponge, and some scattered spicules occur between them. The spicules are principally oxeas 1000–2000 x 15–20 μ, less abundant protriaenes and anatriaenes of about the same length with short rays about 50 μ long, and abundant sigmoid spirasters 15 μ long.

This species was first described by Müller (1776, p. 255) as *Alcyonium cranium*. Specimens collected from New River fishing banks and identified by de Laubenfels as *Craniella crania* (Pearse & Williams 1951) are actually *Trachygellius cinachyra*. In 1947, de Laubenfels placed *Tetilla laminaris* George & Wilson (1919, p. 142) in synonymy with *Craniella crania*. That sponge is treated below as a distinct species.

Craniella crania is distributed north of North Carolina along the American coast.

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Craniella laminaris (George & Wilson) new combination

Several specimens from the Beaufort area represented by U.S.N.M. 23615.

This sponge forms flattened colonies that attach in sand or mud bottoms. The figured specimen (Fig. 55) is a very young specimen only 5 cm high and less than 1 cm thick. Older specimens form a horizontally elongated lamella the size and shape of a man's hand, 2 to 3 cm thick with the upper edge somewhat thickened. It is straw-yellow in color and firm or cartilaginous in consistency.

The surface is superficially smooth, but shows many projecting spicule ends under a lens. Oscules 0.5 to 2 mm in diameter may be found near the upper margin. The thin dermal membrane is also perforated by many microscopic pores. In the interior are vertical spicular tracts, radiating spicular bundles, and scattered individual spicules. Radial tracts extend downward from the base to form rootlets up to 5 cm long, composed of spicules and attached sand grains. The spicules are (1) stout oxeas 600–2300 x 16–20 μ; (2) slender oxeas 800–1000 x 8 μ; (3) protriaenes, long ray 500–2000 x 3–8 μ, short rays 20–50 μ; (4) anatriaenes, long ray 1500–3500 μ, short rays 32 μ; and (5) sigmoid spirasters 12 μ long.

This species was first described by George and Wilson (1919, p. 142) as *Tetilla laminaris*. De Laubenfels (1947) noticed the similarity of its spiculation to that of *Craniella crania* and placed it in synonymy with that species. Spiculation places *laminaris* in the genus *Craniella* as defined by de Laubenfels (1936b), but growth form, color, and habitat differences clearly separate the two forms. *Craniella laminaris* is flattened, orange or yellow colored, and grows in mud or sand, attached by a specialized set of spicule-bearing rootlets; *C. crania*, on the other hand, is ovate or spheroid, light gray-green, and grows attached to a solid or firm substrate.

Craniella laminaris is distributed from North Carolina southward.

CALCIOSPONGIAE

Sponges of this class contain calcareous spicules.

Scypha barbadensis (Schuffner) de Laubenfels

Many specimens from the Cape Hatteras area, including U.S.N.M. 23628, one from Beaufort Harbor, and one from New River fishing banks.

This species attaches to rocks, shells, hydroids, and bryozoan colonies. It forms vase-shaped colonies, wider in the middle than at the ends, with a crown of spicules projecting around the apical oscule (Fig. 57). The figured specimen is 4 mm high; these North Carolina specimens all measure less than 10 mm. They are brownish-white and somewhat stiff in consistency. The surface is microscopically hispid. The apical oscule, about one-half the diameter of the body, is surrounded by a crown of oxeas. The spongiocoel, a cloacal cavity running the length of the body, occupies the central axial region. A system of channels and chambers (50–70 x 80–95 μ) is contained in its walls. The skeleton consists of a colloidal jelly and calcareous spicules. The spicules are (1) regular triaxons with rays 70–90 μ in the side walls, (2) oxeas 260–280 x 5–7 μ projecting from the surface, (3) oxeas at least 280 x 1–2 μ forming the oscular crown, (4) triaxons with lateral rays 60–80 μ and the basal ray longer, 90–130 μ, and (5) tetraxons with lateral rays 40–75 μ, basal ray 120 μ, and a very short, curved ray 30 μ long, that projects into the spongiocoel.

This species was first described as *Sycandra barbadensis* by Schuffner (1877, p. 429), and was transferred to the genus *Scypha* by de Laubenfels (1950a, p. 145). It is distributed from North Carolina southward.

Leucetta floridana (Haeckel) Dendy & Row

Two specimens from New River fishing banks, including U.S.N.M. 23673.

This species is represented by a group of tapering hollow lobes, closely massed, fused at their bases, and measuring 35 mm across (Fig. 59). This species is pinkish-white in life, becoming brownish in alcohol. Its consistency is brittle. Superficially the surface is smooth, but it is microscopically hispid with projecting spicules. Oscules 2 to 5 mm in diameter are located at the tips of the lobes, about 15 mm from the base. The interior is dense and bears many canals. The spicules are chiefly regular triaxons with rays 90 x 9 μ to 600 x 50 μ. In the cloacal lining, alate triaxons occur in which two of the rays are bent. In addition, there occur tetraxons with the fourth ray much shorter than the other rays.

This species was first described by Haeckel (1872, p. 144) as *Leucaltis floridana*, and was transferred to the genus *Leucetta* by Dendy and

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Row (1913, p. 734). The occurrence of tetraxons was not recorded by de Laubenfels (1950a) in his description of specimens from Bermuda. *Leucetta floridana* is a West Indian species.

Leucosolenia canariensis (Miklucho-Maclay) Dendy & Row

Several specimens from off Ocracoke Island, including U.S.N.M. 23634.

This species is represented by a very thin encrustation attached to shells collected at 2 to 3 meters depth. It typically forms masses composed of a series of fused tubes. The color in life is usually yellow, but these North Carolina specimens, collected in mid-August, exhibited the orange coloration noted for specimens in mid-August in Bermuda (de Laubenfels 1950a). Probably this coloration is associated with some phase of the reproductive cycle. The surface is microscopically hispid from projecting spicule ends. Oscules and pores are not visible in these specimens. The skeleton is composed of many triaxons with rays 60–75 x 6–7 μ and irregular, curved oxeas 120–150 x 4–6 μ. These specimens differ from the Bermuda forms described by de Laubenfels (1950a) in having no tetraxons, and in possessing numerous curved oxeas.

This species was first described as *Nardoa canariensis* by Miklucho-Maclay (1868, p. 230), and was transferred to the genus *Leucosolenia* by Dendy and Row (1913, p. 796). It is distributed throughout the West Indian region.

II. Distribution

Of the seventy species of sponges collected in North Carolina waters, six are here described as new: *Hemectyon pearsei*, *Axinella bookhouti*, *Pseudaxinella wilsoni*, *Teichaxinella grayi*, *Ciocalapata gibbsi*, and *Dorypleres carolinensis*. In addition, a large percentage of the species treated are newly recorded from North Carolina. Most of these new records extend the known distribution of the species 500 miles or more along the western Atlantic seaboard.

Records of the following species extend ranges southward to North Carolina: *Haliclona loosanoffi* from Maryland; *H. canaliculata*, *Halichondria bowerbanki*, and *Suberites ficus* from Long Island Sound; *Haliclona palmata* from Woods Hole, Massachusetts; and *Eurypon clavata* and *Pseudosuberites sulphureus* from Iceland. Ranges are extended northward to North Carolina for the following species: *Halicona viridis*, *Callyspongia vaginalis*, *Pseudaxinella rosacea*, *Spirastrella coccinea*, and *Anthosigmella varians* from the Bahamas and Florida; *Haliclona areolata*, *Xestospongia halichondrioides*, *Axinella reticulata*, and *Oxeostilon burtoni* from the Puerto Rican area; *Microciona juniperina*, *Endectyon tenax*, *Halichondria melanadocia*, *Terpios fugax*, *Cliona viridis*, *Scypha barbadensis*, and *Leucosolenia canariensis* from Florida and the West Indies; and *Dictyociona adioristica*, *Axinella polycapella*, *Homaxinella rudis*, *H. waltonsmithi*, *Prosuberites microsclerus*, and *Trachygellius cinachyra* from the Gulf Coast of Florida. This is the first record of *Mycale cecilia* from the Atlantic Ocean, the other records being from the Pacific Coast of Panama and from Hawaii. The record of *Ciocalypta penicillus* is the first from the Western Hemisphere, other records of that species being widely distributed in the Eastern Hemisphere, including the eastern Atlantic. *Pleraplysilla minchini* is recorded for the first time in the western Atlantic.

Because of the geographic location of North Carolina, an analysis of geographic affinities of its sponge fauna is appropriate. The most prominent feature of North Carolina's cuspate coastline is Cape Hatteras, long recognized as the boundary between the Virginian and Carolinian biogeographic provinces (Figs. 62 & 63). The faunas of these two marine geographic provinces are undoubtedly sufficiently distinct for separate recognition, but there is some question as to whether they are not sub-divisions of greater geographic areas (Ekman 1953, Stephenson & Stephenson 1954). The Gulf Stream leaves the Atlantic coast in the Cape Hatteras region, flowing in a north-easterly direction; the warmth of the Gulf Stream system is an important factor to the climate of the marine waters of the southeastern states. North of Cape Hatteras cooler coastal water moves southward to North Carolina, then swings eastward to parallel the western edge of the Gulf Stream. North Carolina is the location of a transition between these two current systems, their respective temperature regimes, and provincial (or regional) faunas.

For geographic analysis, each species is assigned to a group of similar distribution, this distribution being adjudged on the basis of other collections and published records. Where records are not accompanied by any description, we cannot be certain of an identification, and our assignment to a distribution type consequently may be in error. The lack of published studies of

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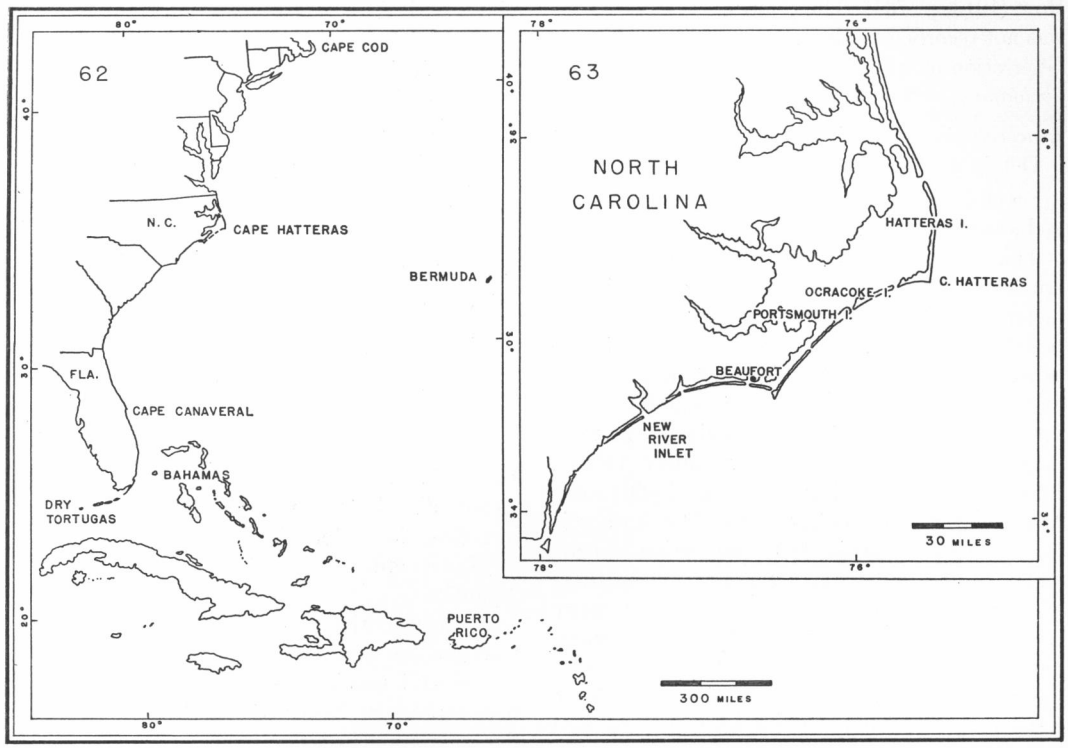

FIG. 62. Chart of western North Atlantic Ocean showing southeastern coast of North American and part of the West Indian region.

FIG. 63. Chart of North Carolina coast showing areas of sponge collections.

sponges between Long Island Sound and North Carolina on the one hand, and between the southern tip of Florida and North Carolina on the other hand, makes such an analysis of distribution along the Atlantic coastline hazardous and difficult. We have assigned each sponge species a distribution type on the basis of available information. Figure 62 shows the relationship of North Carolina to the areas under discussion.

Ten species represented by North Carolina collections have been collected only in the Carolinian province, that area lying between Cape Hatteras and Cape Canaveral, Florida. These species are *Adocia tubifera*, *Hemectyon pearsei*, *Tenaciella obliqua*, *Axinella bookhouti*, *Pseudaxinella wilsoni*, *Teichaxinella grayi*, *Ciocalapata gibbsi*, *Cliona robusta*, *C. spirilla*, and *Dorypleres carolinensis*. It seems likely that further collecting would show that many of these species are truly West Indian forms, and should be included in that group of sponges.

Only two species, *Haliclona canaliculata* and *H. loosanoffi*, have been collected only in the Virginian province, that is between Cape Hatteras and Cape Cod. Eight other species are distributed from North Carolina northward beyond Cape Cod; they are *Haliclona palmata*, *Microciona prolifera*, *Eurypon clavata*, *Halichondria bowerbanki*, *Suberites ficus*, *Pseudosuberites sulphureus*, *Polymastia robusta*, and *Craniella crania*. De Laubenfels (1949a) described the distribution of northern sponges as stopping in the vicinity of New Jersey, and the sponge fauna of North Carolina as being composed of southern species and widespread eurythermal Atlantic Coast forms. In this introduction to a discussion of the algal flora of the New England coast, Taylor (1957) described the distribution of algae along the Middle Atlantic Coast in similar terms, and attributed the scarcity of algae to an absence of suitable substrates. Natural hard substrates are scarce between New York and North Carolina, this part of the coast being dominated by sandy beaches and low marsh-lands. However, many hard substrates have been provided by man as pilings, groins, jetties, navigation aids, and inadvertently an occasional wrecked ship. These structures present a habitat for a number of spon-

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ges, and suitable currents and water temperatures have allowed the establishment of northern species on such structures as far south as the North Carolina Capes. A southerly-flowing current along the eastern seaboard north of Cape Hatteras supplies a slow but gradual transport toward this region (Bumpus 1955). Its colder waters provide a region of lower temperatures north of Cape Hatteras that contrasts with conditions south of the Cape, and the effect of summer warming of these inshore surface waters is often counteracted by an upwelling of colder subsurface water (Wells & Gray 1960). The combination of low winter temperatures (as low as 8°C) and moderated summer temperatures on the northeastern coast of North Carolina permits the survival of northern or boreal species of animals. Their collection moves the southern limit for these species from New Jersey south to North Carolina.

In terms of geographic affinities, the largest group of sponges represented in North Carolina collections is composed of forty-one southern species whose range extends southward to the West Indies. They are *Spongia graminea, Phyllospongia lanuga, Ircinia campana, I. fasciculata, Dysidea fragilis, Aplysilla sulfurea, Haliclona areolata, H. viridis, Xestospongia halichondrioides, Callyspongia vaginalis, Rhizochalina oleracea, Xytopsues griseus, Microciona juniperina, Thalyseurypon carteri, Dictyociona adioristica, Endectyon tenax, Axinella polycapella, A. reticulata, Homaxinella rudis, H. waltonsmithi, Pseudaxinella rosacea, Phakellia folium, Higginsia strigilata, Halichondria melanadocia, Hymeniacidon heliophila, Oxeostilon burtoni, Spheciospongia vesparia, Spirastrella coccinea, Anthosigmella varians, Prosuberites microsclerus, Terpios fugax, Cliona caribboea, C. viridis, Trachygellius cinachyra, Myriastra fibrosa, Geodia gibberosa, Cinachyra cavernosa, Craniella laminaris, Scypha barbadensis, Leucetta floridana, and Leucosolenia canariensis.*

Suitable conditions for the northward transport of larvae of these species are provided by the Gulf Stream system, specifically by the Florida Current that roughly parallels the edge of the continental shelf along the southeastern states (Iselin 1936). North of Cape Hatteras this "ocean river" flows northeasterly, and has much less influence upon inshore water and its fauna. The North Carolina Capes extend across much of the continental shelf, so that coastal North Carolina is much closer to the Florida Current than the coastal regions of South Carolina, Georgia, and northern Florida where the continental shelf is much wider. The Florida Current warms these coastal regions and often moderates wintertime low temperatures. By its proximity to the main axis of the Florida Current, coastal North Carolina stands in a position to receive the maximum benefit from this warming effect of its waters. While winter lows may exclude certain southern species from the shallow inshore waters of South Carolina and Georgia, the same species may survive in coastal North Carolina waters, as a result of the slightly higher temperature conditions here. The barnacle *Balanus tintinnabulum* exhibits this type of distribution on the east coast, being found at the southern tip of Florida and at the North Carolina Capes but absent from the intervening coast—apparently as a result of the temperature requirements of that species (Woods Hole Oceanogr. Inst. 1952). Whether any of these forty-one sponge species exhibits a similar distribution is unknown, for no general studies of sponges have been published for the intervening coast. It is evident that the Florida Current produces temperatures high enough in coastal North Carolina for the development of a large number of sponge species typical of the West Indian region.

An additional species probably should be inwith these southern forms; *Mycale cecilia* has been collected only at Hawaii and at the Pacific end of the Panama Canal. It seems likely that further collecting in the Caribbean or in the West Indies will show that this species is represented on both sides of Central America, and that this North Carolina record represents only a northern outpost of a West Indian distribution.

Six species are found both north and south of North Carolina: *Haliclona permollis, Lissodendoryx isodictyalis, Cliona celata, C. lobata, C. truitti,* and *C. vastifica.* They represent eurythermal species distributed from Cape Cod to the West Indies or wide-spread, cosmopolitan species. *Ciocalypta penicillus* has not been collected previously in the Western Hemisphere but is cosmopolitan in the Eastern Hemisphere. Previously, *Pleraplysilla minchini* has only been reported off the coast of France. For geographical analysis, these eight species must be treated together, as neither northern nor southern species. It is of interest that the first three named species in this group are three of the most common species at Beaufort; though numerically small, this group

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TABLE 3

Numerical analysis of geographic affinities of sponge species collected in North Carolina

Distribution type	Hatteras	Beaufort	New River fishing banks	North Carolina
Northern	10	5	0	10
Southern	22	23	24	45
Both N & S	7	8	0	8
Endemic to N. C.	0	2	5	7
Total	39	38	29	70

forms an important component of North Craolina's sponge fauna.

In this discussion of geographic affinities along the Atlantic Coast, Bermuda occupies a unique position. It has not been included in the account above, because it lies more than 700 miles from the nearest point on the American mainland, which happens to be Cape Hatteras. However, the sponges of Bermuda have been very adequately studied by de Laubenfels (1950a); and because of its geographic position, they are valuable for comparison with the North Carolina sponge fauna. Nineteen species have been collected in both areas. They are *Ircinia fasciculata, Dysidea fragilis, Aplysilla sulfurea, Haliclona permollis, H. viridis, Callyspongia vaginalis, Lissodendoryx isodictyalis, Xytopsues griseus, Eurypon clavata, Homaxinella rudis, Pseudaxinella rosacea, Hymeniacidon heliophila, Spirastrella coccinea, Terpios fugax, Cliona caribboea, Geodia gibberosa, Cinachyra cavernosa, Leucetta floridana*, and *Leucosolenia canariensis*. As in North Carolina, both species of northern affinities and of southern affinities are present, as well as several distributed widely along the Atlantic Coast. The sponge fauna of Bermuda is transitional.

In Table 3, North Carolina sponge collections are analyzed numerically for geographic affinity. Of a total of seventy species collected in North Carolina, forty-five are southern, i.e. are distributed from North Carolina southward, and ten are northern, i.e. distributed from North Carolina northward. The sponge fauna of North Carolina is predominantly southern in affinity, but with a sizeable representation of northern species and widespread eurythermal species. The transitional nature of its sponge fauna reflects its geographic position.

Further analysis of the species from each of the three areas collected also appears in Table 3. More northern species are represented in collections from the Hatteras area, the most northern collection area; only half that number are represented from Beaufort; and none have been collected at the New River fishing banks, the southernmost collection area. The representation of southern species is least in the Hatteras area, and gradually increases numerically farther south. However, the overall importance of southern species increases at the most southern collecting ground, the only other forms being newly described species that may fall into this southern distribution type with further collecting. As one might expect from their geographic positions, in the Hatteras area the northern influence is strongest, though still numerically dominated by southern species, while the New River fishing banks are almost exclusively southern in affinity, the Beaufort area being intermediate in representation.

The variety of collecting methods used and of habitats examined influences the number and type of sponges collected in any area. In the Hatteras area, rock jetties, shells, pilings, and algae in Hatteras and Ocracoke Harbors have yielded many sponges. In Pamlico Sound, shells, algae, *Zostera* blades, and channel markers have been productive of species tolerant to brackish waters.

Of particular interest have been several wrecks of metal ships located on or just off the outer beach of Rodanthe, Waves, Ocracoke, and Portsmouth. These wrecks are oases in the midst of extensive sand bottoms for organisms that require a firm substrate and that cannot tolerate shifting sand. In the Hatteras area they provide the only easily accessible habitat for sponges in water of ocean salinities. In addition to these wrecks, there are an unknown number of metal wrecks totally submerged that may be partially buried in sand but still provide some attachment for sessile organisms, including sponges. Although collections have not been made from these wrecks, many of the fresh sponges collected on the Hatteras beach undoubtedly come from such a habitat.

Collections have also been made of sponges from conglomerate rock dredged from 10 meters depth off Ocracoke Inlet. Outcroppings of this conglomerate rock similarly provide scarce attachment for sessile organisms in the open ocean. Many sponges collected on the beach in fresh condition bear fragments of these conglomerate masses in their base, or are attached to alcyonar-

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ian colonies that bear similar fragments, indicating that they were attached to these outcroppings. Several sponges have been taken in shrimp or flounder trawls by commercial fishing vessels.

In addition, a number of sponges have been recovered from beach drift in the Hatteras area, where many organisms accumulate after severe northeast storms. Although it is possible that some of these had been carried considerable distances, most probably came from nearby habitats. The fact that many contained bits of nearby substrate in their bases, that sponge accumulations usually were restricted to a short length of beach opposite charted hard bottoms, and that many of these sponges were fresh and often began changing color in one or two hours, indicates that they were of local origin. Usually this beach drift included, besides sponges, live "higher invertebrates" which probably came from the same hard substrates and were in equally good condition.

In the Beaufort area, many sponges have been collected on rock jetties, pilings, shells, and algae in Beaufort Harbor and Beaufort Inlet. Sand and shell bottoms in Back and Bogue Sounds and Newport River have yielded sponges to dredging. De Laubenfels (1947) dredged several species from a depth of 5 meters in the Atlantic Ocean off Bogue Bank, and George and Wilson (1919) reported on some sponges dredged from offshore fishing banks. George and Wilson also collected some sponges in beach drift on Bogue Bank near Beaufort Inlet.

Pearse and Williams (1951) collected all sponges reported from the New River area. These were collected from 4 to 17 meters depth by diving with a helmet. Sponges were attached to a reef composed of fossiliferous marl and *Vermicularia* tubes. Apparently little attention was paid to encrusting sponges.

Soft bottoms have been dredged only in the Beaufort area; but because sponges usually attach to hard bottoms, and because only one sand-loving species has been collected there, this collection has only a minor effect upon faunal lists.

The intensive collection of deep water sponges at the New River fishing banks exceeds the coverage of similar offshore reefs farther north, and no shallow water or intertidal sponges are included. Because the fauna of this reef is almost exclusively southern in affinity, the representation of southern forms may be greater in proportion to widespread Atlantic coast species than it would in a collection that involved shallow water or intertidal forms from that area. It appears that deep water sponges on the North Carolina coast are likely to be southern species, and that shallow water on intertidal sponges are likely to include northern and widespread Atlantic coast species as well as southern forms. The proportional representation of these groups will influence to some extent the geographic affinity of a collection. However, this effect is not enough to account for the entire picture of sponge affinities as indicated in Table 3.

Fifty-five species meet their distributional limit in North Carolina. Of the ten northern species collected in the Hatteras area, several are represented by smaller colonies in the Beaufort area, some are found only in the winter, and others have never been reported from there. The limit for many species appears to be in the Cape Hatteras region—where the Carolinian and Virginian provinces meet. The faunal differences which characterize these two biogeographic provinces are accompanied by hydrographic differences in the water masses that lie to either side of the Cape.

To our discussion, the most important physical difference between these water masses is their temperature, for it is the probable cause for the limitation of many species in the Cape region. Temperature is the primary factor determining the distribution of marine organisms, provided substrate and salinity are not limiting. Neither substrate nor salinity are involved here, and the temperature differences are adequate to account for the observed limits to distribution. The temperature regime north of Cape Hatteras fits the requirements for a temperate zone as defined by Vaughan (1940), i.e. ranging from 10° to 25°C. South of Cape Hatteras, the temperature regime fits Vaughan's requirements for a subtropical zone, i.e. ranging from 15 to 30°C. Parr (1933) has shown that a "temperature barrier" exists in the Cape region in winter, and Wells and Gray (1960) have shown that a "temperature barrier" exists here in summer.

While temperature has usually been considered the primary factor in the distribution of sponges, Burton (1930b) has suggested that currents play this role. He traced the distribution of several transoceanic species and related them to dominant ocean currents. Currents flow along the coast toward North Carolina from both north and south, converge in the Hatteras region,

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and flow northeastward from this point. The presence of northern and southern species in the Cape region can be attributed in part to the transport provided larvae by these currents. Because weather-induced currents occasionally do pass around the cape, they can carry larvae beyond this point, and provided suitable environmental conditions, sponges could develop beyond the limit of their previous geographical range. However, unless suitable temperature conditions permit its survival, this sponge will still be effectively limited by the Cape.

There is evidence that such interchanges of water do occur in the Hatteras area (Bumpus & Pierce 1955). However, the continuing limitation of many species in this area, in spite of this occasional interchange, indicates that temperature, and not current, is the limiting factor to their further distribution along this coast.

Dana (1853) and many other workers defined the region lying between Cape Cod and Cape Hatteras as the Virginian biogeographic province, and the region lying between Cape Hatteras and Cape Canaveral as the Carolinian province. While Ekman (1953) treats the Virginian province as being inhabited by a warm-temperate fauna, he considers the Carolinian province to consist of a mixture of warm-temperate and subtropical species. On the basis of their studies of intertidal organisms on this coast, Stephenson and Stephenson (1954) regard the Carolinian province to be warm-temperate and the Virginian province to be a transitional zone between the Carolinian province and the Acadian province north of Cape Cod, a "cold-temperate" province.

In terms of its sponge fauna, the Virginian province is low in endemic species and relatively low in total species. It is probably primarily transitional in nature, or a southern outlier of a northern or boreal fauna. The Carolinian province is relatively low in endemic species but relatively high in total species. It is apparently a subdivision of the West Indian Region, of a subtropical nature with offshore reefs inhabited by a tropical fauna.

This evaluation generally agrees with the Stephenson's analysis of Atlantic coast biogeographic subdivisions. They assign a similar rank to these provinces, but place them in different temperature zones, using a different set of definitions (those of Stephenson 1947). When treating these sponges of Bermuda, de Laubenfels (1950b) considered that area to be at the northern edge of the West Indian Region. In view of the predominance of West Indian species represented in North Carolina sponge collections, we also regard North Carolina as being on the northern edge of the West Indian Region.

By this reasoning, Cape Hatteras is not only a dividing point between the Virginian and Carolinian provinces, but also between a greater Atlantic Boreal Region to the north and a greater West Indian Region to the south, which is primarily tropical in nature. In 1896, Ortman recognized Cape Hatteras as a major dividing point between an Atlantic Boreal Region and an East American Region, which extended as far south as Brazil. Our study of North Carolina sponges supports this view.

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SUMMARY

1. A total of seventy species of sponges from coastal North Carolina have been described.
2. Of these, six are new to science, and thirty-two are new records for North Carolina.
3. In an analysis of distribution, fifty-five species apparently reach their distribution limits in North Carolina, temperature gradients in the Cape Hatteras region apparently being responsible for this limitation.
4. The sponge fauna of North Carolina is principally West Indian in affinity with a much smaller representation of northern species and widespread Atlantic coast species.
5. The proportional representation of southern species is greatest in collections made farthest south along the North Carolina coast, while the representation of northern species is greatest in collections made farthest north.

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6. The Virginian Province is apparently a transition zone between the Carolinian and Acadian Provinces, or a temperate outlier of a northern Atlantic Boreal Region.
7. The Carolinian Province is apparently a subdivision of the West Indian Region, of subtropical nature, with tropical offshore reefs.

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