SMITHSONIAN TROPICAL RESEARCH INSTITUTE LIBRARY

PREFACE

This manual is a general review of the shallow-water Octocorallia of the West Indian region, designed for the guidance of both the general marine biologist or ecologist working in the West Indies, and the systematist who may be interested in that faunal region and in the families of octocorals characteristic of it. Geographically, this résumé includes the tropical and subtropical regions in the western part of the Atlantic Ocean, from Bermuda south to the reefs of Brazil. Bathymetrically, it is limited to the zone between the low-tide line and 25 fathoms, which includes the region of active reef growth and the areas that are most likely to be investigated by diving and small-scale dredging operations.

As a guide to the identification of these shallow-water octocorals, this paper contains keys to the taxonomic subdivisions of the group and to the species recognized. The couplets for the most part are illustrated, in the style first used by VON KOCH in his monograph on the gorgonians in the *Fauna und Flora des Golfes von Neapel*, to obviate, so far as possible, errors of choice – a shortcoming that has always plagued taxonomic keys. Every effort has been made to characterize the various species as accurately and as clearly as present knowledge allows. The descriptions have been limited to the pertinent taxonomic details necessary for specific differentiation, generously supplemented by simple line illustrations of spicular characters. Although these may seem unduly numerous at first glance, those who, like the author, have had occasion to use the voluminous but poorly illustrated literature of the last three quarters of a century will appreciate them.

As a review of the octocoral fauna of the West Indies, this paper attempts to reduce in number the abundant synonyms of the common but variable species, and to reconcile the species that appear to be valid with the names in the literature. The distinguishable species have been included in the synonymies, but a number

of the older nominal species, especially those of LAMARCK, are still unrecognizable and will remain so until their types can be restudied. This paper is therefore not a definitive faunal monograph, but a review in the light of present knowledge and available material which may facilitate the preparation of such a monograph.

The material used in the present study includes, in addition to a collection made by Dr. P. WAGENAAR HUMMELINCK, the extensive West Indian material in the U.S. National Museum, along with specimens collected by the author at various localities in the Florida Keys over a period of more than ten years. Altogether, this material constitutes a more comprehensive collection of West Indian alcyonarians than has been available to any student of the Caribbean area up to the present time.

I am especially indebted to Dr. HUMMELINCK, whose collection forms the nucleus of this paper, and whose encouragement has contributed to its final completion. Dr. F. G. WALTON SMITH, Director of the Marine Laboratory, University of Miami, has extended every convenience and facility at his disposal during my several collecting trips to Florida. Many private individuals have contributed specimens reported herein, including Dr. EUGENIE CLARK, Mr. & Mrs. J. W. DONOVAN, Dr. J. BROOKES KNIGHT, Mr. CONRAD LIMBAUGH, Mr. FRANK LYMAN, Messrs. P. L. and T. L. MCGINTY, Dr. DAVID NICOL, and Mr. & Mrs. JOHN WENTWORTH. My greatest debt is to my colleague Dr. ELISABETH DEICHMANN, of the Museum of Comparative Zoölogy at Harvard University, who has freely given of her wide experience with these perplexing and often exasperating animals. I am mindful of the unselfish help rendered by my associates at the U.S. National Museum, without which this work would not now be completed, and am grateful to my supervisors, who have permitted me to carry out this extended study when I might have been contributing more profitably toward the necessary functions of daily routine and the maintenance of the collections in our charge. In particular, I am indebted to Dr. WALDO L. SCHMITT, Research Associate, then Head Curator of Zoology, and to Dr. FENNER A. CHACE, JR., Curator of the Division of Marine Invertebrates. I wish also to express a special word of thanks to Mrs. PATRICIA ISHAM, zoological illustrator of the U.S. National Museum, who has supplied the guide letters and scales on the drawings and otherwise readied the illustrations for publication, to Mrs. LANELLE W. PETERSON of the Division of Marine Invertebrates, who has assisted immeasurably by her expeditious processing of specimens to prepare them for study and for incorporation in the National Collections, and to my brother, ROBERT W. BAYER, whose help in the preparation of the final manuscript was indispensable.

The greater part of this paper was presented, in slightly different form, to the Faculty of the Graduate Council of The George Washington University as a dissertation in partial fulfillment of the requirements for the degree of Doctor of Philosophy. I am particularly grateful to the members of my consultative committee, especially Drs. IRA B. HANSEN, ELIZABETH E. MORTENSEN and WALDO L. SCHMITT, for their advice, guidance and confidence.

CONTENTS

	Page	Key	Figure	Plate
Preface	1			
Contents	3			
INTRODUCTION	9			
Materials	10			
Present state of our Knowledge	11			
Systematic Characters	12			
Technical Terms	19			
Methods and Techniques	22			
Nomenclature and Systematics	24			
Use of the Keys	25			
SYSTEMATIC DESCRIPTIONS	27			
Octocorallia	27	*1*		
Stolonifera	29			
Telestacea	30	*2*		
Telestidae	31			
Telesto	31	*3*		
– *corallina* Duchassaing	34		1, 9	
– *operculata* sp. n.	36		2, 9	
– *riisei* (Duchassaing & Michelotti)	39		3, 4, 9	XII
– *flavula* Deichmann	42		5, 9	
– *sanguinea* Deichmann	44		6, 9	
– *fruticulosa* Dana	46		7, 9	
– *nelleae* sp. n.	48		8, 9	
Alcyonacea	49	*4*		
Alcyoniidae	51			
Nidaliidae	51			
Nidalia	52	*5*		
– *occidentalis* Gray	53		9, 10	

	Page	Key	Figure	Plate
Nephtheidae	53	6		
Eunephthya	55			
– *nigra* (Pourtalès)	55		9, 10	
Neospongodes	55			
– *portoricensis* (Hargitt)	56		9, 10	
Gorgonacea	56	7		
Scleraxonia	61			
Briareidae	61			
Briareum	61			
– *asbestinum* (Pallas)	62		11	
Anthothelidae	64	8		
Iciligorgia	66			
– *schrammi* Duchassaing	66		12	
Anthothela	67			
– *tropicalis* sp. n.	68		13	
Tripalea	70			
– *clavaria* (Studer)	71		14	
Diodogorgia	71			
– *nodulifera* (Hargitt)	73		15	
Erythropodium	75			
– *caribaeorum* (Duch. & Mich.)	75		16	
Titanideum	77			
– *frauenfeldii* (Kölliker)	77		16	
Anthopodium	78			
– *rubens* Verrill	79		17	
Holaxonia	81			
Keroeididae	82			
Lignella	82			
– *richardii* (Lamouroux)	83		18	
Acanthogorgiidae	84			
Acanthogorgia aspera Pourtalès	85		19	
Paramuriceidae	86	9		
Acanthacis	90			
Villogorgia	90			
Paramuricea	90			
Trachymuricea	90			
Echinomuricea	90			
Placogorgia	90			
Bebryce	90			
Hypnogorgia	90			
Scleracis	90			
Swiftia	91			
Thesea	91			
Plexauridae	91	10		
Plexaura	95	11		
– *homomalla* (Esper)	97		20, 21	I, XVI
– *nina* Bayer & Deichmann	100		22, 28	
– *flexuosa* Lamouroux	104		23	IV, XVI, XVII

	Page	Key	Figure	Plate
Pseudoplexaura	107	12		
– *porosa* (Houtuyn)	109		24	I, XVIII
– *flagellosa* (Houttuyn)	112		24	XVIII
– *wagenaari* (Stiasny)	114		25	I, XIX
– *crucis* sp. n.	115		26	XIII
Eunicella	118			
– *modesta* Verrill	118			XV
Eunicea	118	13		
– *laxispica* (Lamarck)	125		27	XX
– *pinta* Bayer & Deichmann	125		28, 29	
– *palmeri* sp. n.	129		30	I, II
– *mammosa* Lamouroux	132		31	II
– *succinea* (Pallas)	134		32, 33	II
– *fusca* Duchassaing & Michelotti	138		34	III
– *laciniata* Duchassaing & Michelotti	140		35	III, XIV
– *tourneforti* Milne Edwards & Haime	142		36, 37	II, XIV, XXI, XXIV
– *asperula* Milne Edwards & Haime	145		38	II, XIV
– *clavigera* sp. n.	147		39, 40	IV
– *knighti* sp. n.	150		41, 42	III
– *calyculata* Ellis & Solander	154		43–46	III, XXII, XXIII
– sp. indet.	160		47	
Muriceopsis	161	14		
– *sulphurea* (Donovan)	162		48	II
– *flavida* (Lamarck)	163		48	IV
– *petila* sp. n.	165		49	IV
Plexaurella	167	15		
– *dichotoma* (Esper)	170		50	VI, XXIII, XXIV, XXV
– *nutans* (Duchassaing & Michelotti)	172		51	XIII
– *grandiflora* Verrill	173		52	VI
– *grisea* Kunze	175		53	VI
– *pumila* Verrill	177		54	VI
– *fusifera* Kunze	179		54	
Muricea	179	16		
– *muricata* (Pallas)	182		55	V
– *atlantica* (Kükenthal)	184		56	V
– *pinnata* sp. n.	186		57	V
– *laxa* Verrill	188		57	V
– *elongata* Lamouroux	189		58	V
– *pendula* Verrill	191		58	V
Gorgoniidae	192	17		
Lophogorgia	194	18		
– *sanguinolenta* (Pallas)	198			
– *violacea* (Pallas)	199		59	VII
– *barbadensis* sp. n.	199		59	
– *cardinalis* sp. n.	201		60	VII
– *punicea* (Milne Edwards & Haime)	204		61, 62	VII
– *hebes* (Verrill)	207		62, 63	VII

	Page	Key	Figure	Plate
Distribution of Genera and Species (Table 2)	334			
Telestacea	334			
Alcyonacea	335			
Gorgonacea	335			
Pennatulacea	341			
Faunistic Regions (Map)	342		100	
Distribution of the Deeper-Water Fauna (Map)	343		101	
Relationships of the Western Atlantic Alcyonarian Fauna (Tables 3–5)	344			
Amphi-American and Amphi-Atlantic Distribution	347			
Tethyan Distribution	348			
SUMMARY	350			
Suggestions for further Study	356			
REFERENCES	357			
INDEX	365			

INTRODUCTION

The octocoral fauna of the West Indies is unique in its profusion of gorgonians that inhabit the shallow waters of the reefs and lagoons. From the low tide level to a depth of ten or fifteen fathoms, the families Gorgoniidae and Plexauridae flourish as they do nowhere else in the world. It was only natural that specimens of these large and colorful corals found their way back to European curiosity cabinets and museums early in the history of exploration in the New World. They were described and illustrated by the foremost naturalists, among them BAUHIN, BOERHAAVE, CATESBY, CLUSIUS, ELLIS, and TOURNEFORT, and LINNAEUS applied his new binominal system of nomenclature to several of them in the tenth and twelfth editions of his *Systema Naturae*. PALLAS, ESPER, LAMARCK and LAMOUROUX added many species to the rapidly growing list, and DUCHASSAING and MICHELOTTI soon after published the first faunistic studies dealing specifically with the corals of the West Indies. In more recent times, VERRILL, HARGITT and ROGERS, KÜKENTHAL, DUBROWSKY, and STIASNY have published papers on the West Indian fauna. The first modern treatment of the fauna, which was edited and partly written by KÜKENTHAL, appeared between 1916 and 1929 under the general title *Die Gorgonarien Westindiens* in the report on KÜKENTHAL and HARTMEYER's expedition to the West Indies. Then, in 1936, DEICHMANN's great monograph on the alcyonarians of the 'Blake' was published but since that time no significant contributions to our knowledge of the fauna have appeared.

In view of the long history of studies on the octocorals of the West Indies and the large number of published papers dealing with them, it is rather surprising to find the commonest and most

accessible of them so poorly understood. Even the most recent and comprehensive of the works just mentioned fail to provide a reliable means of identifying the common reef-dwelling plexaurids and gorgoniids, which dominate the fauna. This situation prompted the present author to undertake serious research on the taxonomy of gorgonians while a student at the Marine Laboratory of the University of Miami, and led Dr. F. G. WALTON SMITH to urge the preparation of a guide to the Florida shallow-water alcyonarians along the lines of the present paper.

MATERIALS

The comprehensive collection of alcyonarians in the United States National Museum, gathered by the U.S. Fish Commission Steamer 'Albatross', by various Smithsonian Expeditions, and by many private individuals, contains unparalleled raw material for a study of the shallow-water species of the western Atlantic. The specimens collected in the Lesser Antilles by Dr. P. WAGENAAR HUMMELINCK form the nucleus of this paper; all other material from the West Indies was studied concurrently in an effort to define the variational limits of the different species throughout their ranges, and to correlate these with the species described in the literature. The success of this effort remains to be determined by those who put this paper to practical use.

In addition to the specimens collected by Dr. HUMMELINCK, material in the U.S. National Museum (abbreviated as USNM) from the following areas has been especially useful:

1. The east coast of Florida: a number of specimens dredged in shallow water by T. L. MCGINTY and A. R. THOMPSON on the m/v 'Triton'.

2. The Miami area: specimens dredged at moderate depths by Mr. and Mrs. JOHN WENTWORTH, and others collected on the reefs by myself and colleagues of the Marine Laboratory, University of Miami.

3. The Florida Keys: a large number of specimens obtained in 1884 by Dr. EDWARD PALMER, and others recently collected by FRANK LYMAN.

4. The Dry Tortugas: specimens obtained over a period of years

by Dr. WALDO L. SCHMITT, and later by myself and colleagues of the Marine Laboratory while on an expedition upon Mr. WILLIAM MORROW's yacht 'Spindrift', 1948.

5. The west coast of Florida: specimens collected by HENRY HEMPHILL in 1884, ROBERT STEWART in 1951–1952, and Dr. J. BROOKES KNIGHT in 1952–1956.

6. The Gulf of Mexico: many specimens dredged in shallow waters by the 'Albatross' in 1885, the 'Pelican' in 1940, and the 'Oregon' in 1951–1956.

7. The Bahamas: specimens collected at New Providence, Watling's Island and elsewhere by W. J. NYE of the 'Albatross' party, 1886.

8. Diverse localities in the West Indies: the collections of the Johnson-Smithsonian Deep-Sea Expedition of 1933, the Smithsonian Hartford Expedition of 1937, and the Smithsonian-Bredin Caribbean Expeditions of 1956, 1958, 1959 and 1960, as well as those of the U.S. Fish Commission steamers 'Albatross' and 'Fish Hawk'.

PRESENT STATE OF KNOWLEDGE

In perhaps no other group of animals, with the possible exception of the Porifera, is classification and identification so subjective as it is in the Octocorallia, and it is not an exaggeration to state that we still do not know what an alcyonarian species is. This state of affairs results in part from the dearth of material representing the various supposed species, and in part from the variability of the characters that we use to distinguish them. Information on the effects of the physical environment upon the taxonomic characters is almost completely lacking.

At the present time, it is possible to discern two ways in which alcyonarian colonies vary: (1) in the growth form of the colony, which may be profoundly influenced by the surrounding environment; and (2) in the form of the spicules, which presumably reflects the genetic constitution of the colony irrespective of its environment. In certain favorable localities where dense populations of a few species occur under varying conditions, the effect of, for example, depth of water upon growth form can be observed, and some idea can be gained of the variability of spicular characters

among individuals of a clearly defined population. Upon the basis of such observations, the otherwise subjective evaluation of characters in specimens from unknown populations becomes scientifically justifiable. It is possible to group the specimens of any large collection into units that demonstrate reasonable uniformity of taxonomic characters in spite of minor variations, and that are discontinuous from one another, which we can call species for all intents and purposes. However, until detailed field observations and experiments, coordinated with comprehensive collecting, clarify the normal range of variability within species and the influence of environmental factors upon the characters that we consider systematically important, the taxonomy of the octocorals will remain in confusion, cluttered with superfluous 'species' that are mere variants of one, and polyphyletic groups made up of several species erroneously synonymized because of superficial similarity.

Systematic Characters

The characters employed in the classification and identification of many other coelenterates, especially the details of the cnidom, the musculature of the polyps, the arrangement of septa, and other histological features, are generally not employed in the Octocorallia, partly because a large array of species have been described without respect to these characters due to the lack of satisfactorily fixed and preserved material, but mostly because of the overall uniformity of these characters throughout the subclass.

The anatomy of some pennatulaceans has been investigated in detail, and has been useful in establishing the scheme of classification at present employed for that group, but it is still not used as an adjunct to identification. In the order Alcyonacea, one family, the Xeniidae, is set off from the others by peculiarities of its septal filaments, but this feature is employed only in the identification of problematical specimens lacking the other morphological characters typical of the family. In the order Gorgonacea, the several families constituting the suborder Scleraxonia are now defined largely on the basis of the arrangement of the gastrodermal solenia and canals, thanks to the work of Verseveldt (1940, 1942).

The systematic characters of the greatest practical value are therefore those that are present in any specimen regardless of its state of preservation, dry or in alcohol, contracted or expanded. They fall mainly into two general categories, those pertaining to the colonies as a whole, and those pertaining to the skeletal elements.

Features of Colonial Morphology

Size and shape of colony. The size and shape of the colony, which depend upon the extent and pattern of budding, may be used to characterize the major groups in a general way. Thus, the Stolonifera, whose species bud only sparingly and only from a creeping stolon, never attain any great size and are usually inconspicuous membranous expansions growing on rocks, shells, or other solid objects. In the order Telestacea, the asexual production of polyps is more abundant, taking place not only upon the stolons but also from the body wall of older polyps, so that larger, arborescent colonies are produced, but even these are comparatively small, since they rarely exceed a foot in height. In the Alcyonacea and the Gorgonacea, budding is profuse and colonies of large size result. In the former group, the polyps are elongate and the space between individuals is filled in with coenenchyme, thus forming massive, fleshy colonies. In the latter, the polyps are short but the thin layer of coenenchyme in which they are imbedded is spread over an erect, tree-like axial structure made of horny material called gorgonin, or of spicules more or less closely fused together. The resultant colonies may reach an imposing size, as in the case of *Primnoa reseda* and *Paragorgia arborea* of northern waters, which may reach the size of small trees. In the tropics, such excesses are less often met with, but *Gorgonia flabellum* and *G. ventalina* of the West Indies may attain a height of six feet or more, and several plexaurid species approach this size. Other species, perhaps closely related to large ones, never reach a large size even under the most favorable of conditions, making it clear that there is an inherent size limit. Cary's investigations (1918) at the Dry Tortugas indicate that most reef-dwelling species reach a

medium size in from three to five years, after which growth is very slow. He reported no evidence to indicate death from old age.

Pattern of branching. The pattern of branching is often highly characteristic of species and even genera. The commonest plans are dichotomous and pinnate, the nondescript 'lateral' type being usually a modification of one or the other. In the family Gorgoniidae, ramification is usually pinnate, and the strong tendency toward regular anastomosis is accorded generic significance. In other families, anastomosis of branching is generally thought to be a specific rather than generic character. Branching is predominantly dichotomous in the family Plexauridae, although there are exceptions, sometimes within a single genus. Some of the deeper water genera, such as *Chrysogorgia*, have an extremely regular manner of branching, and even the length of the internodes and the number of polyps appearing on them may be almost mechanically uniform.

Distribution of polyps. The distribution of polyps on the branches is of variable importance. In families having a small number of major gastrodermal stem canals, usually two, as is the case in the Gorgoniidae and the Ellisellidae, the polyps are typically arranged in two longitudinal bands separated by the canals, but when there are several longitudinal canals the polyps are scattered on all sides of the stems and branches, as in the Plexauridae. As is the case with the plan of branching, the arrangement of polyps may show greater regularity in genera of deeper waters. Among the Primnoidae, the polyps are commonly arranged in whorls around the branches, and the number of polyps in each whorl as well as the number of whorls in a given length of stem varies only within extremely narrow limits.

Dimorphism. Dimorphism of polyps, i.e., the occurrence of two types of individuals, namely autozooids and siphonozooids, is characteristic of certain genera of Alcyonacea and Gorgonacea; in the Pennatulacea, other types of individuals have been described. The autozooids, commonly called 'polyps', are the individuals with eight tentacles, eight septa and, usually, eight septal filaments; the siphonozooids, often simply called 'zooids' in the earlier literature, are small individuals with tentacles reduced in size and number and only two septal filaments, sometimes none at all. In

the Pennatulacea, the siphonozooids are sterile, but in the Alcyonacea and Gorgonacea they are the sexual individuals of the dimorphic species.

Axis structure. The structure of the supporting axis is a character that has been underestimated in its significance, although its general character has long been used to separate the suborders of Gorgonacea and several of the included families. In those holaxonians that have been investigated, the axial cylinder is the product of a special axis epithelium, best demonstrated at the growing tip of the branches but visible in the older parts of the colony as well. It is ordinarily composed of a central core, soft and cross-chambered in some families, solid and calcified in others, surrounded by concentric layers of gorgonin which may be more or less calcified. In the Scleraxonia, the axial structures are composed of spicular deposits more or less tightly fused together. Since these spicules are the product of scleroblasts lying in the mesogloea, the axis formed by them cannot be considered homologous with the holaxonian axis unless the scleroblasts be considered a fragmented axis epithelium, or unless the presence of a central chord, produced by a terminal axis epithelium, can be demonstrated lying at the center of the spicule-augmented axis. The axis of gorgoniids has a narrow chambered central core surrounded by regular layers of gorgonin bearing little if any calcareous matter, whereas the core of plexaurids is much wider and the layers of gorgonin are separated by numerous lenticular spaces, the loculi, filled with calcareous matter. In the Ellisellidae, Primnoidae, and Chrysogorgiidae the central core is calcareous and not chambered, and the concentric outer layers are heavily calcified. In the Ellisellidae, calcification is radial, in the Primnoidae the layers are undulated, and in the Chrysogorgiidae they are quite smooth and concentric. In both the Holaxonia and the Scleraxonia, families with the calcareous axis interrupted by horny joints occur. Although the holaxonian families have no spicules in the horny nodes, and the calcareous internodes are said to be of a non-spicular nature, they have many basic similarities to the jointed scleraxonians and it is entirely possible that these supposedly divergent families are more closely related than is generally believed.

Color. Color in the Octocorallia is dependent upon three causes, pigments in the tissues, intracellular symbiotic algae in the entoderm, and coloring substance incorporated in the calcareous spicules. The color of preserved specimens is almost always due to the latter cause and is permanent, being insoluble in alcohol, unaltered by drying, and little affected by light. It is sometimes a reliable specific character, as it is in certain species of *Muricea* and the precious corals (*Corallium*), but usually the brightly colored species, especially in the families Gorgoniidae and Ellisellidae, are quite variable. *Leptogorgia virgulata* is one of the finest examples of polychromism, the members of a population ordinarily ranging from nearly white through lemon yellow, ochre, orange, red, and purple to deep violet. The pure yellow and deep violet phases have most or all of their spicules of those colors, but the intermediate colors result from the admixture of red and violet spicules in varying proportions. Other species of Gorgoniidae demonstrate the same phenomenon.

Microscopical Features

The one character most useful in the identification and classification of alcyonarians, the form of the calcareous spicules, was first appreciated by A. VALENCIENNES, who prepared a general revision of the gorgonians founded upon it, but of which only a brief extract (1855) was ever published. Ten years later, KÖLLIKER's *Icones histiologicae* (1865) clearly established the value of spicules in the classification of alcyonarians and presented a new arrangement based upon them. Subsequent authors adopted the system immediately and our present scheme of classification began to take shape.

In the Octocorallia, the coenenchymal sclerites are of two basic types, the monaxial rod or spindle, and the scale or plate. All other spicule forms are derivable from them.

The monaxial forms are *rods* if blunt and nearly cylindrical, *spindles* if fusiform and sharply pointed, and *capstans* if very short, blunt, and surrounded by two regular girdles of tubercles. In some families, such as the Coralliidae and Paragorgiidae, the two whorls

of tubercles on the capstans are composed of three projections each, so that there are a total of eight short rays, including the ends of the main axis, projecting in a regular manner from a very short shaft. These are called octoradiate capstans ('Achter' in German), and the suppression of one or both terminal rays produces septem- and sex-radiates ('Siebener' and 'Sechser'). The characteristic four-rayed 'butterfly' spicules of *Plexaurella* are nothing but sex-radiate capstans with four of the rays much enlarged, but other cruciform spicules are usually twin spindles. Spindles with one end much enlarged are descriptively referred to as *clubs*, of which there are many sub-varieties.

Since spindles and rods in many cases show a tendency to flattening, it is probable that plates, scales and other flattened sclerities are derivatives of these simple types. This is almost certainly true in the Chrysogorgiidae, in which the transitional forms can be seen and in which the calcification is concentric, but there is some question about the derivation of the plates of primnoids, in which the calcification is radial.

The various specialized terms applied to spicules are briefly defined in the glossary. Most of the terms are descriptive, and no complicated spicule terminology has grown up in the octocorals as it has in the sponges.

Not only is the form of the spicules themselves of taxonomic importance, but their arrangement in the various parts of the colony is significant. In practically all Alcyonacea and Gorgonacea, the spicules at the surface of the coenenchyme are of a specialized type differing from those of the deeper layers. In the Gorgonacea, there may be two inner layers, the subsurface outer rind, lying outside the longitudinal stem canals, and the inner rind or axial sheath, lying between the stem canals and the axis. An axial sheath layer is almost universally present, although it is extremely thin in some genera, notably those of the Paramuriceidae. Colored spicules are sometimes confined to the axial sheath, sometimes to it and the inner rind, and sometimes they occur in all layers. The sculpture of spicules in the outer layer is often asymmetrically developed into spines, leafy processes and frills of various kinds, but the spicules of the deeper rind and the axial sheath are usually quite symmetrical.

The presence of spicules in the anthocodial part of polyps varies greatly in the different major groups, but it is usually a reliable character of great importance. Thus we find the polyps heavily armored in some groups, such as the Primnoidae, and weakly spiculate in others, such as the Gorgoniidae, but the arrangement of polyp-scales in the primnoids is remarkably constant and highly characteristic, and the size and shape of the anthocodial rods in gorgoniids seem to be reasonably constant. The large distal spicules of the polyps, which guard the calicular apertures during contraction, were used by KÜKENTHAL (1924, p. 88) as a basis for separating the family Muriceidae ('Polypen mit Deckel') from the Plexauridae and Acanthogorgiidae ('Polypen ohne Deckel'), but the fact of the matter is that all three families have a subtentacular armature and the distinction is one of terminology, with this armature called an operculum ('Deckel') in the Muriceidae, and a crown ('Krone') in the other families. Although the operculum as defined by KÜKENTHAL consists of a transverse ring (the collaret) surmounted by eight triangular or chevroned tracts of spindles in the tentacle bases, whereas a crown consists of spicules less regularly disposed, the distinction is still a difficult one to make on a practical basis and has too many exceptions. For example, *Plexaura homomalla*, the type of the genus, has a perfectly good operculum consisting of collaret and points, while many species of *Muricea* have only a crown of spindles less precisely oriented; thus *Plexaura homomalla* would be a muriceid, according to KÜKENTHAL's criteria, and some Muriceas would fall into the Plexauridae. Polyps that are armed with a crown or an operculum as in the Paramuriceidae (Muriceidae of previous authors), Plexauridae, and Gorgoniidae, have a spicule-free neck zone or introvert, which permits the entire distal part of the anthocodiae to be withdrawn into the anthostele or directly into the cortex. On the other hand, the polyps of certain other groups, such as the Ellisellidae and Coralliidae, have a uniform and uninterrupted armature that permits the tentacles to be infolded and the calicular aperture closed, but does not allow complete withdrawal of the tentacular part into the anthostele.

TECHNICAL TERMS

anthocodia: the upper, tentacular part of the polyp which, in many cases, can be retracted within the rind or calycular structure.

anthostele: the lower, thickened part of the body wall of the polyp, often stiffened by spicules, into which the anthocodia may be withdrawn; often equivalent to 'calyx.'

autozooid: a polyp with 8 well-developed tentacles and septa; the only kind of polyp in monomorphic species, the major polyps of dimorphic species.

axis: the central, supporting structure of Gorgonacea and Pennatulacea; in the former, it may be spicular, consolidated or unconsolidated, or horny, with more or less non-spicular calcareous matter.

axis epithelium: the layer of cells derived from ectoderm that produces the axis of Holaxonia.

axoblasts: individual scleroblasts of the axis epithelium.

bark: the rind of holaxonian Gorgonacea.

calyx: the wart-like projecting anthostele.

cnidoblasts: the cells that produce the nematocysts.

coenenchyme: the colonial spiculiferous mesogloea.

collaret: the transverse, subtentacular ring of spicules.

cortex: the outer coenenchymal layer of gorgonaceans, esp. Scleraxonia; the outer, horny layer of the holaxonian axis, as opposed to its medulla or central chord or core.

crown and points: the transverse collaret with the superposed opercular rays.

filaments: the thickened, convoluted edges of the septa; in Octocorallia, the filaments of the two septa opposite the siphonoglyph are very long and heavily flagellated, whereas the remaining six are shorter and glandular.

loculi: the lenticular, calcified areas in the holaxonian axis, esp. of Plexauridae.

medulla: the central zone of the scleraxonian stem; rarely, the central chord of the holaxonian axis.

mesenteries: the soft septa.

mesogloea: the jelly-like substance separating the two cellular layers of coelenterates.

nematocysts: the 'stinging cells' or 'thread cells' characteristic of coelenterates.

operculum: the anthocodial spicular apparatus that more or less closes the calyx or protects the tentacles in contraction.

pinnules: the digitate lateral branches of the tentacles of octocoral polyps.

polyp: any individual of the alcyonarian colony; equivalent to 'autozooid.'

rind: the outer, spiculiferous coenenchyme of Holaxonia.

sclerites: the calcareous skeletal elements of the mesogloea, irrespective of form.

scleroblasts: the ectodermal cells of the mesogloea that produce the calcareous spicules.

septa: the thin, radial, non-calcareous partitions of the polyp.

siphonoglyph: the strongly ciliated groove extending down one side of the pharynx.

siphonozooid: polyps with reduced tentacles or none, and often reduced septal filaments; usually much smaller than autozooids.

solenia: the canals, lined with gastrodermis, that penetrate the coenenchyme and interconnect the gastric cavities of the polyps.

spicules: the calcareous skeletal elements of the mesogloea, irrespective of form; properly, a long, sharp sclerite. Specialized forms are:

balloon clubs, with practically smooth, spheroidal heads, characteristic of *Eunicella*.

Blattkeulen, leaf-clubs (Ger.).

brackets, scaphoids.

buccal scales, those scales just proximad of the operculars in sub-family Calyptrophorinae.

capstans, monaxial rods with two whorls of tubercles and terminal tufts.

clubs, spicules enlarged at one end, often strongly sculptured.

crampons, scaphoids (Fr.).

disk-spindles, derivatives of capstans with the tubercles of the two whorls fused into disks or wheels.

Doppelrädchen, disk spindles or 'double wheels' (Ger.).

double clubs, the bispheroidal, two-handled sclerites of *Corallium*.

double wheels, disk-spindles.

infrabasal scales, in primnoids the sclerites situated between the basal body scales and the scales of the rind.

Keulen, clubs (Ger.).

Klammern, scaphoids (Ger.).

leaf-clubs, clubs with the heads ornamented with foliate processes.

plates, flat sclerites too thick to be called scales.

radiates, sclerites with processes radiating in one plane (stellate), or in various planes in a more or less symmetrical order.

scales, thin, flat or nearly flat sclerites.

scaphoids, spindles more or less distinctly bent in the form of a 'C' and with warts of the convex side reduced.

Scheibenträger, disk-spindles (Ger.).

spindles, straight or nearly straight, monaxial spicules pointed at both ends.

Stachelkeulen, thorny clubs (Ger.).

Stachelplatten, thorn-scales (Ger.).

thorn-clubs, clubs with processes of the head sharp and spiny.

thorn-scales, scale- or plate-like sclerites with a central or marginal projecting process.

torches, clubs with the foliate processes of the head strongly laciniate, resembling burning torches.

wart-clubs, clubs with only low, blunt protuberances ornamenting the head.

stolon: the creeping basal expansions, ribbon-like or membranous, from which the polyps of Stolonifera and Telestacea arise.

Stützbündel: the spicular supporting bundles of nephtheids (Ger.).

supporting bundle: the sheaf of supporting spicules below the anthocodiae of nephtheid polyps.

verruca: the calyx; the tubercles of sclerites.

zooid: in the more recent literature in English, any individual of the colony, irrespective of its morphological specializations, thus equivalent to polyp; in most German language works, equivalent to siphonozooid.

mesogloea: the jelly-like substance separating the two cellular layers of coelenterates.

nematocysts: the 'stinging cells' or 'thread cells' characteristic of coelenterates.

operculum: the anthocodial spicular apparatus that more or less closes the calyx or protects the tentacles in contraction.

pinnules: the digitate lateral branches of the tentacles of octocoral polyps.

polyp: any individual of the alcyonarian colony; equivalent to 'autozooid.'

rind: the outer, spiculiferous coenenchyme of Holaxonia.

sclerites: the calcareous skeletal elements of the mesogloea, irrespective of form.

scleroblasts: the ectodermal cells of the mesogloea that produce the calcareous spicules.

septa: the thin, radial, non-calcareous partitions of the polyp.

siphonoglyph: the strongly ciliated groove extending down one side of the pharynx.

siphonozooid: polyps with reduced tentacles or none, and often reduced septal filaments; usually much smaller than autozooids.

solenia: the canals, lined with gastrodermis, that penetrate the coenenchyme and interconnect the gastric cavities of the polyps.

spicules: the calcareous skeletal elements of the mesogloea, irrespective of form; properly, a long, sharp sclerite. Specialized forms are:

balloon clubs, with practically smooth, spheroidal heads, characteristic of *Eunicella*.

Blattkeulen, leaf-clubs (Ger.).

brackets, scaphoids.

buccal scales, those scales just proximad of the opercular in sub-family Calyptrophorinae.

capstans, monaxial rods with two whorls of tubercles and terminal tufts.

clubs, spicules enlarged at one end, often strongly sculptured.

crampons, scaphoids (Fr.).

disk-spindles, derivatives of capstans with the tubercles of the two whorls fused into disks or wheels.

Doppelrädchen, disk spindles or 'double wheels' (Ger.).

double clubs, the bispheroidal, two-handled sclerites of *Corallium*.

double wheels, disk-spindles.

infrabasal scales, in primnoids the sclerites situated between the basal body scales and the scales of the rind.

Keulen, clubs (Ger.).

Klammern, scaphoids (Ger.).

leaf-clubs, clubs with the heads ornamented with foliate processes.

plates, flat sclerites too thick to be called scales.

radiates, sclerites with processes radiating in one plane (stellate), or in various planes in a more or less symmetrical order.

scales, thin, flat or nearly flat sclerites.

scaphoids, spindles more or less distinctly bent in the form of a 'C' and with warts of the convex side reduced.

Scheibenträger, disk-spindles (Ger.).

spindles, straight or nearly straight, monaxial spicules pointed at both ends.

Stachelkeulen, thorny clubs (Ger.).

Stachelplatten, thorn-scales (Ger.).

thorn-clubs, clubs with processes of the head sharp and spiny.

thorn-scales, scale- or plate-like sclerites with a central or marginal projecting process.

torches, clubs with the foliate processes of the head strongly laciniate, resembling burning torches.

wart-clubs, clubs with only low, blunt protuberances ornamenting the head.

stolon: the creeping basal expansions, ribbon-like or membranous, from which the polyps of Stolonifera and Telestacea arise.

Stützbündel: the spicular supporting bundles of nephtheids (Ger.).

supporting bundle: the sheaf of supporting spicules below the anthocodiae of nephtheid polyps.

verruca: the calyx; the tubercles of sclerites.

zooid: in the more recent literature in English, any individual of the colony, irrespective of its morphological specializations, thus equivalent to polyp; in most German language works, equivalent to siphonozooid.

Methods and Techniques

Preservation

Because the identification of octocorals depends largely upon the calcareous spicules that occur in the coenenchyme, specimens preserved dry or in ordinary alcohol are entirely satisfactory for study. Although the arrangement of the anthocodial spicules can be detected in dissections from dry or contracted spirit specimens, it may be observed much more clearly in specimens killed with polyps expanded. Consequently, if time and facilities are available, preparation of such specimens is rewarding. Specimens with polyps expanded may be obtained by allowing them to extend in aquaria or other suitable glass containers and treating them with a narcotizing agent prior to fixation. For octocorals, the best are magnesium chloride, magnesium sulphate, and chloretone (Chlorobutanol).

The first chemical is used as a 7.5%–8.0% solution in *fresh* water, which should be carefully substituted for half the liquid in the aquarium containing the specimen. When, after repeating once or twice until most of the sea-water has been replaced by magnesium chloride solution, the polyps remain extended upon mechanical stimulus, neutralized formalin may be added to kill the specimen. After fixation, transfer to spirit for permanent preservation.

Magnesium sulphate, saturated in sea-water, should be added drop by drop to the aquarium containing the extended specimen. When the polyps no longer respond to touch, the specimen may be fixed, as described above.

Chloretone is administered in crystal form by dropping a small amount on the surface of the water. After a time, the polyps will become insensible to touch and the colony may be fixed in formalin as above noted.

Various species react differently to the different narcotizing chemicals, but most will respond satisfactorily to one or the other of the magnesium salts mentioned earlier. A few species may be found which cannot be narcotized by any of the methods I have mentioned. In these cases it probably is not worth the effort to attempt alternative techniques, of which there are several (e.g., CO_2, menthol, hot formaldehyde). Needless to say, fixation of

specimens for histological study must be very carefully effected. Since it is not within the scope of this report to describe histology, techniques pertinent thereto will not be discussed.

Preparation of Spicules

Preparation of spicules for microscopic examination is very easily accomplished without elaborate equipment. The only necessary chemical is a solution of sodium hypochlorite (eau de javelle; milton fluid; anti-formin; Clorox) kept for convenience in a dropper-bottle. The solution should be frequently renewed, because an old and weak solution acts slowly and results in much lost time.

A small fragment of the specimen is placed on a glass slide and a drop of hypochlorite solution added. In a few moments, the organic matter will be entirely dissolved and the spicules freed, whereupon a coverslip may be added and the preparation is ready for examination. Such water-mounts are temporary, but show the calcareous spicules to good advantage because of the discrepancy between the refractive indices of water and calcite. It is important to roll the spicules about, by tapping the coverslip with a fine needle while observing under low magnification, in order to detect any flattening, asymmetry, or other features not obvious from a single view. This is especially important in the Gorgoniidae, in the discussion of which I shall mention the matter again.

The examination of spicules from restricted regions of the colony requires, of course, that samples from those areas be teased out under a stereoscopic microscope and the spicules cleaned separately. It is always instructive, just as a matter of routine, to so dissect a bit of the colony, in order to observe the coenenchymal layers, orientation of spicules in polyps and calyces, and similar details.

For permanent mounts I find it convenient to dissolve out the spicules in a small vial, so that they may be repeatedly washed in clear water to remove all traces of sodium hypochlorite. When clean, the spicules may be dropped on a slide, dried, and mounted in balsam, clarite, hyrax or other medium. The greater the difference between refractive index of specimen and medium, the better, but spicules always become more transparent in permanent mounts.

SMITHSONIAN TROPICAL RESEARCH

To avoid this effect, they may be mounted in glycerin buffered to neutrality in an asphalt cell turned upon an ordinary slide, and sealed under a circular cover. This method, although tedious, produces the best results, because the spicules are not totally immobilized and because their refractive index (calcite: n 1.52) is sufficiently different from that of glycerin (n 1.463) that they may be seen clearly. Observation of spicules in permanent mounts can be greatly facilitated by the use of polarizing filters; I keep one always in the sub-stage filter-holder, and another in the most-used ocular. Ordinarily, the filters are used uncrossed (bright-field) but, for some work, such as the examination of tentacles whole-mounted in glycerin or balsam, to determine the spicule arrangement, crossed filters (dark-field) may be used to bring out details with great brilliance.

The optical equipment I find most useful on my microscope are 10×, 20×, and 43× objectives used with a 15× eyepiece. For the large spicules of certain species, a lower eyepiece, either 10× or 5× may be required. A low-power objective is often useful for drawing calyces and anthocodiae, and for this I use a Zeiss variable 1.2–2.4× objective, with which a great range of small magnifications can easily be obtained. A camera lucida is essential for drawing and measuring spicules. For the latter purpose, the camera lucida is used to trace the image of a stage micrometer upon a piece of paper, which can then be used as a ruler to measure directly the drawings of all spicules made with the same optical combination. This method is vastly more accurate and handy than the use of an eyepiece micrometer or reticle.

Nomenclature and Systematics

As every systematist knows, nomenclature encompasses numerous problems even when the systematic units to which the names refer are clearly defined. When, as is the case in the Octocorallia, the limits of the species as well as of the higher categories are in a state of flux, nomenclatural problems become thorny indeed. It is absolutely essential under these conditions to adhere strictly to the law of priority, since deference to the fanciful idol of usage

creates more difficulties than it avoids. It has therefore been my policy to employ the earliest available name for every recognizable species, even though this policy results in the upsetting of certain names in more or less general use.

At the generic level, no worker has yet taken the trouble to cite the date and method of type fixation, if types are cited at all. Without accurate knowledge of generic types no clear concept of the genera themselves can exist, so I have spared no effort to determine the earliest type selections for all genera whose types were not fixed at the time of original publication. This procedure has already resulted in a few generic name changes that were momentarily distasteful but necessary to stability.

The nomenclatural problems of geographical, ecological, and individual variation in the alcyonarians have not been met by the general recognition of subspecies and infrasubspecific categories, as has been the practice in certain other groups of animals. Among the Octocorallia, the status of these variants is almost completely unknown and for the time being it cannot be determined which ones are valid, genetic subspecies and which ones are the result of individual variation or environmental influences. Difficulties that arise when it becomes necessary to refer to the often divergent growth forms of what appears to be a single species seem best circumvented by the use of form names. In the present treatment I have so recognized a number of such variants in preference to maintaining them as ill-defined and unjustifiable species and subspecies.

The status of many genera likewise demands clarification, and it will probably be found that many arbitrarily separated groups of species will merge once the valid generic criteria are clearly recognized.

Use of the Keys

There are many systematists who feel that it is impossible to compose satisfactory keys for the identification of animals. Certainly, the characters in some groups of animals lend themselves better to expression in key form than others do, and there may indeed be

groups that cannot be keyed at all. In papers on the Octocorallia, it has been almost traditional to present keys, thanks largely to the efforts of W. KÜKENTHAL, who made extensive use of them.

The use of keys may be insidiously misleading due to the combined effect of an intrinsic fault of keys and an inherent shortcoming of their users. The fault of keys lies in the difficulty of expressing succinctly those features that are subject to considerable variation; and the shortcoming of their users lies in the excessive confidence placed in these unavoidably fallible guides. However, if a key is well made, and it is approached with caution, not as an indisputable answer to all questions of identification, but as a guide to the species known to science at the time, then it can be a valuable tool that saves many hours of work.

Accordingly, I have drawn up some new keys and modified some old ones, and furnished them with drawings to illustrate the features expressed in the couplets, hoping thereby to have minimized the fallibility of words and infelicity of expression. Obviously, there is space to show only limited examples of the key characters, so that the natural range of variation is not covered. Perhaps this may call for an even more cautious approach by the user than would otherwise be called for, but it may also result in more accurate and more rapid determinations.

In all cases, the illustrations of spicules are camera lucida drawings of actual examples, and are not diagrammatic. Some of the sketches of colonial form and pattern of branching have been schematized, however.

SYSTEMATIC DESCRIPTIONS

Subclass *OCTOCORALLIA* Haeckel, 1866

Diagnosis. Sedentary, colonial, monomorphic or dimorphic Anthozoa with autozooids invariably bearing eight tentacles, usually pinnate; eight complete septa, with filaments; one siphonoglyph. Siphonozooids, if present, with tentacles reduced in number or lacking, and with filaments on only one pair of septa. Skeleton consisting of calcareous spicules (in all orders but one), a more or less calcified horny central axis that in some groups is made up of fused spicules, or a massive, fibrocrystalline corallum (order Coenothecalia only).

Remarks. The junior term Octocorallia is employed for this subclass in preference to prior names because the first, EHRENBERG's Octactinia, was originally used in a peculiar dual sense ('Zoocorallia Octactinia' and 'Phytocorallia Octactinia') and, moreover, implies relationship with the group well-known as Actiniaria; the second, BLAINVILLE's Zoophytaria, preserves the antiquated botanical association of these animals; and the third, DANA's familiar Alcyonaria, has been used both for the subclass as a whole and for the order here called Alcyonacea. In general discussions, however, it is convenient to use the term 'alcyonarians' in a vernacular sense, in which case it is equivalent to 'octocorals.'

KEY 1

ILLUSTRATED KEY TO THE ORDERS OF OCTOCORALLIA

1a. Colonies are attached to or in the substrate by a special basal disk, creeping stolons, or calcareous root-like processes: 2

1b. Colonies inserted in the soft sea-floor by a fleshy stalk: Order PENNATULACEA

2a. Colonies mostly creeping, encrusting or lobate; if arborescent, the branches lack any trace of axis or medullar region and are perforated to the lowest parts by the long gastric cavities of the polyps; if membranous, composed of only one layer of coenenchyme: 3

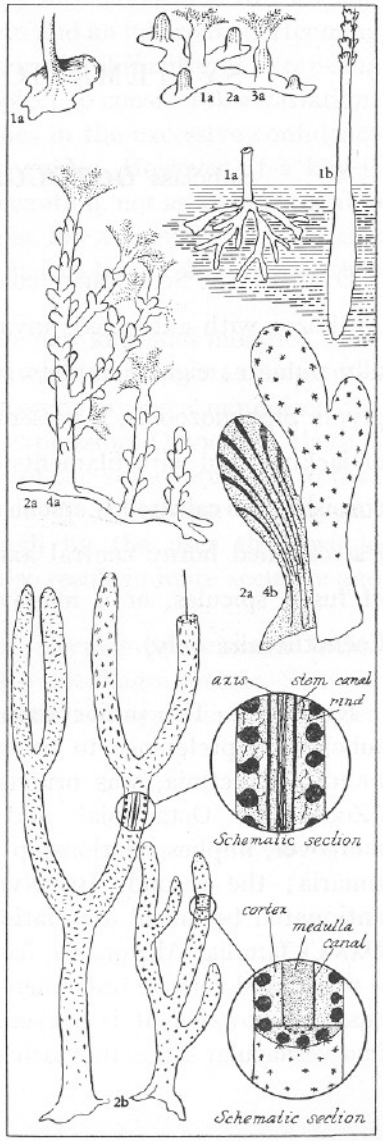
2b. Colonies mostly erect, arborescent, either with a definite axis, horny or calcareous, or a distinct medullar zone into which the gastric cavities do not extend, characterized by spicules of different form or color from those of cortex; if membranous, composed of two layers of coenenchyme; basal layer not penetrated by polyps; gastric cavities short: Order GORGONACEA

3a. Polyps simple, arising from reticulating ribbon-like or membranous stolons; no budding from polyp walls: Order STOLONIFERA

3b. Colonies arborescent or massive: 4

4a. Primary polyps with laterally budded daughters arise from reticulating stolons: Order TELESTACEA

4b. Polyps imbedded in massive, lobate, coenenchymal mass; colonies rarely arborescent, but if so the stems contain extremely long gastric cavities reaching base: Order ALCYONACEA



Order **STOLONIFERA** Hickson, 1883

Diagnosis. Colonies composed of tall or short, simple, cylindrical polyps arising from a basal stolon which encrusts solid objects; the stolon may be ribbon-like, a reticulum of narrow bands, or a thin, flat sheet.

Remarks. Stoloniferan polyps are often tall, and may be distinguished from the Telestacea by the complete absence of secondary polyps budded off from the primary polyp-wall. When a stoloniferan colony is membranous, it can often be distinguished from membranous Gorgonacea only by the absence of any division of the coenenchyme into distinct layers. In the membranous Gorgonacea the colonies have an outer, or cortical, layer containing the gastric cavities of the polyps and an inner, or medullar, layer set off from the former by (1) a zone of boundary canals; (2) spiculation distinctly different in form, color, or both; or (3) boundary canals and different spiculation.

Stoloniferans are not abundant in the West Indian region and I have never encountered them while collecting in reef habitats. The membranous forms usually met with on the reefs belong to the Gorgonacea (suborder Scleraxonia).

Two species of *Clavularia* have been reported from deep waters in the West Indies: *Clavularia tubaria* Wright & Studer, and *Clavularia bathybius* (Kent). POURTALÈS (1868) reported *Sarcodictyon rugosum* from deep water off Havana, but the type is lost and its identity remains unknown. VERRILL described a red, membranous form that he called *Anthopodium rubens*, found on old *Leptogorgia* axes in shallow water at Fort Macon, North Carolina, which DEICHMANN thought to be a stoloniferan. It has just been rediscovered, and seems to be an encrusting gorgonacean. For a discussion of these species, see DEICHMANN (1936, p. 32–37).

Order **TELESTACEA** Hickson, 1930

Diagnosis. Tall polyps, arising from stolons, produce daughter polyps from their lateral walls, thus forming colonies moderately branched to richly arborescent.

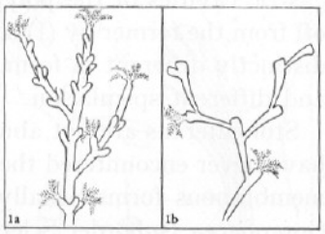
Remarks. This order contains two families distinguished by their manner of budding and colony formation, Telestidae and Pseudocladochonidae. Only Telestidae is known to occur in the Atlantic Ocean.

KEY 2

ILLUSTRATED KEY TO THE FAMILIES AND GENERA OF TELESTACEA

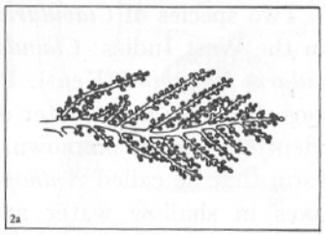
1a. Colonies monopodial, with tall axial and many short lateral polyps: Family TELESTIDAE 2

1b. Colonies sympodial, no dominant axial polyp: Family PSEUDOCLADOCHONIDAE, genus *Pseudocladochonus* (not represented in the Atlantic Ocean)



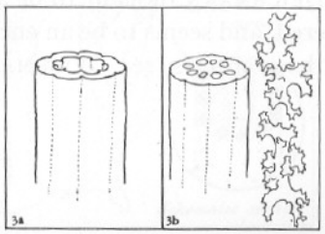
2a. Branching dense, pinnate in one plane: Genus *Coelogorgia* (not represented in the Atlantic Ocean)

2b. Branching loose and open, ordinarily not in one plane, but if so, not dense: 3



3a. Polyps without intrusion of spiculiferous tissue in lower part of gastric cavities; branching commonly beyond third order: Genus *Telesto*

3b. Polyps with spiculiferous mesogloea filling lower part of gastric cavities except for 8 longitudinal canals; branching not beyond third order: Genus *Telestula* (in deep water only)



Family **TELESTIDAE** Milne Edwards & Haime, 1857

Diagnosis. Monopodial colonies with a long axial polyp and shorter lateral polyps.

Remarks. Of the three genera referable to the Telestidae, only one is found in shallow waters of the Atlantic Ocean. The species are easily recognized by their delicate, aborescent colonies which are formed around a long axial polyp that acts as a main stem. It may be rigid because of the spicules in its body-wall, but it is always hollow and never shows any trace of the horny axial rod characteristic of the other arborescent octocorals of the West Indies.

The genus *Telestula* Madsen 1944, created for those species that have the lower part of the gastric cavities filled in with spiculiferous mesogloea except for eight longitudinal canals, occurs in the West Indies but only at considerable depths.

Genus **Telesto** Lamouroux, 1812

Telesto LAMOUROUX 1812, p. 185. (Type species, *Telesto aurantiaca* Lamx., by subsequent designation: MILNE EDWARDS & HAIME 1850, p. lxxvii.)
Telesto, LAMOUROUX 1816, p. 232.
Carijoa F. MÜLLER 1867, p. 330. (Type species, *Carijoa rupicola* Müller, by monotypy.)
Telesco GRAY 1869, p. 21. [Pro *Telesto* Lamx.]
Alexella GRAY 1869, p. 22. (Type species, *T.* (*Alexella*) *Smithii* Gray, by monotypy.)
Telesto, LAACKMANN 1908, p. 41.
Telesto, DEICHMANN 1936, p. 40.

Diagnosis. Colonies monopodial, arborescent; tall, cylindrical polyps arise from reticulating stolons; primary polyps bud off daughters directly from body walls, communicating by way of solenia; gastric cavities open to base of polyps.

Remarks. In my opinion, the western Atlantic species of *Telesto* actually belong in two genera. The first, including *T. riisei* and *T. operculata*, with elongate, often branching, rodlike, colorless sclerites in the body walls, and the anthocodial spicules in two series, septal and interseptal; and the second, including *T. sanguinea*, *T. flavula*, *T. fruticulosa*, and *T. nelleae*, with ovate, sometimes pebble-like bodies in the polyp walls, and the anthocodial sclerites in only one interseptal (i.e., tentacular) series. Unfortunately, it is not possible to divide the genus nomenclaturally because the type species of *Telesto* has not yet been sufficiently described to indicate its position. From LAMOUROUX's figure of *T. aurantiaca*, it seems logical to conclude that it belongs to the group including *T. sanguinea*, which means that *T. riisei* and related forms would be assigned to another genus for which F. MÜLLER's name *Carijoa* is available. According to GRAY's figure of *T.* (*Alexella*) *smithii*, his genus *Alexella* is probably synonymous with *Carijoa*.

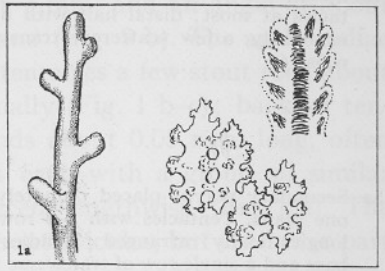
UTINOMI's description (1958) of *Paratelesto*, a new telestid genus from Japanese waters, reached my hands too late for inclusion in the foregoing key. This new genus is distinguished by the great thickening of the body wall of the axial polyps, which contains numerous solenia arranged in several rings, the restricted stolon which takes the form of an expanded base, the short lateral polyps set in spirals, and the rough, coarse protruding spicules set in 8 more or less chevroned double rows in the body walls. A specimen of the type species, *P. rosea* (Kinoshita), from Shirahama, Japan, presented to me by Dr. UTINOMI during a visit to the Seto Marine Biological Laboratory, shows that *Paratelesto* shares certain features in common with the *sanguinea*-group mentioned above but is clearly distinct in the singular development of the coenenchyme in the walls of the axial polyps.

Ecology. Species of *Telesto* may be found from the low-tide line down to great depths. They are not rare on rocky bottoms in moderate depths (5 to 50 fathoms), where they grow upon stones and shells. In shallow water they are commonly found growing upon dock pilings, buoys, and boat bottoms. So far as I know, *Telesto* (specifically, *T. riisei*) is the only octocoral that is a significant fouling organism (see Plate XII).

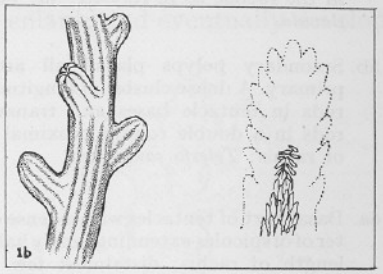
KEY 3

ILLUSTRATED KEY TO THE WEST INDIAN SPECIES OF *TELESTO*

1a. Body walls smooth or with very weak longitudinal grooves; spicules inseparably fused, forming rigid tubes. Pinnules with numerous spicules. Color, bright pink: *Telesto corallina*

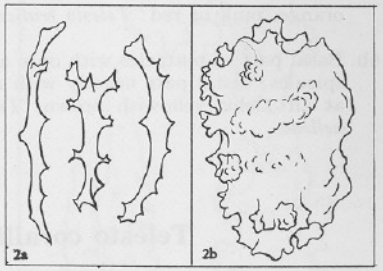


1b. Body walls with distinct longitudinal grooves; spicules fusing in small clumps but not inseparably uniting to form rigid tubes. Pinnules lacking spicules: 2



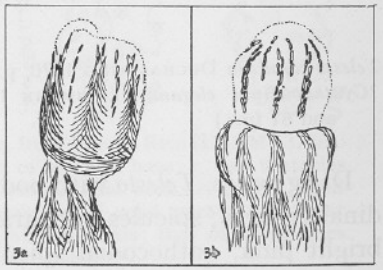
2a. Spicules of body walls in the form of elongate rods with spinose or branching processes: 3

2b. Spicules of body walls chiefly ovate forms with complicated tubercles, often with one side coarse and lumpy: 4



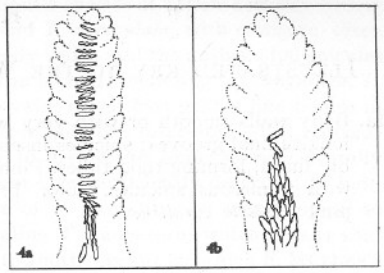
3a. Anthocodial spiculation forming an operculum consisting of transverse collaret and 8 points of flat rods 'en chevron': *Telesto operculata*

3b. Anthocodial spicules longitudinally arranged in sixteen narrow rows: eight on tentacle bases, and eight along septal insertions below the tentacles; not forming an operculum: *Telesto riisei*



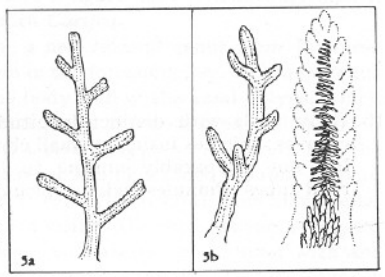
4a. Spicules extending the full length of tentacle rachis: 5

4b. Spicules in only proximal half of tentacles at most; distal half with none, or, rarely, a few scattered, transverse rods: 6



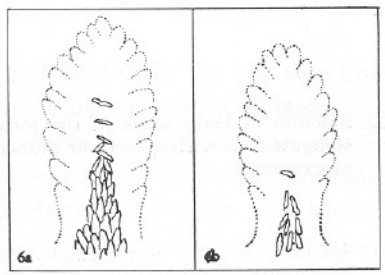
5a. Secondary polyps placed pinnately, in one plane. Tentacles with 2–3 rows of longitudinally arranged spindles at base and a single row of transverse rods in the rachis, as in Key fig. 4a: *Telesto flavula*

5b. Secondary polyps placed all around primary. A dense cluster of longitudinal rods in tentacle bases and transverse rods in a double row in proximal half of rachis: *Telesto sanguinea*



6a. Basal part of tentacles with a dense cluster of of spicules extending nearly half the length of rachis; distalmost few rods sometimes transverse. Color yellow, orange, pink or red: *Telesto fruticulosa*

6b. Basal part of tentacles with only a few spicules; distal part usually with none at all. Color yellowish brown: *Telesto nelleae*



1 **Telesto corallina** Duchassaing, 1870

(Figs. 1, 9 b)

Telesto corallina Duchassaing 1870, p. 19. (Guadeloupe, 300 ft.)
?*Cyathopodium elegans* Deichmann 1936, p. 38, pl. 2 figs. 1–4. (Barbados, 69 and 81 fms.)

Diagnosis. *Telesto* with body walls lacking conspicuous longitudinal grooves; spicules inseparably fused to form rigid tubes; color, bright pink, anthocodial spicules yellow or colorless.

Description. The body walls are filled with inseparably fused spicules (Fig. 1 f–g), forming solid tubes about 1 mm. in diameter. The axial polyps reach a height of about 50 mm. and bear short lateral polyps at intervals of about 7 mm. and an angle of about 45°, on all sides or more in one plane (Fig. 9 b). The anthocodiae are richly spiculate; at the base of tentacles a few stout rods about 0.15 mm. long, arranged longitudinally (Fig. 1 b–c); back of tentacles packed with tiny, prickly rods about 0.05 mm. long, often curved, placed crosswise; pinnules each with a group of similar but smaller (0.03 mm.) rodlets placed lengthwise (Fig. 1 a). The middle part of the neck-zone is without spicules, but the lower part contains sharply pointed, prickly spindles placed lengthwise (Fig. 1 d); proximad these soon begin to enlarge and eventually develop

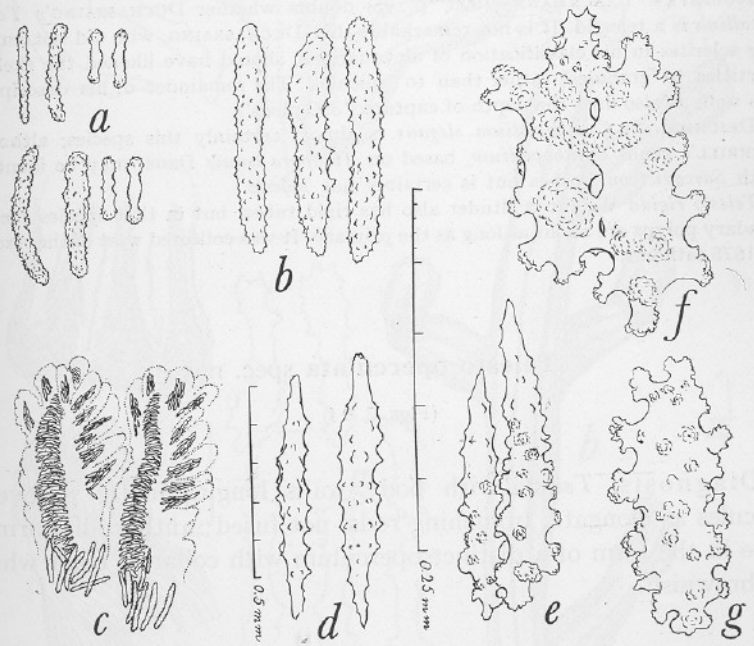


Figure 1. *Telesto corallina* Duchassaing, from Puerto Rico (USNM 43788): *a*, tentacular and pinnular rods; *b*, rods of tentacle base; *c*, two tentacles with spiculation; *d*, spindles from the anthocodial neck; *e*, partly fused spindles from calycular margin; *f–g*, spicules of solid part of calycular walls. (Enlargement of *c* indicated by 0.5 mm. scale; that of all spicules by the 0.25 mm. scale.)

into the warty, lobate bodies characteristic of the upper calyx; as soon as the spindles develop complicated tubercles they show signs of coalescence (Fig. 1 e), and not far below the margin of the calyces they reach so advanced a stage of fusion that the calyx is a solid tube. Color in alcohol usually bright red, occasionally pale pink; anthocodial spicules yellow or colorless.

Material. From off PUERTO RICO, 39–100 fms., Johnson-Smithsonian Expedition, 6 lots (USNM 43784–43788, 49508); BARBADOS, off Pelican Island, 80 fms., University of Iowa Barbados-Antigua Exp., 1 lot (USNM 49524).

Distribution. Puerto Rico to Barbados, 38–100 fathoms; probably occurs at moderate depths throughout the Antilles.

Remarks. LAACKMANN (1908, p. 95) doubts whether DUCHASSAING's *Telesto corallina* is a telestid. It is not remarkable that DUCHASSAING, who did not employ the sclerites in his classification of alcyonarians, should have likened the skeletal particles to 'granules' rather than to 'spicules.' The remainder of his description fits well, as also does the depth of capture ('300 pieds').

DEICHMANN's *Cyathopodium elegans* is almost certainly this species, although VERRILL's genus *Cyathopodium*, based on *Aulopora tenuis* Dana, may be identical with *Sarcodictyon* Forbes but is certainly not *Telesto*.

Telesto rigida Wright & Studer also has rigid tubes, but in that species the secondary polyps are about as long as the primary. It was collected west of the Azores in 1675 fathoms.

2 **Telesto operculata** spec. nov.

(Figs. 2, 9 f)

Diagnosis. *Telesto* with body walls longitudinally grooved; spicules as elongate, branching rods, not fused; anthocodial armature in the form of a distinct operculum with collaret; color white or brownish.

Description. Axial polyps about 75 mm. long and 1.5 mm. in diameter arise from membranous, encrusting stolons. Eight narrow, shallow, longitudinal grooves are visible throughout their length. Secondary polyps arise at wide intervals all around the primary

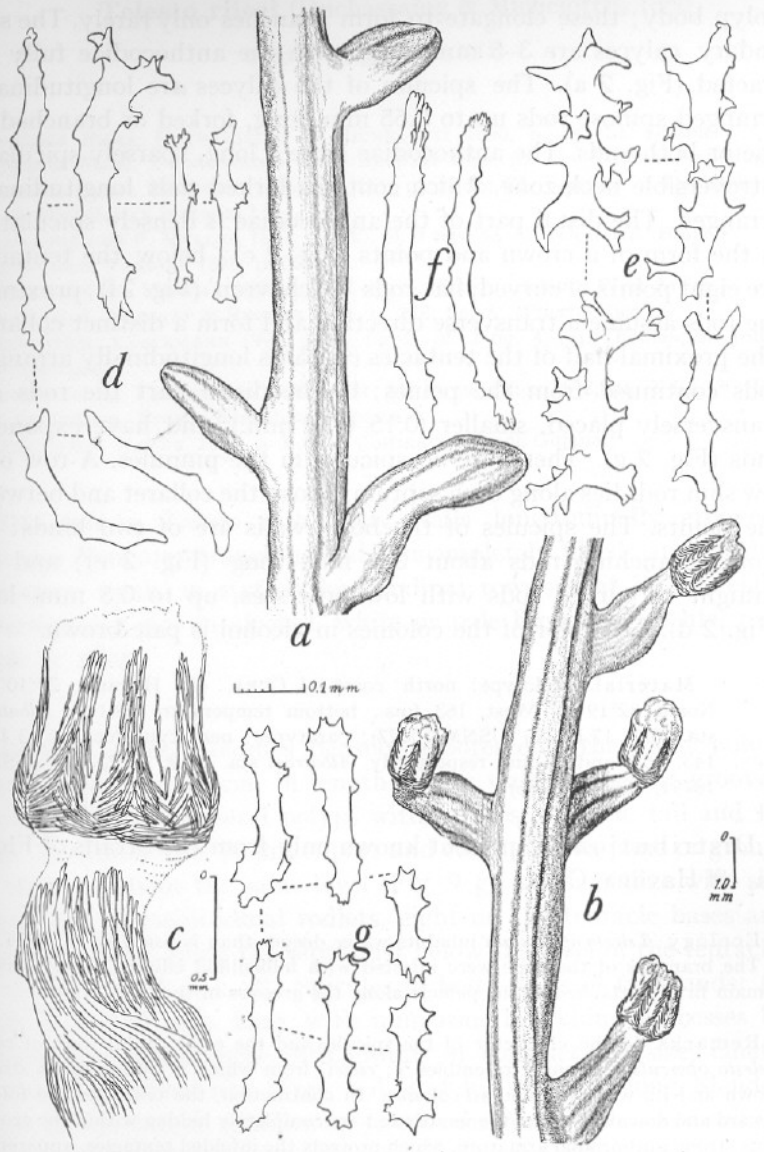


FIGURE 2. *Telesto operculata* spec. nov., the holotype from Cuba (USNM 10127): *a–b*, part of primary polyp with secondary polyps fully retracted and fully exsert; *c*, detail of exsert polyp showing crown; *d*, non-fusing spicules of body wall; *e*, occasionally fusing spicules of body wall; *f*, spicules from the points of the crown; *g*, spicules from the tentacles. (Enlargement of *a* and *b* indicated by 1.0 mm. scale at *b*; of *c*, indicated by adjacent 0.5 mm. scale; of all spicules, *d–g*, by 0.1 mm. scale above *g*.)

polyp body; these elongate to form branches only rarely. The secondary calyces are 3–5 mm. long with the anthocodiae fully retracted (Fig. 2 a). The spicules of the calyces are longitudinally arranged spinose rods up to 0.55 mm. long, forked or branched at one or both ends. The anthocodiae have a long, sparsely spiculate, introversible neck-zone, which contains forked rods longitudinally arranged. The distal part of the anthocodiae is densely spiculated, in the form of a crown and points (Fig. 2 c); below the tentacles are eight points of curved, flat rods 'en chevron' (Fig. 2 f); proximad the rods assume a transverse direction and form a distinct collaret. The proximal half of the tentacles contains longitudinally arranged rods continued from the points; in the distal part the rods are transversely placed, smaller (0.15–0.30 mm.), and have expanded ends (Fig. 2 g). There are no spicules in the pinnules. A row of a few slim rods lies along each septum, above the collaret and between the points. The spicules of the body walls are of two kinds: (1) stout, branching rods about 0.3 mm. long (Fig. 2 e); and (2) straight or curved rods with low processes, up to 0.5 mm. long (Fig. 2 d). The color of the colonies in alcohol is pale brown.

Material. Holotype: north coast of CUBA, off Havana, 23°10'51" North, 82°19'03" West, 163 fms., bottom temperature 79.1°F, *Albatross* sta. 2323, 17.I.1885 (USNM 10127); paratypes: near type locality, 3 lots, 143, 155, and 33 fms. respectively, *Albatross* sta. 2319, 2322, 2324 (USNM 10791, 10858, 10136).

Distribution. At present known only from the Straits of Florida, off Havana, Cuba.

Ecology. *Telesto operculata* inhabits water deeper than is usual for *T. riisei*. The branches of the type were infested with folliculinid ciliates, whose loricae remain firmly attached to the pellicle along the grooves in the body walls.

Remarks. In the character of the spicules and the eight septal rows of rods, *Telesto operculata* strongly resembles *T. riisei*, from which it differs in its strong crown and its weakly branched colonies. In contraction, the tentacles are folded inward and downward over the mouth and are completely hidden within the crown. This strong anthocodial armature, which protects the infolded tentacles, apparently lessens the need for speedy retraction since many of the anthocodiae are preserved exsert (Fig. 2 b), unlike the poorly armed species. However, the entire distal part of the anthocodia, including crown and infolded tentacles, can be completely withdrawn inside the calyx.

3 **Telesto riisei** (Duchassaing & Michelotti), 1860

(Figs. 3, 4, 9 g; Plate XII)

Clavularia Rusei DUCHASSAING & MICHELOTTI 1860, p. 34 (St. Thomas.)
Clavularia Riisei, DUCHASSAING & MICHELOTTI 1864, p. 23. [Emended spelling.]
Clavularia Rusei, KÖLLIKER 1865, p. 131, pl. 18 fig. 24. [Spicules of Duchassaing & Michelotti's material.]
Carijoa rupicola F. MÜLLER 1867, p. 330, pl. 9 figs. 56–67. (Desterro, Brazil.)
Telesto riisei, VERRILL 1870, p. 372.
?*Telesto africana* VERRILL 1870, p. 372, fig. 3. (Sherbro Island, West Africa.)
Telesto riisei, HARGITT & ROGERS 1901, p. 278, fig. A. (Puerto Rico.)
Telesto riisei, LAACKMANN 1909, p. 78, fig. C, pl. 3 fig. 4. (St. Thomas; St. John; Tortugas.)
Telesto rupicola, LAACKMANN 1909, p. 81, fig. D, pl. 2 figs. 1–2, pl. 3 fig. 3. (Rio de Janeiro, Brazil; Kingston, Jamaica.)
Telestro riisei, BAYER, 1959, p. 3. fig. 1 (Surinam, French Guiana.)

Diagnosis. *Telesto* with body walls longitudinally grooved; spicules elongate, branching rods, incompletely fused; anthocodial armature weak, in sixteen longitudinal rows, eight septal, eight interseptal. Color in alcohol, white or pale brownish; in life, pale pink or white.

Description. Colonies densely arborescent, the axial polyps often exceeding 30 cm. in length. Body wall with eight grooves, usually distinct. Lateral polyps with calyces 3–5 mm. tall and 1.5 mm. in diameter, 5–10 mm. apart and commonly in pairs or groups of three at about the same level (Fig. 9 g). Anthocodiae with sixteen rows of longitudinal rodlets, eight on the tentacle bases and the other eight along the septa just below the level of the tentacles (Figs. 3 a, b, f; 4 c, d). Spicules in body walls of two kinds: (1) rods 0.15–0.35 mm. long, with numerous branching processes by which they anastomose into groups of considerable size, chiefly in the longitudinal ribs (Figs. 3 d, g; 4 b, f); and (2) long, slender, more or less curved spindles up to 0.6 mm. long, with a few spinose processes but not fusing together (Figs. 3 c, e; 4 a, e), lying beneath the shorter, anastomosing spicules. Color in life, body walls flesh

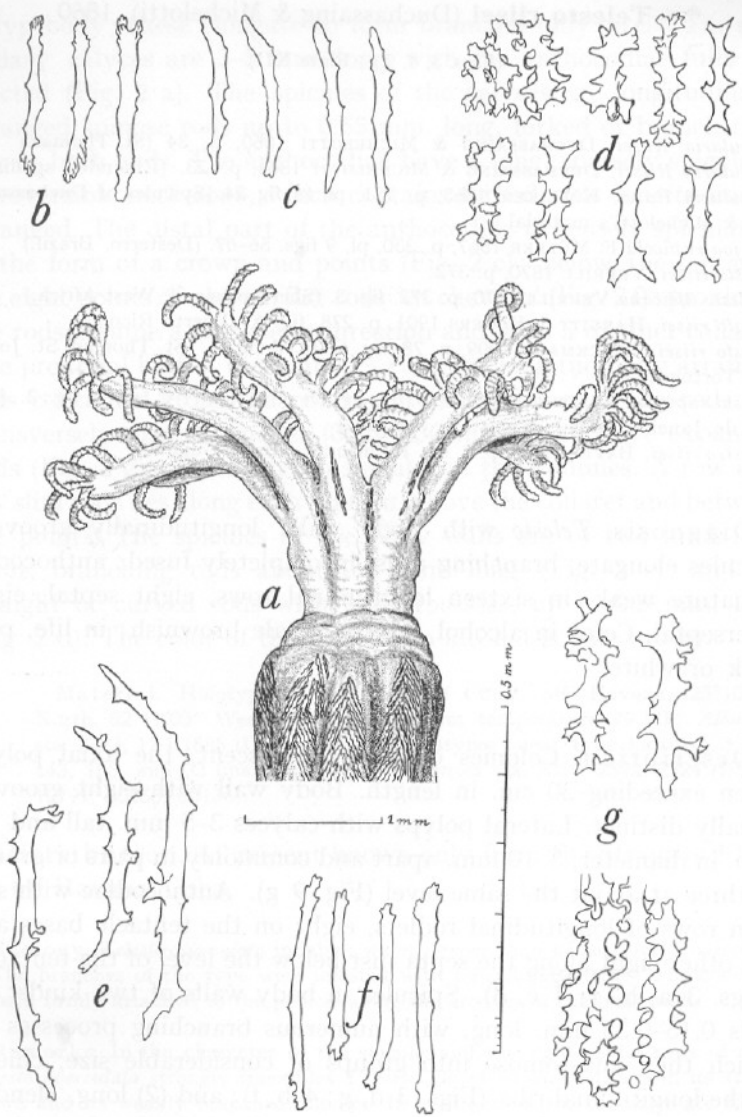


FIGURE 3. *Telesto riisei* (Duchassaing & Michelotti): *a*, polyp of a specimen from Florida (USNM 44066); *b*, anthocodial spicules of a specimen from Puerto Rico (50378); *c*, non-fusing spicules from body wall of same specimen; *d*, partially fusing spicules from body wall of same specimen; *e*, non-fusing spicules from body wall of a specimen from Curaçao (50374); *f*, anthocodial spicules of same specimen; *g*, partially fusing spicules of body wall of same specimen. (Enlargement of *a* indicated by 1 mm. scale; that of all spicules by 0.5 mm. scale at *g*.)

pink, anthocodiae white; in alcohol, all white or brownish, the anthocodiae usually a little darker than the body walls.

Material. Several specimens from Dr. Hummelinck's collection: ARUBA, wharf of Eagle Petroleum Company, on iron beam in open sea, depth 0–1.5 m., station 1302, 4.V.1955 (USNM 50375). CURAÇAO, Caracas Baai, on iron buoy, 10 m. or more deep, sta. 1334, J. S. Zaneveld, 9.II.1955 (USNM 50374, 51273, branches, dry and in alcohol). VENEZUELA, Guanta, on wooden piles in muddy area, 2 m deep, sta. 1202, 15.VIII.1936.

Also studied were the following lots in the collections of the U.S. National Museum: FLORIDA, off Palm Beach (50381); Biscayne Bay (44065–44067, 49691); Key West (50379); DRY TORTUGAS (50096); HISPANIOLA, Dominican Republic, Samana Bay (50380); PUERTO RICO (42146, 42151, 42596, 42597, 50378); JAMAICA, Kingston (7541); ST. LUCIA, near Marigot Bay (51410–51412); SURINAM (50838–50844); FRENCH GUIANA (50912); BRAZIL, Rio de Janeiro (50376), and Bahia (50377).

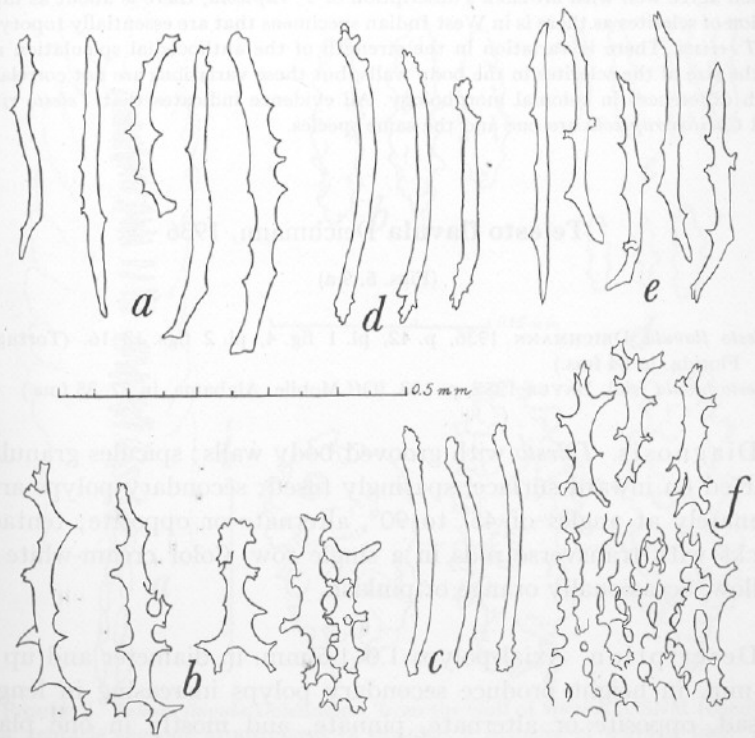


FIGURE 4. *Telesto riisei* (Duchassaing & Michelotti), spicules. *a–c*, of a specimen from Bahia, Brazil (USNM 50377): *a*, non-fusing spicules of body wall; *b*, partially fusing spicules of body wall; *c*, anthocodial spicules. *d–f*, of a specimen from Hispaniola (50380): *d*, anthocodial spicules; *e*, non-fusing spicules of the body wall; *f*, partially fusing spicules of the body wall. (All figures drawn to the same scale.)

Distribution. Palm Beach, Florida, to Brazil; low tide line down to about 30 fathoms.

Ecology. This abundant shallow-water species is often found growing in dense clusters just below the low tide line on dock pilings, often in company with the bryozoan *Zoobotryon pellucidum*. These two large fouling organisms supply shelter to an interesting community of invertebrates including the creeping ctenophore *Coeloplana*, flatworms, nemerteans, and crustaceans.

Remarks. I have gone over the specimens noted above, from widely separated localities extending from Florida to Brazil, and can find among them no justification for the separation of two species. In none of the specimens, regardless of locality, is a completely cohesive skeleton formed by inseparably fused spicules, as LAACKMANN (1908, p. 80) holds to be the case in *T. riisei:* "Die Spicula bilden in der ganzen Stammlänge ein zusammenhängendes Skelet. Längeres Kochen mit Kalilauge bringt keinen Zerfall der Scleriten hervor." In the Brazilian specimens, which agree well with MÜLLER's description of *T. rupicola*, there is about as much fusion of sclerites as there is in West Indian specimens that are essentially topotypes of *T. riisei*. There is variation in the strength of the anthocodial spiculation and in the size of the sclerites in the body walls, but these variations are not correlated with differences in colonial morphology. All evidence indicates that *Telesto riisei* and *Carijoa rupicola* are one and the same species.

4 **Telesto flavula** Deichmann, 1936

(Figs. 5, 9 a)

Telesto flavula DEICHMANN 1936, p. 42, pl. 1 fig. 4, pl. 2 figs. 13–16. (Tortugas, Florida, in 54 fms.)
Telesto favula [sic], BAYER 1952, p. 183. (Off Mobile, Alabama, in 27–35 fms.)

Diagnosis. *Telesto* with grooved body walls; spicules granular, warted on inward surface, sparingly fused; secondary polyps arise pinnately at angles of 45° to 90°, alternate or opposite; tentacle backs with transverse rods in a single row. Color cream-white or yellow, occasionally orange or pinkish.

Description. Axial polyps 1.0–1.5 mm. in diameter and up to 50 mm. in height produce secondary polyps increasing in length basad, opposite or alternate, pinnate, and mostly in one plane (Fig. 9 a). The secondaries originate at angles from 45° to 90°, and occasionally elongate into branches that bear tertiary polyps. All

body walls have eight narrow but distinct grooves. The anthocodiae are armed with a few rows of rods about 0.13 mm. in length, longitudinally arranged beneath each tentacle. A single row of transversely placed flat rods about 0.08 mm. long extends from base to tip of the tentacle-backs (Fig. 5 a, c). The neck-zone is weakly spiculated with flat rods about 0.05–0.07 mm. in length (Fig. 5 d). The body walls contain rugose, oval granules about 0.2 mm. long with tubercular sculpture on the inner surface (Fig. 5 e), among which very little fusion occurs. Color in alcohol, cream-white or yellowish, occasionally orange or pinkish; less brightly colored than *T. sanguinea* and *T. fruticulosa*.

Material. Eight lots, all from the northern GULF OF MEXICO in 27–35 fms. (USNM 10384, 10393, 10568, 10569, 10780, 10782, 50393, 50394).

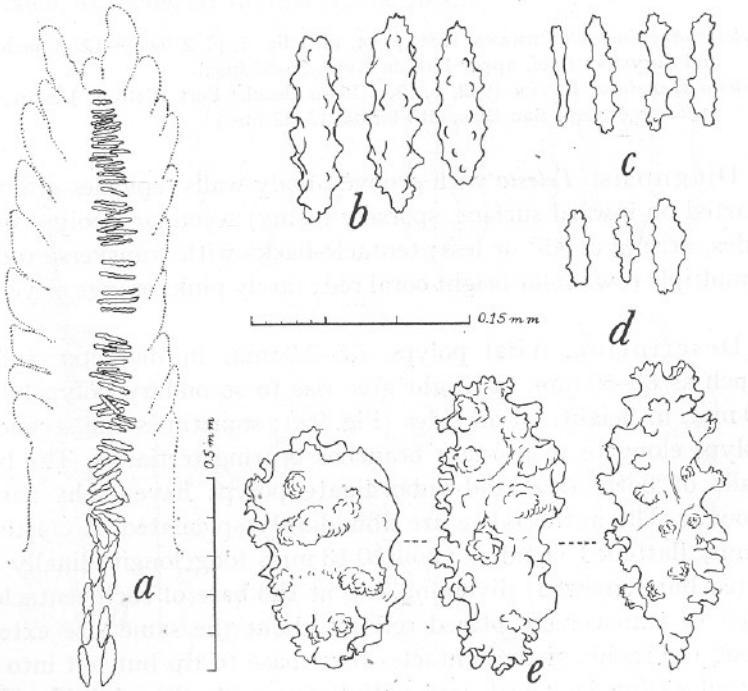


FIGURE 5. *Telesto flavula* Deichmann, from the Gulf of Mexico (USNM 10568): *a*, tentacle showing arrangement of spicules; *b*, spicules of tentacle base; *c*, spicules from tentacle rachis; *d*, spicules from anthocodial neck; *e*, spicules from body wall. (Enlargement of *a* indicated by adjacent 0.5 mm. scale; that of all spicules by 0.15 mm. scale to left of *d*.)

Distribution. Gulf of Mexico, Tortugas.

Ecology. On sandy ground where there is no solid material for support, *Telesto flavula* is sometimes found growing prone. Such specimens, without the usual attachment to rocks, might account for Bosc's *Telesto pelasgica*, although the green color reported for that species is difficult to explain. The unattached colonies were found together with free-living specimens of *Leptogorgia*.

Remarks. *Telesto flavula* is very similar to *T. sanguinea*, but differs in the following points: (1) pinnate arrangement of secondary polyps, which diverge at a wide angle; (2) fewer spicules in the sub-tentacular groups; (3) smaller, flat rods in one row in the tentacle-backs; and (4) weaker spiculation in the neck-zone.

5 **Telesto sanguinea** Deichmann, 1936

(Figs. 6, 9 e)

Telesto sanguinea Deichmann 1936, p. 41, pl. 1 fig. 3; pl. 2 figs. 9–12. (Conch Reef and Carysfort Reef, upper Florida Keys, 36–52 fms.)
Telesto sanguinea, Bayer 1952, p. 183. (Palm Beach; Fort Walton; Destin; Cape St. George; Cape San Blas, all Florida, 13–32 fms.)

Diagnosis. *Telesto* with grooved body walls; spicules granular, warted on inward surface, sparsely fusing; secondary polyps on all sides, arising at 45° or less; tentacle-backs with transverse rods in a multiple row. Color bright coral red; rarely pink, orange or yellow.

Description. Axial polyps 1.5–2.0 mm. in diameter and as much as 50–60 mm. in height give rise to secondary polyps about 10 mm. in height, on all sides (Fig. 9 e); sometimes the secondary polyps elongate to produce branches bearing tertiaries. The body walls of both axial and subordinate polyps have eight narrow grooves. The anthocodiae are abundantly spiculated: a cluster of blunt, flattened spindles about 0.13 mm. long longitudinally oriented but somewhat diverging, lies at the base of each tentacle; a tract of transversely placed rods of about the same size extends along the rachis of the tentacles from base to tip but not into the pinnules (Fig. 6 a); neck-zone with flat spindles (Fig. 6 d) like those of the tentacle bases but smaller, usually about 0.08 mm. long, arranged longitudinally in the polyp wall between the septa, increasing in abundance proximad. The sclerites of the body walls

(Fig. 6 e) are granular bodies about 0.2 mm. long, with one side sculptured with complicated tubercles; there are also some small rods with branched processes. A small degree of fusion occurs among the spicules of the body walls but not enough to produce rigid tubes. The color is bright coral red, rarely pink, orange, or yellow, in both fresh and preserved specimens.

Material. From the U.S. National Museum: South Carolina to north Florida, 4 lots (50356–50359); Palm Beach to Miami (49509, 49696, 49933, 50360, 50970); upper Florida Keys (14602, 50809); Tortugas area, 5 lots (50361–50365); northern Gulf of Mexico, 7 lots (43221, 44100, 44125, 49558, 49599, 50061, 50355).

Distribution. South Carolina to the Florida Keys and Gulf of Mexico, at moderate depths (13–60 fms.).

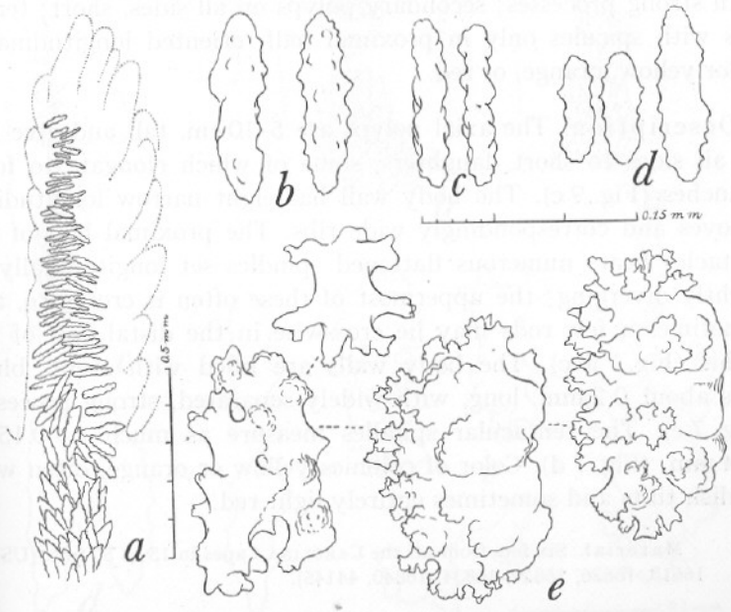


Figure 6. *Telesto sanguinea* Deichmann, from the Gulf of Mexico (USNM 43221): *a*, tentacle showing arrangement of spicules; *b*, spicules of tentacle base; *c*, spicules of tentacle rachis; *d*, spicules of anthocodial neck; *e*, spicules of body wall, occasionally fusing. (Enlargement of *a* indicated by adjacent 0.5 mm. scale; that of all spicules by 0.15 mm. scale below *c–d*.)

Remarks. *Telesto sanguinea* is closely allied to *T. flavula* Deichmann and *T. fruticulosa* Dana. *Telesto flavula* differs in its pinnate sequence of budding, and *T. fruticulosa* has a much reduced tentacular spiculation.

Telesto sanguinea is not rare at moderate depths from the southern tip of Florida to the Dry Tortugas and north to Apalachee Bay, where it is characteristically met with on coral rubble bottoms. It has not yet been discovered in the Antilles, where *T. corallina* replaces it.

6 **Telesto fruticulosa** Dana, 1846

(Figs. 7, 9 c)

Telesto fruticulosa Dana 1846, p. 632. (Charleston, South Carolina.)
Telesto fruticulosa, Laackmann 1909, p. 74, fig. B.
Telesto fructiculosa [sic], Deichmann 1936, p. 43, pl. 2 figs. 20–22. (Cape Fear, North Carolina.)

Diagnosis. *Telesto* with grooved body walls; spicules blunt rods with strong processes; secondary polyps on all sides, short; tentacles with spicules only in proximal half, oriented longitudinally. Color yellow, orange, or red.

Description. The axial polyps are 5–10 cm. tall and give rise on all sides to short daughters, some of which elongate to form branches (Fig. 9 c). The body wall has eight narrow longitudinal grooves and correspondingly wide ribs. The proximal half of the tentacles bears numerous flattened spindles set longitudinally or slightly diverging; the uppermost of these often is crosswise, and sometimes a few rods may lie crosswise in the distal half of the rachis (Fig. 7 a–c). The body walls are filled with stout, blunt rods about 0.2 mm. long, with widely separated, strong processes (Fig. 7 e). The tentacular spindles measure as much as 0.15 × 0.04 mm. (Fig. 7 d). Color of colonies yellow or orange, often with reddish tints and sometimes entirely light red.

Material. Six lots from off the Carolina Capes in 15 to 50 fms. (USNM 16613, 16826, 16829, 16834, 16840, 44145).

Distribution. Coast of the Carolinas.

Remarks. *Telesto fruticulosa* is the common telestid of the middle Atlantic coast of North America. It is recognized by the tentacular spiculation, which

usually extends only half the length of the rachis and is mostly longitudinal; and by the spicules of the body walls, which are not lumpy granules like those of *T. sanguinea*.

The colonies are commonly overgrown by a sponge that covers everything but the anthocodiae yet seems to do no damage. The sponge may, in turn, be infested with zoanthids.

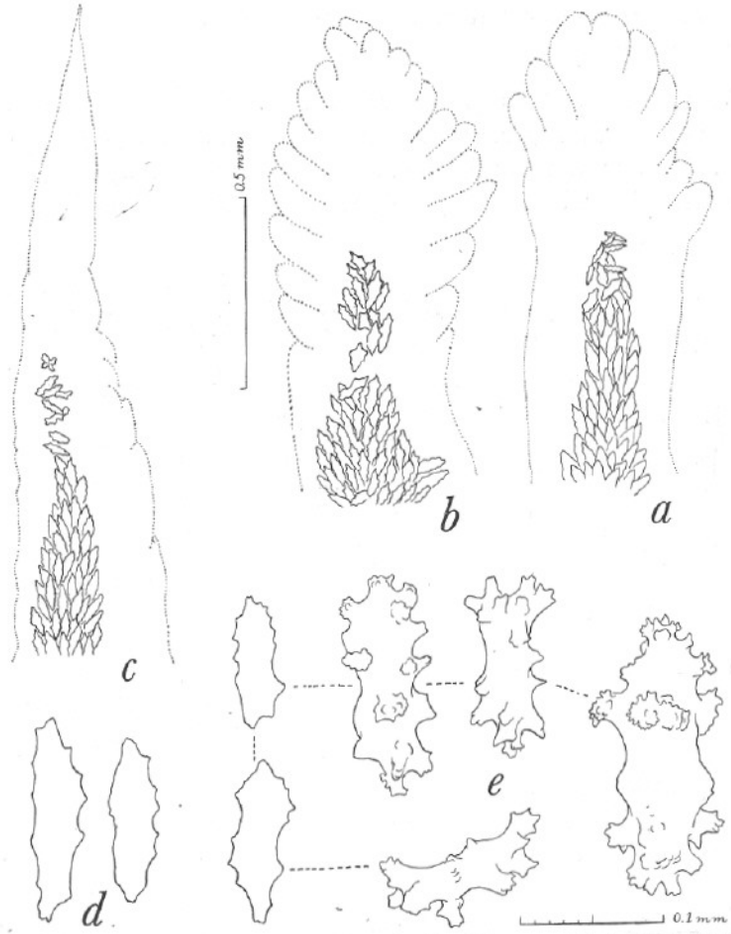


Figure 7. *Telesto fruticulosa* Dana, from the Carolina capes: *a*, tentacle (USNM 16829), showing arrangement of spicules; *b*, tentacle (16834); *c*, tentacle(16826); *d*, tentacular spicules of the same specimen; *e*, spicules from body wall of same specimen. (Enlargement of *a–c* indicated by 0.5 mm. scale adjacent to *b*; that of spicules by 0.1 mm. scale adjacent to *e*.)

7 **Telesto nelleae** spec. nov.

(Figs. 8, 9 d)

Diagnosis. *Telesto* with grooved body walls; spicules oval or rodlike, with complex tubercles, and small rods with branching projections; rachis of tentacles with no spicules at all, or a very few extending a short distance up from the basal cluster. Color, yellowish brown.

Description. Axial polyps about 2.0 mm. in diameter and up to 10 cm. in height give rise on all sides to secondary polyps 5 mm. tall and 3–5 mm. apart (Fig. 9 d). The secondaries may elongate to form branches with tertiary polyps. The body walls of the polyps

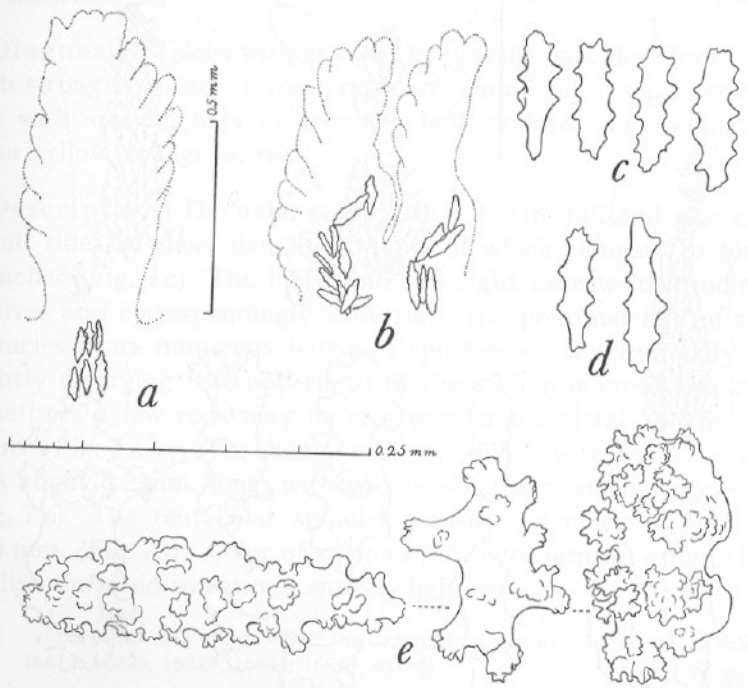


FIGURE 8. *Telesto nelleae* spec. nov. *a*, tentacle of specimen from Straits of Florida (USNM 17306), showing arrangement of spicules; *b*, tentacles from the holotype (50703), showing arrangement of spicules; *c*, tentacular spicules of the type; *d*, spicules from anthocodial neck, type; *e*, spicules of body wall, type. (Enlargement of *a–b* indicated by 0.5 mm. scale at *a*; that of all spicules by 0.25 mm. scale below *a*.)

of all orders have eight distinct, narrow grooves. The anthocodiae are weakly spiculated: a small cluster of perhaps ten flat rods 0.1 mm. long, longitudinally arranged, lies at the base of each tentacle; rachis with few or no spicules (Fig. 8 a–c); neck-zone with a few rods like those of the tentacles (Fig. 8 d). Body walls with elongate (up to 0.25 mm. long) or oval (up to 0.17 mm. long) bodies with complicated tubercles; and smaller rods with branching processes (Fig. 8 e). Color in alcohol, yellowish brown.

Material. Holotype: off Cape Hatteras, NORTH CAROLINA, 35°08′30″ North, 75°10′00″ West, 49 fms., *Albatross* sta. 2596, 17.X.1885 (USNM 507031). Paratypes: several colonies from the same station as the type (USNM 16816 ; and 1 lot from the Straits of Florida, off Havana, CUBA, 23°10′54″ North, 82°17′45″ West, 115 fms., *Albatross* sta. 2322, 17.I.1885 (USNM 10114). Other material: Two additional lots from the Straits of Florida (USNM 50704, 50705) and 7 from the vicinity of Cape Hatteras (USNM 8357, 8358, 8369, 8373, 16817, 16846, 17306).

Distribution. North Carolina to the Straits of Florida, 15 to 163 fathoms.

Remarks. Three old lots (USNM 8357, 8369, 8373) bear the label '*Telesto aurantiaca*' in VERRILL's handwriting, but they do not at all resemble the original figure of LAMOUROUX's Australian species.

Telesto nelleae is similar to *T. fruticulosa* but differs in having the tentacular spiculation reduced even further, in the form of the sclerites of the body walls, and in color.

Order **ALCYONACEA** Lamouroux, 1816 (emend. Verrill, 1866)

The order Alcyonacea, so well represented in the Indo-Pacific, is a minor element in the Atlantic fauna. In the West Indian region, with which we are at present concerned, there are no species of this order reaching up to the reef habitats of the immediately subtidal zone. A few species are found in relatively shallow water, and the present treatment is limited to them.

The alcyonaceans form massive or lobate colonies, occasionally arborescent, in which there is no solid axis or differentiated medulla, and in which the gastric cavities of many polyps reach to the base of the colony, thus attaining a length of several centimeters.

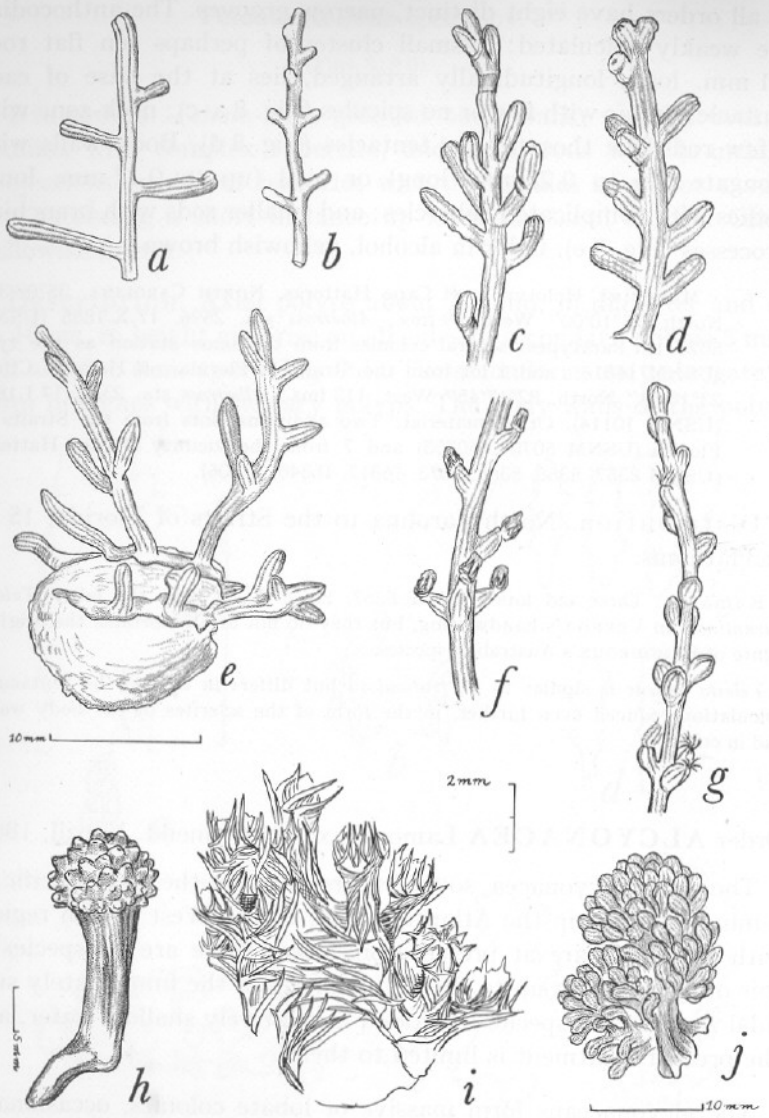


FIGURE 9. Colonies of Telestacea and Alcyonacea: *a*, *Telesto flavula* Deichmann (USNM 10568); *b*, *Telesto corallina* Duchassaing (43784); *c*, *Telesto fruticulosa* Dana (16829); *d*, *Telesto nelleae* spec. nov. (16816); *e*, *Telesto sanguinea* Deichmann (50360); *f*, *Telesto operculata* spec. nov. (10127); *g*, *Telesto riisei* (Duchassaing & Michelotti) (50378); *h*, *Nidalia occidentalis* Gray (49697); *i*, *Neospongodes portoricensis* (Hargitt) (7184); *j*, *Eunephthya nigra* (Pourtalès) (15916). (Enlargement of *a–g* indicated by 10 mm. scale at *e*; that of *h* by adjacent 5 mm. scale; that of *i* by 2 mm. scale; that of *j* by 10 mm. scale.)

Two species forming distinctive, clavate colonies (genus *Nidalia*) are found in moderately shoal water around Florida and in the West Indies, and four others of arborescent growth form (genera *Eunephthya* and *Neospongodes*) inhabit somewhat greater depths. Several more species occur in the deep littoral and coast abyssal zones, but no species of this order are subtidal in the warmer parts of the western Atlantic.

The three families representing the Alcyonacea in West Indian waters may be distinguished by the following key.

KEY 4

KEY TO THE WEST INDIAN FAMILIES OF ALCYONACEA

1a. Colonies arborescent, with polyps scattered or in clusters at the ends of branchlets. Polyps monomorphic: Family NEPHTHEIDAE

1b. Colonies lobate or digitate, with polyps uniformly distributed; or simple, divided into a polypiferous capitulum and a barren stalk: 2

2a. Colonies clavate, with a polypiferous capitulum and a long barren stalk. Polyps strictly monomorphic. Spicules large, colony rough and firm: Family NIDALIIDAE, subfamily Nidaliinae

2b. Colonies lobate or digitate; if simple, mushroom shaped and with a rather short stalk, always dimorphic, and of a somewhat soft or leathery consistency: Family ALCYONIIDAE

Family **ALCYONIIDAE** Lamouroux, 1812 (emend. May, 1899)

In this family the colonies may be lobate or digitate, but the branches are not finely divided as in Nephtheidae. The polyps are uniformly distributed over the lobes or on a discoidal capitulum, and may be of two kinds, autozooids and siphonozooids. The predominant type of spicule is the spindle.

The only alcyoniid genera inhabiting the warm western Atlantic are *Alcyonium* and *Anthomastus*, which occur only at considerable depths.

Family **NIDALIIDAE** Gray, 1869

Nidalidae GRAY 1869, p. 127.
Siphonogorgiacea KÖLLIKER 1875, p. 22.
Nidaliidae, UTINOMI 1958, p. 115.

Diagnosis. Colonies simple or divided into stiff, cylindrical branches. Surface rough, consistency of coenenchyme rigid and brittle, because of densely packed, large, tuberculate spindles. Always monomorphic, anthocodiae partially or completely retractile within bluntly conical verrucae projecting more or less conspicuously above the surface; anthocodial armature in the form of a crown and points.

Remarks. This family has recently been reestablished by UTINOMI (1958) to include the only alcyonacean commonly found at moderate depths in the West Indian region, and the arborescent forms, such as *Siphonogorgia*, of the tropical Indo-Pacific. The Nidaliidae consists of two subfamilies, the Nidaliinae with two genera (*Nidalia* Gray and *Agaricoides* Simpson) and the Siphonogorgiinae with possibly three (*Siphonogorgia* Kölliker, probably *Nephthyigorgia* Kükenthal, and perhaps *Dactylonephthya* Thomson & Simpson).

Genus **Nidalia** Gray, 1835

Nidalia GRAY 1835, p. 59. (Type species, *Nidalia occidentalis* Gray, by monotypy.)
Nidalia, DEICHMANN 1936, p. 55.
Nidalia, UTINOMI 1958, p. 101–119, *passim*.

Diagnosis. Colonies clavate ('torch-like;' UTINOMI), with a hemispherical polypiferous capitulum borne upon a long sterile stalk. Monomorphic, polyps withdrawing into tapered, subcylindrical or bluntly conical calyces. Coenenchyme rigid because of large, tuberculated spindles. Pharynx and introvert of polyps with oval platelets and small, flat scales.

Remarks. The club-shaped or torch-shaped colonies of *Nidalia* are immediately separable from the lower, mushroom-like *Anthomastus* by their firm consistency, prominent calyces, and monomorphic polyps. There are two species of *Nidalia* in the western Atlantic, only one of which has been found at all commonly in shallow water. They may be separated as follows:

KEY 5

KEY TO THE WESTERN ATLANTIC SPECIES OF NIDALIA

1a. Spindles slender, length about six times the diameter. Proximal part of introvert or neck-zone of polyps containing numerous flat scales with scalloped edges, and in addition many granulated platelets which abound also in the pharyngeal walls: *Nidalia occidentalis* Gray

1b. Spindles stout, coarse and often blunt, length only about four times the diameter, occasionally even less. Proximal part of introvert containing abundant platelets but few larger scales: *Nidalia rigida* Deichmann

8 **Nidalia occidentalis** Gray, 1835

(Figs. 9 h, 10 a–c)

Nidalia occidentalis GRAY 1835, p. 60. (Montserrat.)
Nidalia occidentalis, DEICHMANN 1936, p. 56, pl. 1 fig. 5; pl. 4 figs. 1–3. (Tortugas to Barbados, 38–170 fms.)
Nidalia occidentalis, UTINOMI 1958, p. 102, figs. 1–3. (Cape Canaveral, Fla.; Montserrat.)

Diagnosis. *Nidalia* with spindles having a diameter about one-sixth the length.

Material. USNM specimens: SOUTH CAROLINA. off Charleston (49676); FLORIDA, off Cape Canaveral, 7 spec. (50398); off Palm Beach, 9 spec. (49697, 49698); off Miami Beach 2 spec. (50158); off Sombrero Light (50397); DRY TORTUGAS (50396); in 20–170 fms.

Distribution. From South Carolina to Barbados, in 20 to 170 fathoms.

Remarks. The characteristic yellowish brown, clavate colonies of this species are a common constituent of shallow-water dredgings in the West Indian region.

Family **NEPHTHEIDAE** Gray, 1862 (emend. Utinomi, 1954)

In the Nephtheidae, the polyps, which are never dimorphic, are placed in clusters at the ends of the slender branches of predominantly arborescent colonies. This family, profusely abundant in the shallow waters of the Indo-Pacific, is not represented in the reef

habitat of the West Indies, and only sparsely so in greater depths. The two genera of the western Atlantic are separated by DEICHMANN (1936, p. 58) according to the following key.

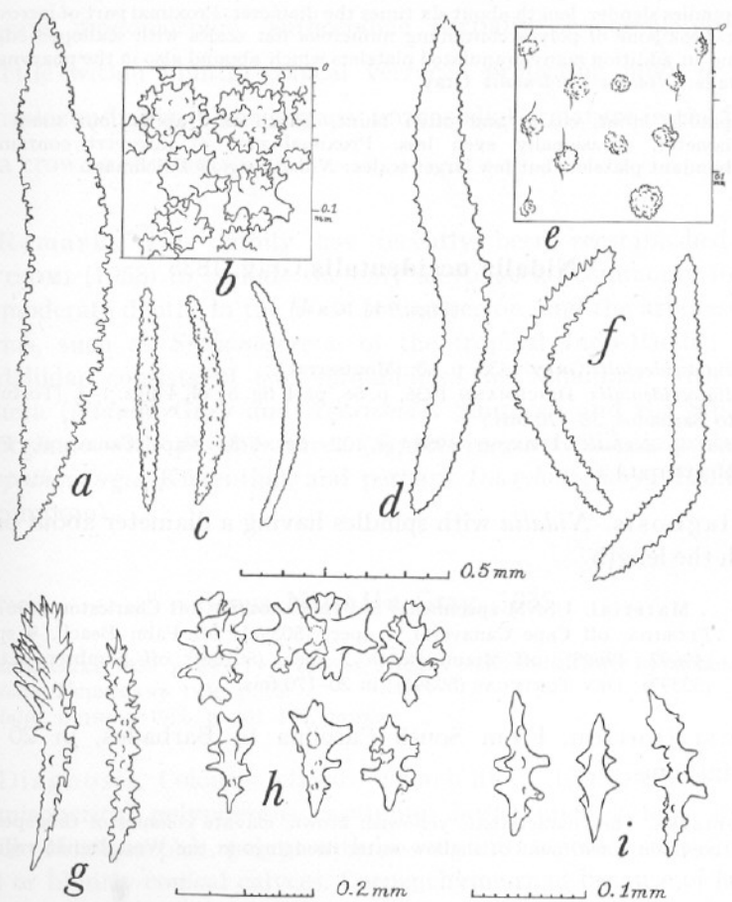


FIGURE 10. *Nidalia occidentalis* Gray, from Florida (USNM 50398): *a*, spindle of stalk; *b*, detail of ornamentation of spindle; *c*, anthocodial spindles. *Neospongodes portoricensis* (Hargitt), from Cuba (7184): *d*, spindle of stalk; *e*, detail of ornamentation of spindle; *f*, anthocodial spindles. *Eunephthya nigra* (Pourtalès), from Florida (15916): *g*, spicules from polyp walls; *h*, spicules from surface layer of stalk; *i*, spicules from interior of stalk. (Enlargement of *a*, *c*, *d*, and *f* indicated by 0.5 mm. scale between *c* and *d*; that of *b* and *e* by scales adjacent; that of *g* by 0.2 mm. scale adjacent; that of *h* and *i* by 0.1 mm. scale below *i*.)

KEY 6

KEY TO THE WESTERN ATLANTIC GENERA OF NEPHTHEIDAE

1a. Zooids in clusters or singly, without projecting bundles of spindles on their outer side: Genus *Eunephthya* Verrill.

1b. Zooids singly, with projecting bundles of spindles on their outer side: Genus *Neospongodes* Kükenthal

Genus **Eunephthya** Verrill, 1869

Eunephthya VERRILL 1869, p. 284. (Type species, *Nephthya thyrsoidea* Verrill 1865, by original designation.)
Eunephthya, DEICHMANN 1936, p. 59.

Diagnosis. Arborescent colonies with clusters of polyps at the branch ends; no bundles of supporting spicules on the outer side of the polyps.

Remarks. One species is fairly common at moderate depths in Florida waters, and may occur in the West Indies. Other species are found in the northern Pacific, the northern Atlantic, and South Africa.

9 **Eunephthya nigra** (Pourtalès), 1868

(Figs. 9 j, 10 g–i)

Nephthya nigra POURTALÈS 1868, p. 130. (Sand Key, Florida, 120 fms.)
Eunephthya nigra, DEICHMANN 1936, p. 60, pl. 1 fig. 7; pl. 4 figs. 5–13; pl. 27 figs. 1–2. (Florida Keys, 98–130 fms.)

Diagnosis. Colonies with a short stalk and compact, rounded clusters of polyps. Spicules of the polyps chiefly rods with simple projections, and bent clubs with foliate heads. Color, sepia brown or slaty gray, the polyps with eight pale bands where the longitudinally disposed spicules show through the epidermis.

Material. Off GEORGIA, 276–440 fms., 168 specimens (USNM 10506, 10543, 10813, 17045); FLORIDA, off Daytona, 438 fms., 20 spec. (USNM 14607, 15916); off Miami, 150 fms. (USNM 50157).

Distribution. Off southern Georgia to the Florida Keys, in 150 to 440 fathoms; not yet reported from the West Indies proper.

Genus **Neospongodes** Kükenthal, 1903

Neospongodes KÜKENTHAL 1903, p. 273. (Type species, *Neospongodes atlantica* Kükenthal, by subsequent designation: DEICHMANN, 1936.)
Neospongodes, DEICHMANN 1936, p. 66.

Diagnosis. Colonies arborescent; polyps in clusters or scattered on the terminal branches, supported by a group of stout spicules ('Stützbündel') on the abaxial side.

Remarks. Five species have been described in the western Atlantic, two of them off Brazil and three in the West Indies proper. Of these five, two, *Neospongodes agassizii* Deichmann and *N. caribaea* Deichmann, belong to the genus *Siphonogorgia*, not previously reported in the western Atlantic, and hence to the foregoing family. Only one true nephtheid seems to be at all common in the Caribbean area.

10 **Neospongodes portoricensis** (Hargitt), 1901

(Figs. 9 i, 10 d–f)

Spongodes portoricensis Hargitt 1901, in: Hargitt & Rogers, p. 279, fig. B. (Porto Rico, 75–76 fms.)

Neospongodes portoricensis, Deichmann 1936, p. 67, pl. 1 fig. 10; pl. 27 figs. 3–12. (St. Croix to Barbados, 56–264 fms.)

Diagnosis. A number of stubby branches arise from a stout stalk. Polyps tall and curved inward, supported by a group of stout, converging spindles that project little if at all. Operculum consisting of eight usually unequal pairs of bent spindles, and a few accessory rods. Color of colonies creamy white in alcohol; spicules colorless.

Material. Cuba, off Havana, 122 fms. (USNM 7184); off the north coast of Puerto Rico, 80–120 fms. (USNM 50399).

Distribution. Straits of Florida to Barbados (and possibly Brazil), in 38 to 278 fathoms.

Order **GORGONACEA** Lamouroux, 1816 (emend. Verrill, 1866)

Diagnosis. Polyps with uniformly short gastric cavities. An axial structure of some kind always present; either a dense, horny or calcareous central cylinder, or a medullar zone of spicules bound together more tightly than those of the cortex. Medullar spicules usually of different form, and sometimes different color, from those of cortex.

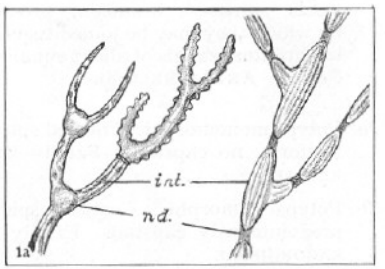
Distribution. Marine waters from Arctic to Antarctic; low tide line to the abyssal.

Key 7

Illustrated key to the families of Gorgonacea

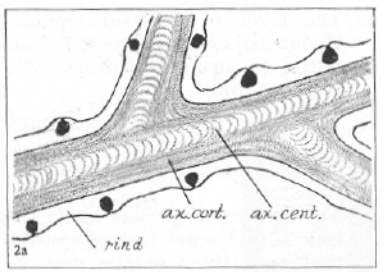
1a. The axis is composed of alternating horny and calcareous joints: 16

1b. The axis is not jointed: 2



2a. Axis with a soft, cross-chambered central core: 8

2b. Axis without a cross-chambered central cofe: 3

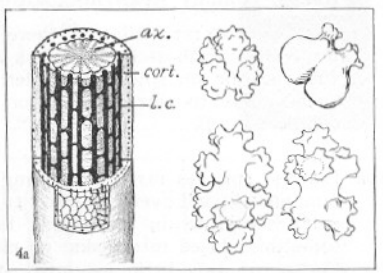


3a. The axis is a spicular medulla, in one family rigidly calcareous: 4

3b. The axis is a calcified but more or less flexible horny rod with a solid core: 12

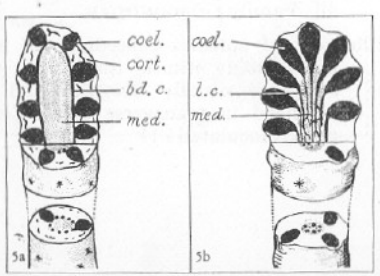
4a. The axis is solidly calcareous; cortical spicules chiefly capstans with 6, 7, or 8 rays, sometimes modified into double clubs: Family Coralliidae

4b. The axis is a medulla containing separable spicules: 5



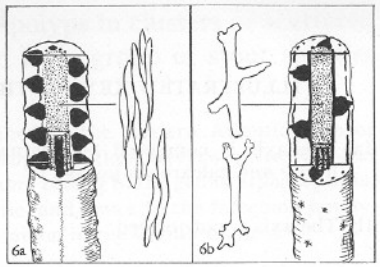
5a. The medulla is separated from the cortex by a ring of longitudinal boundary canals; no gastrodermal canals in medulla: 6

5b. No ring of boundary canals separating medulla from cortex; gastrodermal canals perforate the medulla: 7



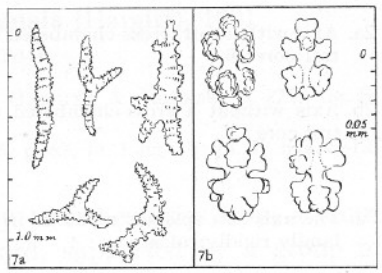
6a. Medullar spicules smooth and anastomosing. Two larger longitudinal canals on opposite sides of the branches: Family SUBERGORGIIDAE

6b. Medullar spicules ornamented with warts, spines or branching processes by which they may be joined together; longitudinal canals of about equal size: Family ANTHOTHELIDAE



7a. Polyps monomorphic. Cortical spicules fusiform, no capstans: Family BRIAREIDAE.

7b. Polyps dimorphic. Cortical spicules predominantly capstans: Family PARAGORGIIDAE

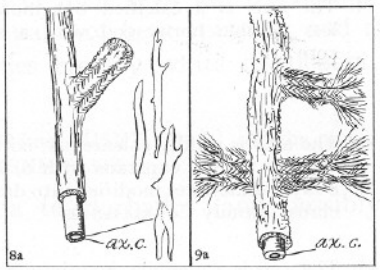


8a. The layer of axis surrounding the chambered core is composed of smooth flattened, fusiform spicules: Family KEROEIDIDAE

8b. The layer of axis surrounding the chambered core never contains calcareous material in spicular form: 9

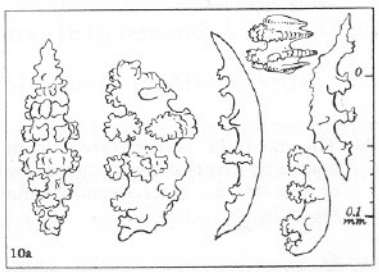
9a. The anthosteles project stiffly; polyps lack a neck-zone free of spicules, so that only the tentacles may be retracted: Family ACANTHOGORGIIDAE

9b. Anthocodiae retractile; if there are projecting anthosteles, a neck-zone with few or no spicules enables the anthocodiae to retract more or less completely: 10

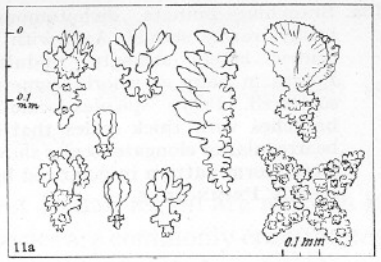


10a. Longest spicules rarely exceeding 0.2 mm., usually not over 0.15 mm.; tubercular sculpture in transverse belts, sometimes fused into disks; no clubs. Cortex of axis little loculated if at all: Family GORGONIIDAE.

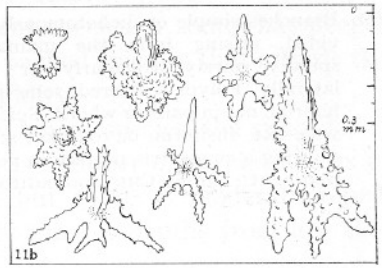
10b. Longest spicules exceeding 0.2 mm., often many times that size, with sculpture usually irregular and not arranged in transverse belts. Cortex of axis loculated: 11



11a. Spicules almost always including clubs of various kind; if clubs absent, the typical sclerites are 4-rayed 'butterflies', or large spindles often with spines on the outer surface. Crown usually weak and irregular. Branches usually stout: Family PLEXAURIDAE

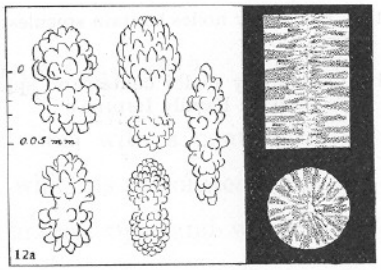


11b. Spicules including thornscales, stars, rosettes, foliate spindles, large plates or spindles, but no clubs. Crown strong, forming 8 regular points over a distinct transverse collaret. Branches usually slender; Family PARAMURICEIDAE



12a. Spicules as characteristic double heads or clubs. Axis calcification radially oriented: Family ELLISELLIDAE

12b. Spicules as minute corpuscles, large scales, or spindles. Axis calcification not radially oriented: 13

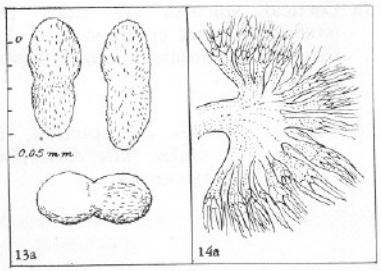


13a. Spicules as minute, discoidal or bidiscoidal corpuscles 0.025 to 0.07 mm. in greatest diameter: Family IFALUKELLIDAE

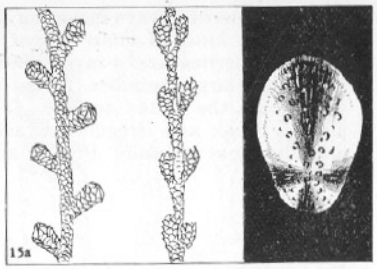
13b. Spicules as large scales or spindles: 14

14a. Polyps united by their bases to form polyp-leaves disposed biserially along unbranched stems. Spicules as scales: Family AINIGMAPTILIDAE

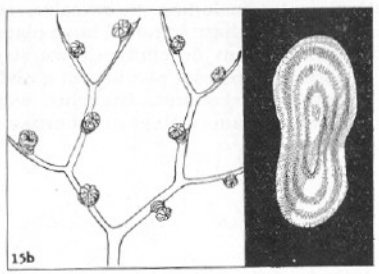
14b. Polyps isolated or in whorls, never united to form polyp-leaves: 15



15a. Branching pinnate, dichotomous or bushy, rarely simple. Axis with concentric layers strongly undulated. Polyps in pairs or whorls, sometimes scattered. Polyp spicules scale-like; branches with thick scales that may be irregular or elongate; scales showing a cruciform pattern in polarized light: Family PRIMNOIDAE

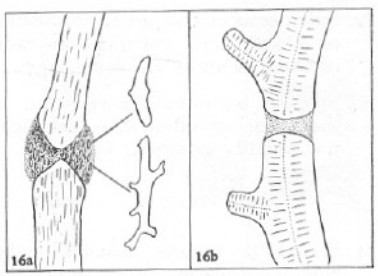


15b. Branches simple or dichotomously divided, arising from the mainstem spirally, rarely irregularly or unilaterally. Polyps scattered, sometimes biserial, not in pairs or whorls. Spicules scale-like, fusiform, or rod-like; scales showing a concentric pattern in polarized light: Family CHRYSOGORGIIDAE



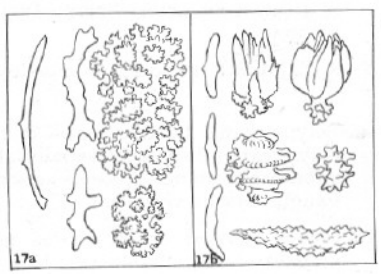
16a. The horny nodes contain spicules: 17

16b. The horny nodes contain no spicules whatever: Family ISIDIDAE



17a. Cortical spicules are thick plates (stellate in their young stages) closely fitted as in mosaic: Family PARISIDIDAE

17b. Cortical spicules are spindles, disk-spindles or clubs, not flat plates: Family MELITHAEIDAE



Suborder *SCLERAXONIA* Studer, 1887

Diagnosis. Gorgonaceans with axial structure composed of spicules, either free or inseparably fused.

Remarks. The waters of the West Indian region are not rich in scleraxonians, of which only three species are commonly encountered in reef habitats; they are readily recognized by their encrusting or lobate colonial form. The arborescent species of somewhat deeper water have a central axis of closely packed spicules that affords the colonies a considerable degree of rigidity.

Distribution. Except for a few boreal species, the suborder is limited to warm waters. The greatest number of species occurs in the East Indies and Philippines, but there is moderate representation in the West Indies. They inhabit depths from low tide to the abyssal.

Family **BRIAREIDAE** Gray, 1859

Diagnosis. Monomorphic Scleraxonia with a continuous medulla containing separable spicules, which is perforated by gastrodermal canals all the way to the branch tips, and which is not separated from the cortex by a ring of boundary canals.

Distribution. Tropical western Atlantic; Indo-Pacific.

Genus **Briareum** Blainville, 1830

Briareum BLAINVILLE 1830, *6o*, p. 484. (Type species, *Briareum gorgonoideum* Blainville = *Briareum asbestinum* (Pallas), by monotypy.)
Asbestia NARDO 1845, p. 106. (Type species, *Asbestia asbestina* (Pallas), by monotypy.)
Solenopodium KÜKENTHAL 1916a, p. 174. (Type species, *Solenopodium stechei* (Kükenthal), by subsequent designation: KÜKENTHAL 1916b, p. 468).
Briareum, KÜKENTHAL 1919, p. 45.
Briareum, DEICHMANN 1936, p. 79.

Diagnosis. Briareids with large, tuberculate spindles and three-armed bodies.

Remarks. The phylogenetic position of this genus has long been the subject of debate. The most recent, as well as the most thorough, investigation of the matter is that of VERSEVELDT (1940, p. 9), but I believe that his conclusion regarding the relationship of *Briareum* remains open to question because of certain points of interpretation. Consequently, the usual arrangement of the genus among the Gorgonacea is retained, at least for the present.

I can find no reason for retaining the Pacific species of *Solenopodium* in a separate genus. Moreover, KÜKENTHAL's *Erythropodium marquesarum* undoubtedly came from the Atlantic rather than the Pacific Marquesas and therefore belongs also to *Briareum*. This view is borne out by the fact that KÜKENTHAL described from the same collection (KÖLLIKER's, in Munich) a *Eunicella marquesarum*, which is nothing more than the common West Indian *Plexaura flexuosa*.

11 **Briareum asbestinum** (Pallas), 1766

(Fig. 11)

Alcyonium asbestinum PALLAS 1766, p. 344. (Mare Americanum.)
Briareum gorgonoideum BLAINVILLE 1830, *6o*, p. 484.
not *Alcyonium gorgonoides* ELLIS & SOLANDER 1786, p. 181, p. 9 figs. 1–2. [A zoanthid.]
Ammothea polyanthes DUCHASSAING & MICHELOTTI 1860, p. 15, pl. 1 fig. 6 (St. Thomas.)
Erythropodium marquesarum KÜKENTHAL 1916a, p. 173. [Nomen nudum.]
Briareum asbestinum, KÜKENTHAL 1916b, p. 469, figs. F–H, pl. 23 fig. 2. (Florida; Tortugas; Haiti; St. Thomas.)
Erythropodium marquesarum KÜKENTHAL 1919, p. 34, fihs. 1–7. (Marquesas-Inseln in 22–37 m Tiefe.)
Erythropodium polyanthes, DEICHMANN 1936, p. 77, pl. 5 fig. 23. (St. Thomas; type material.)
Briareum asbestinum, DEICHMANN 1936, p. 79, pl. 5 figs. 1–2. (Carysfort Reef, Florida.)
Briareum asbestinum, VERSEVELDT 1940, p. 9, figs. 2–4.

Diagnosis. As for the genus.

Material. In Dr. Hummelinck's collection the species is represented from ST. BARTHÉLEMY, island of La Fourche, on rock debris at 2 m., sta. 1124, 2. VI. 1949, 2 dry colonies, 1 in alcohol (USNM 50400, 51314). Found by Dr. J. H. Stock at ST. EUSTATIUS, Gallows Bay, 11. II. 1959, dried piece (Amsterdam).

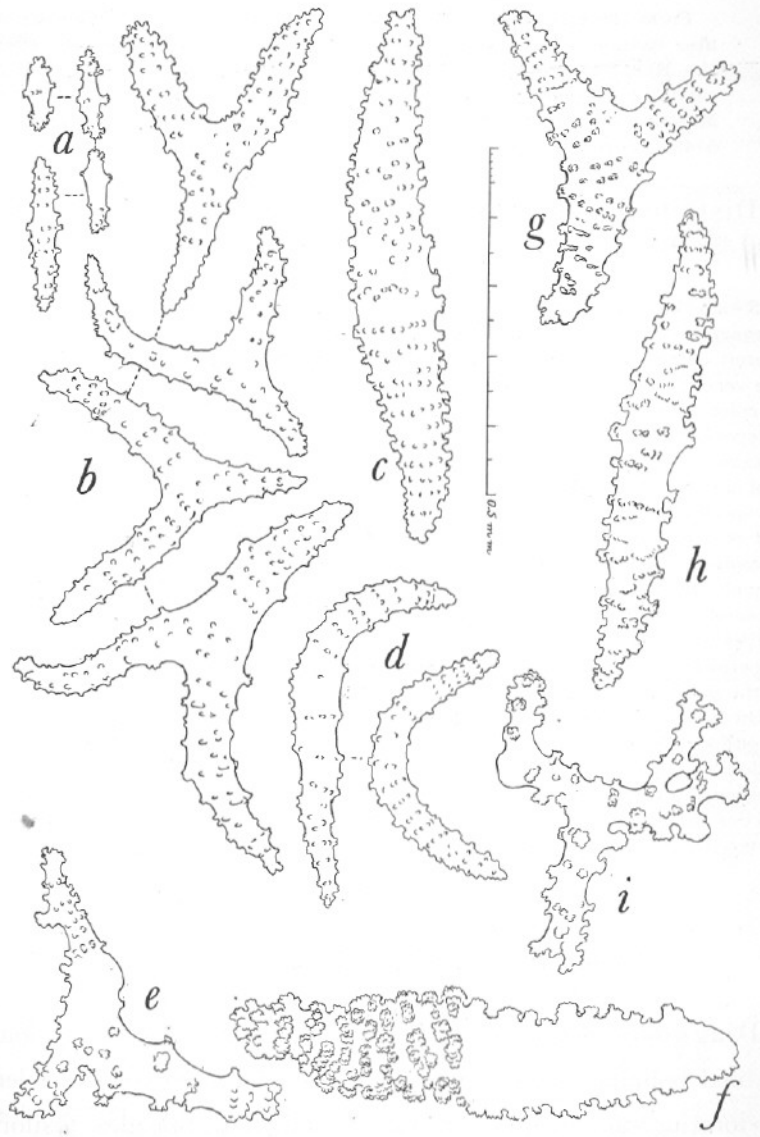


FIGURE 11. *Briareum asbestinum* (Pallas). *a–f*, spicules of a specimen from St. Barts (USNM 50400): *a*, stubby rods of outer layer; *b*, colorless tripods of outer layer; *c*, white spindles of outer layer; *d*, curved white spindles of outer layer; *e*, purple tripod of inner layer; *f*, purple spindle of inner layer (sculpture partially shown). *g–i*, spicules of one of the original specimens of *Ammothea polyanthes* from St. Thomas (Leiden Museum): *g*, colorless tripod of outer layer; *h*, colorless spindle of outer layer; *i*, purple tripod of inner layer. (All figures drawn to the same scale.)