STUDIES ON THE FAUNA OF CURAÇAO AND OTHER CARIBBEAN ISLANDS: No. 137.

POLYPLACOPHORA OF THE CARIBBEAN REGION

by

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INTRODUCTION

The present monograph has been drawn up chiefly from material collected by Dr. P. WAGENAAR HUMMELINCK, secretary of the Foundation for Scientific Research in Surinam and the Netherlands Antilles, during his trips to the Caribbean in 1936/37, 1948/49, 1955, 1963, and 1967. This collection comprises about 1500 specimens of Polyplacophora belonging to 21 species, among which 4 are new to science.

As up till now no comprehensive work on the chitons of the Caribbean area has been published the author made it his task not only to draw up a report on specimens collected by Dr. HUMMELINCK but also to give a general review of all the species of Polyplacophora occurring in the Caribbean Province.

FISCHER, FORBES, a.o. included in their so- called Caribbean Province the area bordered by the North-, Central-, and South-American mainland from Jupiter Inlet, Florida, to the mouth of the river Orinoco in Venezuela, and the chain of Bahamas and Antillean Islands.

It is, of course, difficult to define the limits of zoogeographic areas. Especially the North of the Atlantic coast of Florida forms a transition between the Carolinian Province and the Caribbean. The author, therefore, took into consideration the whole of the Florida coast as far North as Fernandina, and also the Bermudas, where the fauna closely resembles that of the West Indies, evidently as a result of being washed by the Gulf Stream.

In the Caribbean Area thus defined 34 species of Polyplacophora have been met with, representing all of the six families into which the subclass is divided. Most species live in the tidal zone, clinging to rocks and debris, feeding on algae, which they rub off by means of their radulas. Only three species, belonging to the Lepidopleuridae, are found at great depths.

As many as 32 out of the 34 known Caribbean species could be examined by the author. Two species are chiefly boreal in their distribution, five others also occur in more southern tropical regions, two species were also recorded from the Pacific, but those records still need confirmation (Table 1).

In the Netherlands Antilles 21 species have been found with certainty (Table 2).

Materials

Besides the material collected by Wagenaar Hummelinck, and the specimens from the private collection of Mr. A. N. Ch. ten Broek and the author, large series of Caribbean Polyplacophora in the Rijksmuseum van Natuurlijke Historie, Leiden, and in the Zoölogisch Museum, Amsterdam, were studied. The author hereby expresses his thanks to Dr. C. O. van Regteren Altena and to Dr. W. S. S. van der Feen, née van Benthem Jutting, for entrusting to him material in their charge from the Leiden and Amsterdam museums respectively.

The author is also greatly indebted to Dr. W. J. Kuenzi of the Zoologisches Museum at Bern, who granted him the loan of many types and other specimens from the Shuttleworth Collection; to the late Dr. G. L. Wilkins of the British Museum (Natural History), London, who enabled him to study several types and other specimens from the famous Museum H. Cuming; to Dr. Clyde F. E. Roper, National Museum of Natural History, Smithsonian Institution, Washington, D.C., and to Dr. W. D. Hartman, Yale-Peabody Museum, New Haven, Connecticut, who were kind enough to send valuable type specimens of rare deep water species on loan.

Dr. W. J. Clench of the Museum of Comparative Zoology at Harvard College, Cambridge, Massachusetts, Dr. H. de Souza Lopes of the Instituto Oswaldo Cruz, Rio de Janeiro, Mr. A. Koto and Miss A. S. Koto of Beloit, Wisconsin, private collectors, were so kind as to contribute interesting specimens which were gratefully received by the author. Mrs. J. H. Beerman, née Paul, a passionate collector in Aruba, and Mr. Kees M. de Jong, who collected several fine specimens in Curaçao, put the author under an obligation by affording him the opportunity to study series of chitons from their private collections.

Dr. G. Ranson of the Laboratoire de Malacologie in Paris gave his much valued help by sending photographs of type specimens and providing data about other

specimens. Dr. E. LELOUP of the Institution Royal des Sciences Naturelles de Belgique, in Bruxelles, was kind enough to enable the author to study type-specimens in the collection of the Institution. Prof. dr. H. BOSCHMA's kind intermediation made it possible to illustrate the present monograph with some fine drawings by Mr. H. HEYN, then one of the artists of the Rijksmuseum van Natuurlijke Historie at Leiden.

Most photographs were taken by Mr. H. VAN KOOTEN and his staff at the Zoological Laboratory of the State University, Utrecht. The other pictures were obtained by courtesy of the Palaeontological Laboratory of Shell Company, The Hague (IV 5, 6; V 4–7; VI 1–4; VII 2) and the Laboratoire de Malacologie, Paris (VI 7, 8).

Finally the author wants to express his gratitude for the continuous encouragement and support he received from Dr. P. WAGENAAR HUMMELINCK whose vast knowledge of the Antillean faunas has put its stamp on the present paper.

HISTORICAL REVIEW

In the 10th edition of his "Systema Naturae" (1758) LINNAEUS described four species of *Chiton*, placing them with the other Mollusca among the Vermes. Only one of these species, *Chiton tuberculatus* from the West-Indies, is recognizable and has been selected as the type of the genus. In the "Museum Ulricae" (1764) LINNAEUS described a second West-Indian species, *Chiton squamosus*.

In 1784 J. H. CHEMNITZ published a treatise "Von einem Geschlechte vielschalichter Conchylien mit sichtbaren Gelenken," in which ten species of Polyplacophora were described. One year later, in the eighth volume of Martini's "Conchyliencabinet" CHEMNITZ even described 20 species, accompanied by rather good illustrations. CHEMNITZ, who had many specimens from St. Croix and St. Thomas, listed in his treatise the following Caribbean species:

Chiton laevis variegatus = *C. marmoratus* Gmelin
Chiton marmoreus ab insula St. Thomas = *C. marmoratus* Gmelin
Chiton scaber variegatus = *C. squamosus* Linnaeus
Chiton squamosus ex Museo Spengleriano = *C. tuberculatus* Linnaeus

and in vol. 8 of the "Conchyliencabinet":

Chiton Magellanicus = *Acanthopleura granulata* (Gmelin)
Die peckschwarze granulirte Chiton, *Chiton piceus granulatus* = *do.*

In vol. 10 of this work also a West Indian species appeared:

Chiton squamosus denticularis = *Chiton viridis* Spengler
Chiton squamosus denticularis testa septen-valvi-striata = *do.* (7-valved specimen)

Thus by the end of the 18th century five of the bigger species of the Caribbean were known.

In the early 19th century many species of Caribbean Mollusca found their way to British collectors and institutions. In those years GRAY, BRODERIP, SOWERBY I & II, and REEVE described and figured many new species but their localities are not always reliable.

The Rev. L. GUILDING, (1829) living in St. Vincent, published an important paper in which he proposed a classification of the Polyplacophora into 5 genera, principally based on the characteristics of the shell plates and girdle. In the same paper he described a new Caribbean species, *Chitonellus latus*, now *Choneplax lata* (Guilding).

C. B. ADAMS (1845) introduced many new shells from Jamaica among which were 7 species of Polyplacophora, viz:

Chiton squamulosus = *Ischnochiton striolatus* Gray
Chiton purpurascens = *Ischnochiton purpurascens* (C. B. Adams)
Chiton multicostatus = *Ischnochiton pectinatus* (Sowerby)
Chiton papillosus = *Ischnochiton papillosus* (C. B. Adams)
Chiton erythronotus = *Ischnochiton erythronotus* (C. B. Adams)
Chiton squalidus = *Ceratozona rugosa* (Sowerby)
Chiton costatus = *Chiton viridis* Spengler

Eight years afterwards, during a stay in St. Thomas, Prof. ADAMS was affected by yellow fever and died in January 1853. Meanwhile he had sent abroad many Caribbean specimens of shells, among others to his friend R. SHUTTLEWORTH, an Englishman by birth, living in Switzerland, with whom ADAMS had kept up correspondence.

SHUTTLEWORTH felt himself much drawn to the study of the Polyplacophora. In 1853 he published a valuable paper in which he pro-

posed a new classification of the Polyplacophora partly based upon that of DE BLAINVILLE (1825) and GRAY (1847). After a careful examination of more than 100 species SHUTTLEWORTH distinguished three genera, viz *Chiton* (girdle without pores), *Plaxiphora* (girdle with a double row of many bristle-bearing pores), and *Phakellopleura* (girdle with a single row of 18 needle-bearing pores). Each of them was divided into sections conforming to the genera described by GRAY, to which SHUTTLEWORTH added five new names. In the concluding part of his paper SHUTTLEWORTH listed the Polyplacophora of the Antilles and Canaries describing several new species. From the Caribbean he recorded 20 species:

Chiton (*Lophurus*) *squamosus* = *Chiton tuberculatus* Linnaeus
Chiton (*Lophurus*) *assimilis* = *do.*
Chiton (*Lophurus*) *excavatus* = *Chiton viridis* Spengler
Chiton (*Lophurus*) *fasciatus* = *Chiton squamosus* Linnaeus
Chiton (*Lophurus*) *marmoratus* = *Chiton marmoratus* Gmelin
Chiton (*Lophurus*) *gemmulatus* = *Chiton viridis* Spengler
Chiton (*Ischnochiton*) *purpurascens* = *Ischnochiton purpurascens* (C. B. Adams)
Chiton (*Ischnochiton*) *lateritius* = *Ischnochiton erythronotus* (C. B. Adams)
Chiton (*Ischnochiton*) *erythronotus* = *do.*
Chiton (*Ischnochiton*) *lutulatus* = *Ischnochiton striolatus* Gray
Chiton (*Ischnochiton*) *squamulosus* = *do.*
Chiton (*Ischnochiton*) *papillosus* = *Ischnochiton papillosus* (C. B. Adams)
Chiton (*Ischnochiton*) *reticulatus* = *Callistochiton shuttleworthianus* Pilsbry
Chiton (*Ischnochiton*) *pectinatus* = *Ischnochiton pectinatus* (Sowerby)
Chiton (*Chaetopleura*) *rugosus* = *Ceratozona rugosa* (Sowerby)
Chiton (*Acanthopleura*) *piceus* = *Acanthopleura granulata* (Gmelin)
Chiton (*Acanthopleura*) *mucronulatus* = *do.*

TABLE 1

DISTRIBUTION OF POLYPLACOPHORA

○ according to material collected by P. WAGENAAR HUMMELINCK

× according to specimens from other sources

\+ data from literature only

	Bermuda	E. Florida + Keys	Dry Tortugas	W. Florida	Gulf of Mexico	Bahamas	Cuba	Cayman Islands	Jamaica	Hispaniola	Puerto Rico	Vieques	Culebra	St. Thomas	St. John	St. Croix	Anguilla	St. Martin	St. Barts	Saba	St. Eustatius
1. *Lepidopleurus pergranatus*		×			+						+										
2. *Lepidopleurus binghami*																					
3. *Hanleya tropicalis*		×																			
4. *Lepidochitona liozonis*		×									+		×								
5. *Lepidochitona rosea*																					
6. *Ceratozona rugosa*		×				○	+		+		+				○	+				○	○
7. *Cryptoconchus floridanus*		×	+																		
8. *Acanthochitona hemphilli*		+	×					+					+								
9. *Acanthochitona rhodea*																					
10. *Acanthochitona bonairensis*																					
11. *Acanthochitona spiculosa*	+	×	+	×		×	+				+			+							
12. *Acanthochitona pygmaea*		+	+	+			+				+						○	?		○	○	○
13. *Acanthochitona elongata*		×																			
14. *Acanthochitona interfissa*																					
15. *Choneplax lata*											+	+		+	○						
16. *Calloplax janeirensis*		+	×	×									+	+	○			○		○	
17. *Chaetopleura apiculata*		+		+						+											
18. *Ischnochiton purpurascens*	+?	+	+		+				+		+			+	○			○			
19. *Ischnochiton floridanus*		×	+	×			+						+								
20. *Ischnochiton boogii*	×																				
21. *Ischnochiton striolatus*		+					+		×		×		+	×	○	○					
22. *Ischnochiton erythronotus*	+	×	×						+		○			×							○
23. *Ischnochiton papillosus*		×		+					+				+	+							
24. *Ischnochiton pseudovirgatus*																					
25. *Ischnochiton hartmeyeri*			+																		
26. *Ischnochiton exaratus*		+																			
27. *Ischnochiton pectinatus*		+					+		+												○
28. *Callistochiton shuttleworthianus*		×					+				×										
29. *Chiton tuberculatus*	+	+		+	+	+	×		+	×	+	+		×	○	+	○		○	○	○
30. *Chiton squamosus*		+					+		×	×	×			+	○	+		○	○	○	○
31. *Chiton marmoratus*	+	+			+		+		+		+			+	○	+		○		○	○
32. *Chiton viridis*						○	+	×	×		+			×	○			○	○		
33. *Acanthopleura granulata*	+	+		+		○	+	+	+	+	○	+	+	+	○	○	○	○	○	○	○
34. *Tonicia schrammi*	+	○									+										

IN THE CARIBBEAN REGION

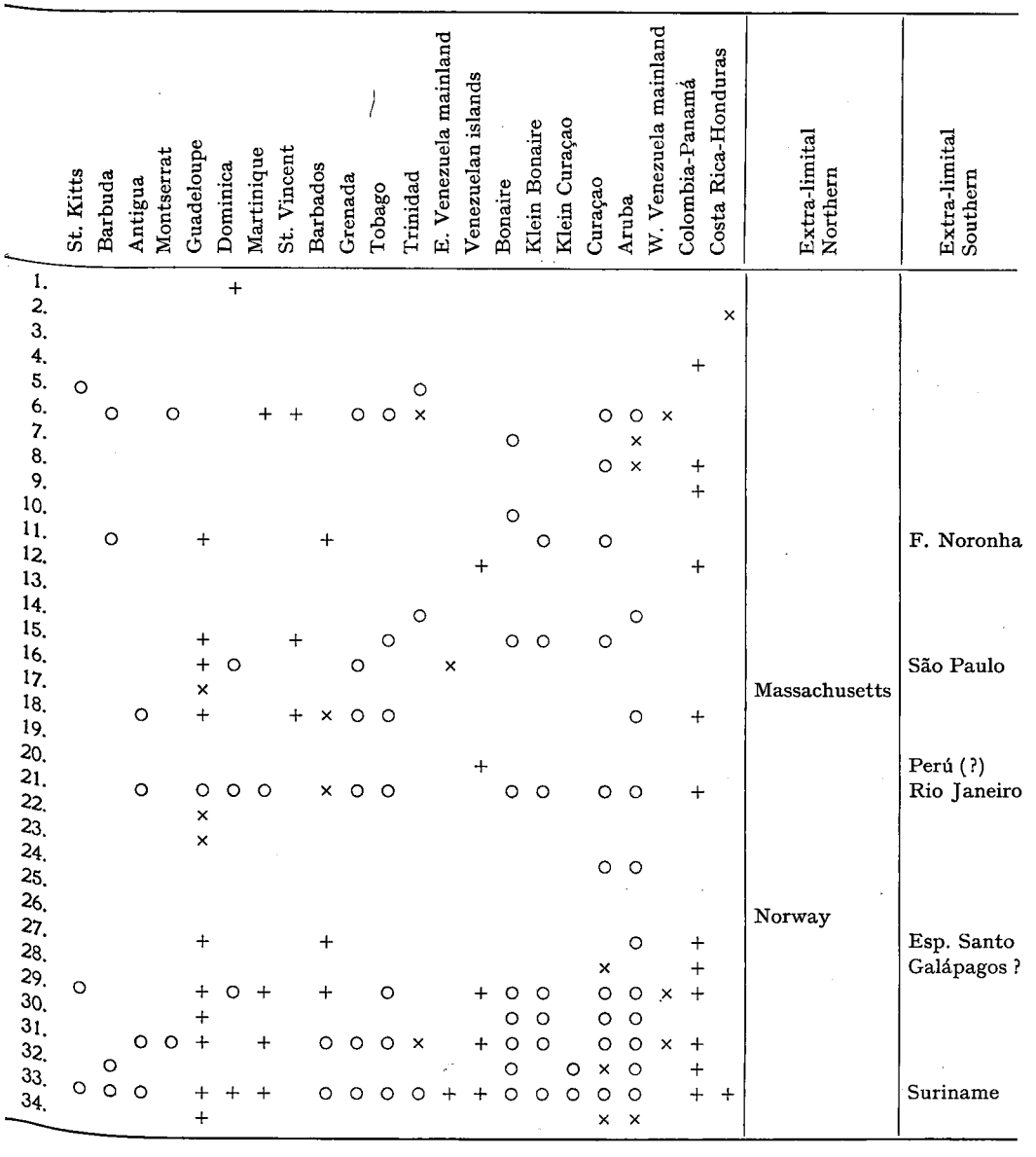


TABLE 2

DISTRIBUTION OF POLYPLACOPHORA IN THE NETHERLANDS ANTILLES

○ according to material collected by P. WAGENAAR HUMMELINCK × according to specimens from other sources	St. Martin	Saba	St. Eustatius	Bonaire	Klein Bonaire	Klein Curaçao	Curaçao	Aruba
Ceratozona rugosa		○	○				○	○
Cryptoconchus floridanus				○				×
Acanthochitona hemphilli							○	×
Acanthochitona bonairensis				○				
Acanthochitona spiculosa					○		○	
Acanthochitona pygmaea		○	○					
Acanthochitona interfissa								○
Choneplax lata				○	○		○	
Calloplax janeirensis	○	○						
Ischnochiton purpurascens	○							○
Ischnochiton striolatus				○	○		○	○
Ischnochiton erythronotus			○					
Ischnochiton pseudovirgatus							○	○
Ischnochiton pectinatus			○					○
Callistochiton shuttleworthianus							×	
Chiton tuberculatus		○	○	○	○		○	○
Chiton squamosus	○	○	○	○	○		○	○
Chiton marmoratus	○	○	○	○	○		○	○
Chiton viridis	○			○		○	×	○
Acanthopleura granulata	○	○	○	○	○	○	○	○
Tonicia schrammi							×	×

Phakellopleura (*Acanthochites*) *astrigera* = *Acanthochitona spiculosa* (Reeve)

Phakellopleura (*Acanthochites*) *spiculosa* = *do.*

Phakellopleura (*Acanthochites*) *strigata* = *Choneplax lata* (Guilding)

Three years afterwards SHUTTLEWORTH described four new species from Guadeloupe; the specimens were provided by BEAU and put at SHUTTLEWORTH's disposal by P. [PETIT DE LA SAUSSAYE] who listed

the marine Mollusca of that island. SHUTTLEWORTH (1856) described:

Chiton (Chaetopleura) candisatus	= *Chaetopleura apiculata* (Say)
Chiton (Chaetopleura) asper	= *do.*
Chiton (Acanthopleura) Blauneri	= *Acanthopleura granulata* (Gmelin)
Chiton (Acanthopleura) Schrammi	= *Tonicia schrammi* (Shuttleworth)

So out of 8 species newly described by SHUTTLEWORTH only one proved to be really new, for which this author cannot be blamed as the descriptions of C. B. ADAMS, GRAY, SOWERBY I, and REEVE were absolutely inadequate.

After SHUTTLEWORTH it was not until 1883 that the chitons of the Caribbean region were scrutinized again. In that year DE ROCHEBRUNE described four supposed new species from "Ile Cochino," Guadeloupe [possibly the Ilet à Cochons in front of Pointe-à-Pitre], viz:

Lepidopleurus corrosus	= *Ischnochiton striolatus* (Gray)
Gymnoplax spiciferus	= *Ischnochiton pectinatus* (Sowerby)
Onithochiton pruinosum	= *Ischnochiton purpurascens* (C. B. Adams)
Onithochiton margaritiferum	= *Calloplax janeirensis* (Gray)

Meanwhile DALL (1881–1883) published several notable papers, adding three new species to the tropical West-Atlantic fauna:

Hanleyia tropicalis	= *Hanleya tropicalis* (Dall)
Lepidopleurus pergranatus	
Notoplax floridanus	= *Cryptoconchus floridanus* (Dall)

The first two were procured during dredging expeditions in deep water.

In 1889 a paper of more than ordinary importance appeared, DALL's "Preliminary Catalogue" in which the author put on record the marine Mollusca of the East coast of North America. In this work 19 species of Polyplacophora were listed from Florida and the Caribbean Islands, including his only recently described species.

A new milestone in the history of Polyplacophora was reached in 1892–1893 with the coming out of PILSBRY's monograph on this group in TRYON's "Manual of Conchology," vols. 14 and 15. PILSBRY had the disposal of the extremely valuable manuscripts of P. P. CARPENTER who died before having finished the results of his very profound investigations and careful examination of specimens in many museums and institutions embodied in a planned monograph.

Besides those already known PILSBRY described five species new to the fauna of the Caribbean area, *viz*:

Acanthochites rhodeus	= *Acanthochitona rhodea*
Acanthochites pygmaeus	= *Acanthochitona pygmaea*
Acanthochites (Notoplax) hemphilli	= *Acanthochitona hemphilli*
Callistochiton shuttleworthianus	
Ischnochiton (Stenoplax) floridanus	

Simultaneously THIELE (1893) examined the radulae of 125 species of Polyplacophora and published the results of his investigations in TROSCHEL's "Das Gebisz der Schnecken." While PILSBRY, partly based upon CARPENTER's studies, proposed a new system of classification founded upon the characteristics of the shell plates and girdle elements, THIELE tried to come to a classification resting upon the structure of the radulae. A few years afterwards (1899–1901) PLATE made a study of the anatomy of many species of Polyplacophora, chiefly from the West coast of South America, whereby he could affirm in broad lines the scientific utility of PILSBRY's system.

In 1901 DALL & SIMPSON studied "The Mollusca of Porto-Rico." They listed 17 species of Polyplacophora of which *Ischnochiton (Trachydermon) liozonis* was new to science.

THIELE (1910) recorded 15 species of Polyplacophora in his "Molluskenfauna Westindiens," collected by W. KÜKENTHAL and R. HARTMEYER. Among these was a new species, *Ischnochiton hartmeyeri*, from the Dry Tortugas.

The next addition was *Ischnochiton (Stenoplax) bermudensis* described by DALL & BARTSCH (1911), but this proves to be a synonym to *Ischnochiton boogii* (Haddon).

NIERSTRASZ (1927) was the first to list the Chitonida of Curaçao. He recorded eight species, collected by C. J. VAN DER HORST, viz:

Chiton tuberculatus	*Tonicia schrammi*
Chiton squamosus	*Acanthopleura granulata*
Chiton viridis	*Ischnochiton striolatus*
Chiton marmoratus	*Acanthochiton spiculosus* var. *astriger*

BOONE (1928) described a third deep water species dredged off the coast of British Honduras, *Lepidopleurus binghami*, and in 1940 PILSBRY published photographs of two species supposed to be new from Bonefish Key [1]), Florida, *Lepidochitona tropica* and *Acanthochitona balesae*, without describing them. They are described in the present paper.

Another species of *Lepidochitona*, *Trachydermon parvulus* LELOUP, 1941 is identical to *L. liozonis* (Dall & Simpson).

I fail to see in what respects *Ischnochiton pseudostriolatus* LELOUP (1961) from Cuba and Santa Marta (Col.) differs from juvenile *I. striolatus* (Gray).

Ischnochiton dispar (Sowerby) which was mentioned from the "Antilles" by LELOUP (1961) is a species from the Pacific coast of Panamá. As long as no reliable records of this species in the Caribbean area are available it appears to be advisable not to include it into the Caribbean fauna.

New to science are the following species described hereafter:

Lepidochitona (*liozonis* D. & S. var.?) *tropica* (Pilsbry, *nom. nud.*)
Lepidochitona rosea
Acanthochitona bonairensis

[1]) On request of dr. HUMMELINCK a thorough investigation was made by SALLY DIANA KAICHER (Redington Beach, Fla.) on the situation of Bonefish Key, which locality proved to be undetectable on Florida maps. At last it was located by THOMAS L. MCGINTY (Boynton Beach, Fla.) in the Middle Florida Keys, "between Grassy Key and Marathon where Dr. B. R. BALES and his wife did a lot of very good collecting. Actually it was a little group of cottages on the edge of the Florida Bay shore, really the shacks used to house the construction workers while building the automobile road through the Middle Keys. These shacks were all moved in and fixed up for rental, each with the name of some sea creature, Parrot Fish, Angel Fish, Bone Fish, Turtle, etc. ADELE KOTO (now a Mrs. BEDELL and mostly active in ornithology at present) together with her father, and also the MCGINTY family, quite often joined the BALES to collect at their better collecting localities. All of the Chitons which I [MCGINTY] recall being found were taken from the rocky shore of the Florida Bay side. While this little colony of cottages was called Bonefish Key at that time, the marine charts would likely have shown it as being on Fat Deer Key."

Acanthochitona elongata (= *A. balesae* Pilsbry, *nom. nud.*)
Acanthochitona interfissa
Ischnochiton pseudovirgatus.

The new material collected by HUMMELINCK has been presented to the Rijksmuseum van Natuurlijke Historie, Leiden, the Zoölogisch Museum, Amsterdam, and the Zoölogisch Museum, Utrecht. The holotypes are deposited in the Leiden Museum.

SYSTEMATICS

In the references to the specimens examined the following abbreviations are used:

H. 1048A = Dr. P. WAGENAAR HUMMELINCK, followed by the number of the station described (1953) or to be described elsewhere in this series of papers.

KtB 1584 = the common collection of the author and Mr. A. N. CH. TEN BROEK, followed by the register number of the specimen(s).

BMNH = British Museum (Natural History), London.

MCZ = Museum of Comparative Zoology, Cambridge, Massachusetts.

RMNH = Rijksmuseum van Natuurlijke Historie, Leiden.

USNM = National Museum of Natural History, Washington, D.C.

ZMA = Zoölogisch Museum, Amsterdam.

ZMB = Zoologisches Museum, Bern.

ZMU = Zoölogisch Museum, Utrecht.

If no indication is added as to the way of preservation, the specimens are kept in alcohol.

KEY TO THE FAMILIES OF POLYPLACOPHORA

1a. Insertion plates wanting, or at best the head valve with a narrow, unslit insertion plate . . . . . *Lepidopleuridae*
1b. All valves with insertion plates bearing a variable number of fissures or slits 2

2a. Insertion plates strongly pectinated outside . . . *Chitonidae*
2b. Insertion plates smooth, at best somewhat rugose 3

3a. Girdle yellowish to brownish, horny, sparingly clothed with

rather long, pointed, calcareous spines, with flexible, slender corneous beards among them . . . . . *Mopaliidae*

3b. Girdle not so 4

4a. Girdle naked or finely and densely spiculose, bearing 18 tufts of longer spicules (14 at the sutures of the valves, 4 around the head valve), or girdle naked, covering the valves but for a narrow, linear band at the carina . . . . . *Cryptoplacidae*

4b. Girdle not so 5

5a. Girdle covered with imbricating, mostly striated scales or sparingly clothed with hyaline hairs, but then the valves sculptured with longitudinal "chains" of granules . *Ischnochitonidae*

5b. Girdle leathery, apparently naked to the eye, except for a marginal fringe of calcareous spicules. Valves smooth or nearly so . . . . . *Lepidochitonidae*

Ordo **LEPIDOPLEURIDA**

Valves without insertion plates, or only one or both of the end valves with an unfissured insertion plate.

Family **LEPIDOPLEURIDAE**

Characters of the order. In the Caribbean Region only three species, belonging to two genera, all living offshore in deep water.

KEY TO THE GENERA OF LEPIDOPLEURIDAE

a. All valves lacking insertion plates . . . . . *Lepidopleurus*

b. Only the head valve with an unfissured insertion plate . *Hanleya*

Lepidopleurus Risso, 1826

Valves wholly exposed, generally uncoloured, the tegmentum granulated all over, the granules often arranged in chain-like series, especially on the central areas of the intermediate valves. Insertion plates wanting. Sutural laminae small, widely separated; girdle with oblong, striated scales, sometimes with scattered spicules among them or wholly spiculose.

Type-species: *Chiton cajetanus* Poli.

Subgenus **Deshayesiella** (Carpenter MS) Dall, 1878

Girdle with scales and longer glassy spicules.

Type of the subgenus: *Leptochiton curvatus* (Carpenter MS) Dall.

KEY TO THE SPECIES OF DESHAYESIELLA IN THE CARIBBEAN AREA

a. Valves with a distinct mucro, dorsal side of the girdle without ribbed spicules-scales . . . . . *L.* (*D.*) *binghami*
b. Valves without a distinct mucro, dorsal side of the girdle with small, ribbed spicules-scales and elongate spicules . . . . . *L.* (*D.*) *pergranatus*

1 **Lepidopleurus (Deshayesiella) pergranatus** (Dall, 1889)

Fig. 1–6

Leptochiton pergranatus DALL, 1889, p. 414; 1889–a, p. 172.
Lepidopleurus pergranatus, PILSBRY 1892, p. 6; DALL & SIMPSON 1901, p. 451, pl. 58 f. 1a–c; WARMKE & ABBOTT 1961, p. 213.
Lepidopleurus pergrantus [*sic*!], JOHNSON 1934, p. 12.

DOMINICA: Off Dominica, 192–138 fms., bottom temp. 63.75°F, "Blake" Coll., USNM 95171. Lectotype and 17 syntypes, dried and curled up.

Thanks to Dr. CLYDE F. E. ROPER, USNM, I could study the type lot of this deep water species. As DALL's original diagnosis, copied by PILSBRY (1892), was rather short and did not give details about the girdle elements, a redescription of the species is given here.

Shell elongate oval, moderately elevated, carinated, the side slopes angularly convex, flattening towards the girdle. Intermediate valves not or only very slightly beaked; the lateral areas not raised, hardly perceptible.

The central areas are sculptured with longitudinal chains of minute, clearly cut, roundish granules, separated by narrow shallow grooves; there are about 30–40 of these chains or riblets on either side of the dorsal ridge. Lateral areas also sculptured with granules, arranged in quincunx.

Head valve semicircular, the front slope a little concave, the granules in quincunx; tail valve with a slightly swollen mucro, a little anterior, about two-fifths the length of the valve, the back slope decidedly concave, the post-mucronal area sculptured like the head valve, the ante-mucronal area like the central areas of the intermediate valves. The sutural plates small, more or less triangular, separated by a wide, shallow sinus.

Colour whitish or greyish white, not glossy; inside white.

The girdle is rather narrow, dorsally clothed with minute, blunt, coarsely ribbed spicule-like scales, about 50–65 μ long (Fig. 4); amongst them long, slender, pointed glassy spicules are found, which are 170–210 μ long, only very finely striate, emplanted in a chitinous shaft (Fig. 5). The ventral side of the girdle is covered with close set, short, finely striated, pointed glassy spicules of about 80 μ long; they are directed towards the outer margin, the marginal ones somewhat longer, forming a short fringe (Fig. 6).

Length 12 mm; width 6.5 mm (dimensions given by DALL).

DALL (1889, p. 414) remarks: "This fine species is nearest the Atlantic *L. cancellatus* (Sowerby) and the Japanese *L. fuliginatus* (Adams & Reeve). It differs from both in its concave or excavated, instead of convex, terminal valves, in the absence or obsolete condition of the posterior mucro, in its much larger and more regular granules, and in the subdepressed appearance also of the part of the median valves near the girdle on each side. It is larger than *cancellatus* and smaller than *fuliginatus*, and without the dingy blackish painting of either. *L. cancellatus* is narrower, higher

and with a sharper median angle. In *L. fuliginatus* the middle valves are shorter from front to back, the sutural laminae smaller and much more triangular. There is no sign of a mucro on these valves, but in *L. pergranatus* there is a beginning of one, quite perceptible. The latter is a proportionally wider and flatter species, with a stronger and more prominent girdle densely set with elongated silvery scales like short stiff gray hairs; these form a pretty fringe at the periphery. The sculpture follows the pattern of *L. cancellatus*, but the lateral areas are less clearly defined, the granules are more clearly cut, more regularly arranged than in any of the species hitherto known. There are twelve gills on each side, reaching forward to about the middle of the sixth valve."

Distribution. Near Dominica, in 192–138 fms. (DALL, type locality). – Florida Keys, West-Florida; Gulf of Mexico (114–1181 fms.); Puerto Rico: off San Juan.

2 **Lepidopleurus (Deshayesiella) binghami** Boone, 1928

Fig. 7–12

Lepidopleurus binghami BOONE, 1928, p. 14, f. 2.

> BRITISH HONDURAS: Off British Honduras, N. of Glover Reef, 484 fms, "Pawnee" Exp. I, 20.IV.1925, 1 specimen (holotype), dry, Yale-Peabody Museum reg. nr. 15636.

Through the kind intermediation of Dr. W. D. HARTMAN, Yale-Peabody Museum, I had the opportunity to study the holotype. The specimen is dried and wholly curled up. As Miss BOONE's description, though correct, is rather confusing, the species is redescribed here.

Animal elongate, moderately elevated, the side slopes nearly straight. The head valve is very slightly concave, the post-mucronal area of the tail valve strongly concave. Mucro of the tail valve somewhat swollen, blunt, slightly anterior (two fifths the length of the valve).

The intermediate valves are decidedly beaked, having a small but distinct mucro, the lateral areas only slightly raised, stronger towards the side margins.

Head valve, lateral areas of intermediate valves and post-mucronal area of the tail valve very finely and evenly granulose, the granules not much raised, not clearly cut, roundish, arranged in quincunx.

Towards the margin there are a few regular concentric lines of growth.

The central areas of the intermediate valves and the antemucronal area of the tail valve are also granulose or pustulose, the granules on the jugal area very fine, hardly elevated, and arranged in longitudinal series or "chains," which are close together. On the pleurae they become much larger, more irregular, like double or treble longitudinal rows of which the granules are fused transversely. The rows or chains are separated by rather wide grooves, which are deepest and widest at the anterior margin, becoming shallower posteriorly, and ending shortly before the diagonal ridge, quite unlike any other *Lepidopleurus* species.

Colour of the tegmentum yellowish white, girdle also whitish.

The girdle is dorsally covered with close-set, erect, short, conical, white spiculae, which are very delicately striate, about 50 μ long, 15 μ wide (Fig. 10). Scattered among them much longer, slender, solitary spicules are found, which are 170–200 μ long, 16–20 μ thick (Fig. 11). The ventral side of the girdle is covered with elongate conical scales or spicules up to 84 μ long, 20 μ wide (Fig. 12). There is no marginal fringe of longer spicules.

Length 15.3 mm; width 8 mm (measurements given by Miss BOONE).

Miss BOONE writes: "It differs also from *L. pergranatus* (Dall), described from near Dominica, West-Indies, depth 138 fms., in the presence of a jugum and of apices on the valves, which are lacking in *pergranatus*." The author also compares it to *L. cancellatus* (Sowerby) from the E. Atlantic and *L. juliginatus* (Adams & Reeve), from Korea, but this is quite arbitrary, for *L. binghami* has nothing to do with those species.

According to Miss BOONE "two specimens were taken in the dredge North of Glover Reef, off the coast of British Honduras, depth 484 fms., April 20, 1925; the larger specimen is the type of the species.

L. binghami was found clinging to the arm of a huge *Astrophyton muricatum* Lamarck. The snail had its body closely appressed to the arm of the Gorgonocephalid, near the base, and its anterior valve directed toward the mouth of this enchinoderm, prompting one to query whether or not the chiton is an external semi-parasitic commensal, feeding on the food collected by the ophiuran."

Distribution. Off British Honduras (BOONE).

Hanleya Gray, 1857

(= *Hanleyia* Dall, 1881).

Valves as in *Lepidopleurus*, but for the head valve which has an unslit insertion plate. Girdle with elongated spicules and long, slender spines.

Type-species: *Chiton hanleyi* Bean.

3 Hanleya tropicalis (Dall, 1881)

Fig. 13–18

Hanleyia tropicalis Dall, 1879, p. 101 (*nomen nudum*); 1879–a, p. 319 (*nom. nud.*); 1881, p. 53 (descr.); 1882, p. 411; 1889, p. 415, pl. 26 f. 8c, d; 1889–a, p. 172, pl. 26 f. 8c, d.
Hanleya tropicalis, Pilsbry 1892, p. 19, pl. 6 f. 12–18; Johnson 1934, p. 12.

Florida: *Sand Key*, Pourtalès, 128 fms., 1 specimen (paratype?), dry, dissected, valve I wanting, Blake Coll., USNM 95172.

Through the kind intermediary of Dr. Clyde F. E. Roper, USNM I had an opportunity to study the paratype (?) specimen mentioned above.

The specimen lacks the head plate. The angle of divergence of the median plates is about 100°, the side slopes are nearly straight. The posterior valve has the mucro about central, prominent, somewhat swollen. The hinder margin is decidedly waved upward in the centre, a characteristic which is not shown in *H. hanleyi* (Bean) from the Norwegian coast. The dorsal side of the girdle is densely clothed with three kinds of vitreous spiculae: large slender ones, 620 μ long (not 1–1.5 mm as Dall states); small slender ones, 50–80 μ long and thicker small ones of about the same size (Fig. 17). Ventrally the girdle is covered by close-set, sharply pointed spicules of about 125 μ long (Fig. 18).

Dall's description (1881), copied by Pilsbry (1892), reads as follows: "Chiton about 10.0 mm in length and 5.0 mm in width, with

the usual characters of the genus, *i.e.* anterior valve with an unslit insertion plate, other valves without even the plates; back with an angle of about 90°. Girdle in the dried specimens thin, narrow, covered with close-set, white, glassy, slender spines (1.0–1.5 mm in length) above, and below with similar but much shorter ones. Anterior valve with a well marked mucro from which proceed concentric striae of growth, and in front of which the valve is a little concave; sculpture of little tessellated flattened nodules radiating from the mucro, above which are irregularly distributed small opaque white pustular bubbles of shelly matter looking like attached grains of coral sand; posterior valve smaller, flatter, with similar sculpture, but the pustules take on a decidedly cylindrical shape and are elongated, looking like the stalks of decapitated mushrooms; this arrangement is still more marked on the posterior lateral areas of the intermediate valves, the anterior lateral areas also exhibit it (less prominently), but with an obliquely antero-posterior radiation, while the former have it more entirely lateral from the mucrones; dorsal areas with the tessellated sculpture alone, arranged longitudinally. Color entirely white."

Distribution. Florida: Sand Key (DALL).

Ordo **CHITONIDA**

Valves with generally fissured insertion plates; only the tail valve sometimes with a reduced insertion plate or a callus.

Family **LEPIDOCHITONIDAE**

Surface of the valves regularly granulated all over, rarely with a weak radial or longitudinal sculpture. Insertion plates of head and tail valves with a varying number of slits. Eaves of the tegmentum often porous. Girdle covered with minute, somewhat elongated scales or spicules, from which much longer spicules, isolated or in small groups, stick out; sometimes the girdle is covered with very minute calcareous corpuscules of different forms and sizes.

Subfamily LEPIDOCHITONINAE

Valves without intrapigmental eyes, sutural plates separated from each other. Intermediate plates at best with 1–1 slits in the insertion plates.

Lepidochitona Gray, 1821

Valves smooth or finely granulated, lateral areas hardly elevated. Girdle with very small scales, not imbricating, or with calcareous corpuscules of different forms and sizes.

Type-species: *Chiton marginatus* Pennant (= *Chiton cinereus* Linnaeus).

Subgenus **Lepidochitona** s.s.

(= *Craspedochilus* G. O. Sars, 1878; *Adriella* Thiele, 1893).

KEY TO THE SPECIES OF LEPIDOCHITONA IN THE CARIBBEAN AREA

a. Lateral areas of intermediate valves distinctly raised, obsoletely radially grooved, girdle with only a short marginal fringe of club-shaped spicules . . . . . *L. liozonis*
b. Lateral areas not distinctly raised, nor obsoletely radially grooved, girdle with a marginal fringe of long, cylindrical spicules . . . . . *L. rosea*

4 **Lepidochitona (Lepidochitona) liozonis** (Dall & Simpson, 1901)

Fig. 19–40; Pl. I fig. 1

Ischnochiton (Trachydermon) liozonis DALL & SIMPSON, 1901, p. 452.
Trachydermon liozonis, THIELE 1910, p. 109, pl. 9 f. 1–5.
Lepidochitona tropica PILSBRY, 1940, pl. 12 f. 4 (*nom. nud.*).
Trachydermon parvulus LELOUP, 1941, p. 42, f. 8, 9, pl. 1 f. 3.
Lepidochitona liozonis, WARMKE & ABBOTT 1961, p. 214.

FLORIDA: *Bonefish Key*, A. Koto leg., 4 specimens, dry, labelled "*Lepidochitona tropica* Pils.," KtB 2848.
PUERTO RICO: Culebra, Ensenada Honda, U.S. Fish Comm., 1 sp., dry, holotype, USNM 161920.

Thanks to Dr. CLYDE F. E. ROPER, USNM, I have the holotype before me, a description of which follows.

Animal elongate oval, moderately elevated, carinated, the side slopes somewhat convex. Head valve semicircular, finely granulated all over, with a few concentric lines of growth and some indistinct, rather obsolete radial grooves. The intermediate valves have the lateral areas distinctly raised, especially in the second valve, the elevation gradually diminishing posteriorly. They are decidedly beaked. On the central areas the granulation is arranged in longitudinal, on the lateral areas in radiating rows. On this part of the valves obsolete radiating grooves or impressions are to be observed, crossed by close concentric lines of growth which are more distinct on the central areas.

Posterior valve with a central mucro, slightly swollen, the posterior slope concave, flattening towards the margin. Colour of the tegmentum light reddish brown, with a few scattered white speckles on the central areas and larger whitish dots on the lateral areas and the pleurae close to the girdle. The post-mucronal area of the tail valve with a white median sector directly behind the mucro.

Inside of the valves white, very porous, the slit rays well marked by rows of perforations. Sutural laminae rather distant, somewhat sinuate, the jugal sinus rather wide, gradually narrowing in the more posterior valves, moderately deep. The insertion plates are slightly rugose outside; head valve with 9, intermediate valves with 1–1, tail valve with 10 inequidistant slits, the eaves spongy.

The girdle is reddish brown with a few whitish spots, moderately wide, dorsally clothed with short cylindrical calcareous corpuscules with rounded "heads," distally finely longitudinally grooved, apparently enveloped by a roundish sheath. They are about 35 μ long, for the greater part orange-brown or yellowish, a few are white (Fig. 20). Among them, irregularly scattered, occur a few long, slender, finely grooved white spicules, rising from a chitinous cup embedded in the girdle-tissue, 50 μ long (Fig. 21). There is a short marginal

fringe of club-shaped, distally grooved white or yellowish spicules, 50 μ long (Fig. 22), among which very small and slender white spicules occur, about 10 μ long (Fig. 23). The ventral side of the girdle is closely clothed with oblong, obtusely pointed spicules-scales arranged in radiating rows, the points directing towards the margin, about 42 μ long (Fig. 24).

Length ± 10 mm; width ± 7 mm.

Undoubtedly THIELE (1910, p. 109) had the same species before him of which he described the perinotum elements; a translation reads: I represent the small, cylindrical, calcareous corpuscules of the upper side of the girdle among which occur scattered, solitary, longer and more slender spicules ("Ringschaftnadeln") and small groups of larger spicules; the marginal spicules are clubshaped, the distal half grooved, pointed. With regard to the radula he remarks: The radula has the rhachidian tooth ("Mittelplatte") pinched in the middle, the front side roundish, with a well-developed cusp; the minor lateral tooth ("Zwischenplatte") is rather small, the front side slanting, the cusp minute; the cusp of the major lateral ("Hakenplatte") with three equal denticles, that of the spatulate uncinal ("Seitenplatte") small, denticulated. On account of the spatulate uncinal plate the species matches the West American ones.

Also LELOUP's *Trachydermon parvulus* (1941, p. 42) is identical with *L. liozonis* as is shown by the description and illustrations of the valves and girdle elements (Fig. 34–40). LELOUP apparently overlooked the papers of DALL & SIMPSON (1901) and of THIELE (1910) as he explicitly declares not to know of any other *Trachydermon* species in the Caribbean Region. A translation of his description of the perinotum elements reads: The girdle is of the *Trachydermon* character. The upper side is covered with minute calcareous corpuscules which are oblong, grenade-shaped, of a brown-orange colour, rarely white, the point blunt, ornamented with a few weak ribs; they appear to be enveloped by a sheath and arranged without order (Fig. 37). Closer to the outer margin than to the valves settle long, cylindrical, obtusely pointed, bent, lucid spicules, generally in two's and apparently united; by means of a short sheath they fit a cupule of the derm (Fig. 38). The underside is covered with oblong, rather

slender, lucid scales having a broad base and a sharp point; they are weakly longitudinally ribbed and arranged in rather regular series perpendicular to the shell, partly covering one another by their tips (Fig. 39). The outer margin is fringed with handsome elongated spicules-scales of a beautiful orange hue, thick and sculptured with longitudinal ribs; their bases are broad and their tips rounded (Fig. 40).

Length 2 mm; width 1.25 mm (1.5 × 1.25 mm, curled).

A study of the type specimens in Bruxelles, in July 1971, brought to light that the specimens were decalcified, due to the camphorated alcohol in which they were preserved.

PILSBRY (1940, p. 53) attached the name *Lepidochitona tropica* to a specimen from Bonefish Key, Florida, of which he gave a photograph but no description. I was fortunate enough to receive four dried specimens of this "species" in 1951, collected by A. KOTO in the type locality (KtB 2848). Though the specimens are much larger than those of *L. liozonis* I have not been able to trace any difference of sufficient taxonomic value to justify specific separation, so that in my opinion PILSBRY's new species may be considered at best a local form or variety of *L. liozonis*. For safety's sake a full diagnosis follows:

Lepidochitona liozonis var. *tropica* (Pilsbry MS) var. n.

Fig. 25–33; Pl. I fig. 1

Shell oblong oval, rather elevated, carinated, the side slopes nearly straight. Colour olive, greenish, or reddish brown, mottled or speckled with small white or light greenish spots, rarely with interrupted, short white stripes on the pleurae. In all specimens the tail valve (Fig. 25, 26) has a white median sector on the ante-mucronal area and also one in the middle of the post-mucronal area.

Lateral areas rather strongly raised in the second valve, gradually decreasing in the 3d to 7th valves, but still decidedly perceptible. The central areas are apparently smooth, the lateral areas, especially in the 4th (Fig. 27, 33) to 7th valves, show some obsolete radial

grooves or only slight radial depressions. Seen under a high power lens the outer surface of all valves turns out to be very finely and closely grooved in longitudinal direction. The grooves are interrupted by many close lines of growth dominating over them. On the central areas as well as on the lateral ones the aesthetes are distinctly arranged in quincunx.

The valves are rather strongly beaked, the beaks sharp, the dorsal ridge moderately sharp, the posterior margins straight or nearly so. Head valve semicircular, elevated, smooth; tail valve much more depressed, with a decidedly anterior mucro which is but little elevated and not or only slightly swollen. The posterior slope is convex, except for a slight depression directly behind the mucro. There is, however, great variation in the degree of elevation. One of the paratypes has the mucro highly elevated and swollen, the posterior slope steep and deeply concave, the median valves more sharply beaked, the lateral areas of III, IV and V with 2–3 subobsolete radials, the posterior margins of the valves concave.

Inside of the valves white or light brownish to roseate, with a thick valve callus and a porous area behind the jugal sinus. The sutural plates are well developed, white, somewhat sinuate, not very distant, the sinus widely U-shaped, gradually narrowing from the second to the tail valve; that of the latter very narrow.

The insertion plate of the head valve has 8 equidistant slits, the teeth moderately long, somewhat rugose outside. Median valves with 1–1 slits, posterior valve with a very short insertion plate and 11 inequidistant slits, the teeth short, obtuse. The eaves in all valves are very porous.

The girdle is moderately wide, dorsally clothed with very minute, close set, not imbricating, calcareous corpuscules, which are short, cylindrical, obtusely pointed, about 6–8 μ long. They are for the greater part of a light brown colour, only those near the sutures are white (Fig. 28). At the sutures, nearer to the valves than to the outer margin, occur long, slender, more or less strongly bent, white spicules, generally in groups of two or three. These are up to 235 μ long, longitudinally striate or costulate (Fig. 30).

Scattered on the dorsal surface a few solitary, straight, striated spiculae are found, 50–150 μ long (Fig. 29). There is a very short

marginal fringe of conical spicules, about 40–50 μ long (Fig. 31). Ventral side of the girdle covered with radiating rows of oblong, pointed scales, about 50 μ long (Fig. 32).

Length of holotype (RMNH) 10.7 mm; width 6 mm. Length of largest paratype 14.4 mm; width 7.2 mm.

Distribution. Florida: Bonefish Key (KOTO); Culebra: Ensenada Honda; Puerto Rico (DALL & BARTSCH); Barbados (THIELE); Colombia: Cabo la Vela, 12–15 fms. ("Mercator," LELOUP).

5 **Lepidochitona (Lepidochitona) rosea** sp. n.

Fig. 41–49

ST. KITTS: Frigate Bay, base of cliff of volcanic tuff with boulders and coarse sand, 20.VII.1955, 1 specimen, damaged, now lost (H. 1397).
TRINIDAD: *Monos*, Avalon Bay, large pebbles of metamorphic rock with some coarse sand, 10.I.1955, 1 sp., holotype, in the Rijksmuseum van Natuurlijke Historie, Leiden (H. 1382).

Animal elongate oval, only little elevated, the back rounded, not carinated, the side slopes a little convex. The head valve is semicircular, without any sculpture, very finely granulose, the granules more or less arranged in radiating rows, with a few concentric lines of growth. The intermediate valves (Fig. 44, 45) are not beaked, but have a small, distinct mucro; the lateral areas are not raised, apparently smooth, but under a lens they appear to be granulated like the head valve, the granules arranged in radiating rows on the lateral and in longitudinal rows on the central areas.

Tail valve (Fig. 41–43) with the mucro a little anterior, about two fifths the length of the valve, not swollen, the back slope nearly straight. Post-mucronal area like the head valve, ante-mucronal area like the central areas of the intermediate valves.

The colour of the tegmentum is of a slight rose-red, with a few darker, brownish spots near the anterior margin of the valves, the back marbled with white.

Inside white, the articulamentum very porous, the head plate with 9, the intermediate valves with 1–1, and the tail valve with 10 slits in the insertion plates, the teeth unequal, somewhat rugose outside,

the slit-rays decidedly marked by rows of perforations, the eaves spongy.

The sutural plates are somewhat thrown forward, rather wide apart, sinuate, the jugal sinus moderately wide, deep.

The girdle is rather narrow, reddish brown, dorsally clothed with cylindrical calcareous corpuscules which are variously coloured: yellowish, ochraceous and yellowish brown or white; they are embedded in the girdle tissue, only the "heads" projecting, circular when seen from above, about 24 μ in diameter (Fig. 47). Among them occur only very few solitary long, curved, blunt spines of about 180 μ long, rising from a chitinous cup in the derm. Very small spicules of 16 μ long are found towards the margin (Fig. 46). There is a beautiful marginal fringe of slender, yellowish, cylindrical spicules, which are finely longitudinally ribbed, rather abruptly tapering to a point, about 130 μ long (Fig. 48). Ventrally the girdle is densely covered with white, sharply pointed spicules, which are broad-based, about 30 μ long, 12 μ wide, arranged in radiating rows and partly covering each other (Fig. 49).

Length ± 6.5 mm; width ± 3.5 mm.

This new species is quite different from *Lepidochitona liozonis*. The lateral areas are not raised, the back is not carinated and there is a beautiful fringe of long slender spicules. Especially the profile of the tail valve differs widely from the foregoing species.

The tegmentum as well as the articulamentum are very porous and brittle. That's why both specimens were in a bad state when I received them; the one from St. Kitts fell apart as soon as it was taken out of the alcohol in which it was kept; the holotype specimen from Trinidad had all the valves, except VII and VIII broken in the median part, probably due to the way of collecting or of handling in sorting it out.

Distribution. St. Kitts (H.); Trinidad: Monos (H.).

Family **MOPALIIDAE**

Shell plates generally with radial ribs corresponding to the slits of the insertion plates, and a sculpture of grooves or a network pattern. Valve I with about 8 slits; sutural plates large, sometimes connected. Girdle clothed with small spicules or scales and with longer bristles or corneous processes of various kinds.

Ceratozona Dall, 1882

(= *Ceratophorus* Carpenter, 1873, *non* Diesing, 1850; *Newcombia* (Carpenter MS.) Pilsbry, 1893, *non* L. Pfeiffer, 1854).

Insertion teeth of the head valve rugose outside, peculiarly "propped" at the slits, corresponding in position to the radial ribs of the surface. Median valves with 1–1 slits, the teeth also "propped." Tail valve with shorter, thick, rugose teeth. Girdle with simple, unramified corneous spines.

Type-species: *Chiton guildingii* Reeve (= *Chiton rugosus* Sowerby).

There is only one more species of *Ceratozona* known, *C. setosa* (Sowerby) (= *C. angusta* Thiele), living on the West coast of Central America.

6 **Ceratozona rugosa** (Sowerby, 1840)

Fig. 50–54; Pl. I fig. 2-3

Chiton rugosus ("Gray") Sowerby, 1840–a, nr. 6, f. 49; Reeve 1847, pl. 18 f. 115.
Chiton (*Chaetopleura*) *rugosus*, Shuttleworth 1853, p. 191, 207.
Ceratozona rugosa, Pilsbry 1893, p. 290, pl. 61 f. 33–37, 41–45; Dall & Simpson 1901, p. 454; Thiele 1909, p. 21, pl. 2 f. 76; id., 1929, p. 10; Johnson 1934, p. 13; Leloup 1942, p. 9, f. 3, pl. 1 f. 5; Smith, M. 1945, p. 23, pl. 56 f. 4, pl. 57 f. 1.
Chiton squalidus C. B. Adams, 1845, p. 8; Clench & Turner 1950, p. 344, pl. 42 f. 1.
Ceratozona squalida, Warmke & Abbott 1961, p. 214, f. 33c.
Chiton guildingii Reeve, 1847, pl. 21 f. 138.
Ceratophorus guildingi, Carpenter 1873 (Table of Regular Chitons, *n.v.*, *fide* Pilsbry 1893, p. 290).

Ceratozona guildingi, DALL 1882–a, p. 286; 1889–a, p. 172.
Chiton bicolor (C. B. Adams MS) GRAY, 1847, p. 67.

FLORIDA: Boca Raton, A. Koto leg., 3 specimens, KtB 2845.
BAHAMAS: *North Bimini*, Entrance Point, W. shore, beachrock with sandy pools, 18.VIII.1949, 10 sp. dry, 1 sp. in alcohol (H. 1152).
ST. JOHN, Turner Bay, boulders of porfiritic rock with coarse sand, tidal zone, 18.VI.1955, 1 sp., dry (H. 1407).
SABA: Fort Bay, andesitic rock, 0–1 m deep, 21.VII.1949, 3 sp. in alcohol, 1 spec. dry; (H. 1120); Spring Bay, andesitic rock, tidal zone, 29.VII.1949, 1 sp. (H. s.n.); Cove Bay at Flat Point, andesitic boulders, tidal zone, 5.X. 1963, 4 sp. (H. 1432).
ST. EUSTATIUS: Down Town at Billy Gut, sandy shore with tuffoid rock debris, ½–1 m, 13.VII.1949, 1 sp. juv., dry (H. 1118).
BARBUDA: Two Feet Bay, surf-swept limestone cliff with sandy rock pools, 10.VII.1955, 1 sp. in formaline (H. 1395).
MONTSERRAT: Foxes Bay, andesitic boulders in tidal zone, 20.VII.1967, 1 sp. (H. 1542).
GRENADA: White Bay at Point Salines, sandy beach with beachrock 26.I. 1955, 5 sp. dry, 1 sp. in alcohol (H. 1389).
TOBAGO: Red Point, SW. of Scarborough, boulders of volcanic rock, tidal zone, 14.I.1955, 1 sp., dry (H. 1388).
TRINIDAD: Maracas Bay, Ingvar Kristensen leg., 17.VI.1961, 1 sp., RMNH 1767. *Monos*, Avalon Bay, large pebbles with coarse sand, ½–1½ m, 10.I.1955, 2 sp. (H. 1382).
CURAÇAO: Fuik Baai, coral debris, littoral at sea-side, J. S. Zaneveld leg., 1955, 1 sp., dry.
ARUBA: Boca Andicuri, E. corner, surf swept non-calcareous rock near sandy beach, 11.V.1955, 1 sp. dry, 1 sp. in alcohol (H. 1311); Boca Andicuri, W. corner, coral rock on sandy beach, 11.V.1955, 3 sp., dry (H. 1312).
VENEZUELA: Naiguatá, E. of La Guaira, on rocks, C. Beets leg., 6 sp. RMNH, 1 sp. KtB 3683.

PILSBRY gave an excellent description of this well-known species, which follows here:

"Shell oblong, rather convex, the back broadly arched. Surface generally much eroded, green, olive, or slate-blackish at the sides, the central areas whitish along the middle, flamed with blackish at the sides, or green there; tail valve having a broad pink ray behind.

The valves are strong, and when not eroded they are somewhat beaked. Lateral areas hardly raised, but defined by a strong rounded rib, sometimes with a lower wide rib behind; having a sculpture of irregular wavy wrinkles over ribs and interval, and also upon the sides of the central areas. Head valve having about 11 low radiating ribs and superficially waved concentrically. Tail valve rather de-

pressed with a sub-central, slightly projecting mucro, the area behind it obsoletely radiated.

Interior blue green, varying in intensity. Sutural plates moderate, separated by a rather wide smooth sinus. Anterior valve having 7–10 slits, the teeth long, acute, slightly rugose outside and denticulate at the edge, generally thickened or propped very strongly along the slits; central valves with 1 slit, the teeth much thickened at the edges of the slit; posterior valve having 8–10 slits, the teeth much shorter and blunter than in front, wedge-shaped, denticulate at the edge, not perceptibly propped or thickened along the slits. Eaves very narrow, having a single series of pores along the bases of the teeth.

Girdle very tenacious, rather wide, yellowish, armed with numerous corneous, yellow, rather long and pointed spines, most numerous around the edge, and in most specimens showing a bunch of several at each suture; among these larger spines, slender, flexible beards are scattered.

Length 40, breadth 25 mm.; generally smaller."

LELOUP, who described the elements of the perinotum, did not add much to PILSBRY's remarks about these formations. The two authors ascertain the existence of simple, horny or chitinous, unramified, curved spines or bristles of various sizes on the upper side of the girdle.

I cannot agree with PILSBRY's observation that the girdle in the natural condition would be dull and dark. The alcohol specimens that I could examine possess a horny yellow girdle. Only in the juvenile specimen from St. Eustatius (= Statia) the girdle is dark. In the dried specimen from Boca Raton, Florida, the girdle is of a dark brown colour. Here the "sutural tufts" are inconspicuous but in the former ones they can easily be observed, each of them generally consisting of one long, thick, slightly curved spine and one to three smaller, more slender and more strongly curved, sharply pointed ones.

LELOUP saw a Cuban specimen with small groups of long spines near the sutures and groups of much smaller spines between them. The whole dorsal surface of the girdle is sparsely but regularly set

with minute spines, each consisting of a long shaft bearing a tiny calcareous pointed spicule.

LELOUP found the ventral side of the perinotum covered with very small, broad-based, sharply pointed spines-scales, conspicuously ornamented with 4–5 very fine longitudinal ribs. These are white and transparant, becoming longer toward the outer margin, which is provided with a fringe of longer and stronger spicules. This author described and figured the spines of the upper side of the girdle as to be sculptured with very fine and close set longitudinal grooves, crossed by as many fine lines of growth; the frayed tip of each of them seems to end into a round opening, but the author could not observe any fine calcareous spicules fitting to them.

In examining the alcohol specimens I observed a curious characteristic never described up to now. When holding the glass jars containing the animals in alcohol close to a strong source of light the spines on the upper part of the girdle show a very beautiful nacreous irradiance, chiefly in bright pink and light blue, of which the pink predominates, especially toward the tips of the spines. When taken out of the jars the spines still show this irradiance until they have dried, becoming whitish or yellowish, opaque and rather lustreless.

The spines are deeply implanted in the girdle and not easily rubbed off with the cuticula; the shell plates are also very strongly held in the tough tissue of the girdle. The valves are light grey or greenish inside, very porous in the middle, the slit rays distinct. In adult specimens the tegmentum is generally much eroded and, like the girdle, covered with all kinds of marine growth. So are the specimens examined with exception of the juvenile one and one of the Boca Raton specimens. The latter agrees fairly well with PILBRY's figure 36, drawn from a specimen from Jupiter Inlet, Florida. According to PILSBRY the sculpture varies a good deal.

LELOUP also examined the aesthetes. These are very strongly ramified and in the dorsal area arranged in longitudinal series. This author values the number of micraesthetes on 25–30 per aesthete.

THIELE described and figured the radula (1909: 21, pl. 2 f. 76). The rhachidian tooth is roundish in front, broad, with a distinct cusp, narrowing backwards, somewhat pinched in the middle; the minor lateral tooth without a distinct cusp, the outer edge a little curved;

major lateral with a large tridental cusp of which the central one is largest; the spatulate uncinal tooth with a small roundish cusp; the ultimate uncinus about as broad as long.

The gill-formation is holobranchial and pre-anal. One of the Saba-specimens has 40–50 gills on either side.

The animals live in the tidal zone, clinging to rocks, etc. Nothing is known of the life history of this species.

Distribution. Florida, East-coast: Boca Raton, Jupiter Inlet; Bahamas: N. Bimini; Cuba; Jamaica; Puerto-Rico; St. John; St. Croix; Saba; St. Eustatius; Barbuda; Martinique; St. Vincent; Grenada; Tobago; Trinidad; Curaçao; Aruba; Venezuela: Naiguatá, E. of la Guaira.

Family **CRYPTOPLACIDAE**

Valves mostly sculptured with roundish or elongated granules, without differentiation into central and lateral areas, the dorsal ridge often longitudinally striated. Valve I with 5 or 3 (rarely 0) slits in the (sometimes very wide) insertion plate; sutural laminae generally large. The very musculous girdle strongly developed, dorsally covered with glassy spicules, or naked, and bunches of longer spines near the sutures and around the head valve, ventrally with scales or spicules.

KEY TO THE GENERA OF THE CRYPTOPLACIDAE

1a. Girdle naked to the eye, covering the valves except for a narrow linear jugal area. Sutural tufts inconspicuous . *Cryptoconchus*
1b. Girdle densely (though sometimes microscopically) spiculose. Tegmentum of valves exposed. Sutural tufts visible 2

2a. Tail valve with at least two slits . . . . . *Acanthochitona*
2b. Tail valve unslit . . . . . *Choneplax*

Subfamily ACANTHOCHITONINAE

Head valve generally with 5 slits, intermediate valves with 1–1-slits, tail valve with 2 or more slits in the insertion plates; the valves connected and articulating.

Cryptoconchus Burrow, 1815

Valves nearly wholly covered by the girdle; tegmentum only narrow, linear, articulamentum very large and strong. Insertion plates large, with 5 slits in the anterior, 1–1 in the intermediate and 3–5 slits in the posterior valve. Girdle very wide, musculous; sutural tufts present though much reduced. Gills posterior.

Type-species: *Chiton porosus* Burrow.

The three species of *Cryptoconchus* hitherto known occur in very restricted and remote parts of the world, *C. porosus* (Burrow) living in New Zealand, *C. burrowi* (Nierstrasz) in the Moluccas, and *C. floridanus* (Dall) in the Caribbean Region.

7 **Cryptoconchus floridanus** (Dall, 1889)

Fig. 55–57; Pl. I fig. 4, 5

Notoplax floridanus DALL, 1889, p. 416; 1889–a, p. 174.
Acanthochites (Notoplax) floridanus, PILSBRY 1893–a, p. 37, pl. 3 f. 63–64; JOHNSON 1934, p. 14.
Acanthochites floridanus, M. SMITH 1945, p. 24, pl. 57 f. 4.
Cryptoconchus floridanus, THIELE 1910, p. 110; WARMKE & ABBOTT 1961, p. 214, f. 32b.

FLORIDA: *Bonefish Key*, A. Koto leg., 1 specimen, dry, 18.5 × 7.5 mm, KtB 2853.
BONAIRE: Lac, Boca, sandy reef debris, 1–2 m deep, 1.X.1948, 1 spec. juv. 4 × 3 mm, slightly curled (H. 1086a).
ARUBA: Lagoen near Pos Chiquito, Mrs. J. H. Beerman-Paul leg., 1 spec., dry, KtB 4474.

DALL's original description reads: "Surface of the valves entirely covered except a small rounded point at the mucro of the anterior valve and a linear space extending forward from the mucro of the

others. The exposed parts are whitish and smooth, or transversely finely striate. They are more conspicuous in dry than in fresh or spirit specimens. The exposed part occupies just about the space which the median suture does in the valves of *Schizoplax*. The covered parts of the valves are whitish clouded with pink. The valves as a whole are wider than long, rectangular, with a very shallow and narrow sinus, except the anterior one are keeled in the median line, overlap each other about half their length, and the two central ones are a little narrower than the others. The valves have about one third the total width of the fresh animal, but about half in the dry specimens. The anterior valve has five notches, the others two each. The mucro of the tail valve is not very prominent, but a little way behind it the immersed portion falls abruptly so that the posterior slope is nearly vertical and the form blunt and high. The part of the tail plate between the notches is not serrate as in *N. speciosa* but slightly radiately striate, and the sinus is very narrow, shallow, and almost obsolete.

The girdle resembles that of *Katharina* when fresh, being smooth, of a black or brown colour with the texture of a moist prune above; below whitish, fleshy, a border of extremely minute spines at the margin. When dry there is a granular irregularity to the surface, as if there were little irregular grains in the substance of the girdle.

There are five [read: four, which is the usual number in the family] small pores about the anterior plate, and a pair at each suture between the valves. There are no pores around the tail plate. The pores are very small in the fresh, and invisible or nearly so in the dry specimen; they are filled with fine glassy spicules, which, in the specimens I have seen, do not rise above the surface, but have probably worn off. The gills extend forward halfway to the head. The muzzle is surrounded by a crumpled veil. The anus is on a papilla. I have seen no spicules on the upper surface outside of the pores. The largest specimen I have seen in alcohol measures 24.0 mm long, by 13.0 mm wide."

PILSBRY (1893, p. 37) says that "the posterior valve has a gentle upward wave posteriorly, with a single Mopaloid slit on each side, and several (4) unequal slits between them."

DALL (1889) writes: "This remarkable species attracts the attention at once by its dark glistening girdle, and a long line of white streaks on its median line, like exclamation points without the dots (!)."

PILSBRY (1893–a) examined the specimens collected by HEMPHILL, "one of which lacks black pigment in the girdle, being of a light brown tint."

I did not dissect the single specimen from Bonefish Key (Pl. 1 fig. 4), but I examined the ventral side of the girdle, which is closely covered with white glassy spicules. These are deeply grooved lengthwise, giving the impression of united pairs, growing together from a common sheath; others, however, appear to be "single," smooth, not grooved. They are about 80 μ long (Fig. 57).

The juvenile specimen collected in Bonaire (Fig. 55, 56) was milky white when fresh. In examining it under a microscope it dried very quickly and then the girdle became yellowish. I could detect only three sutural tufts, composed of only two or three very short and delicate spicules, hardly rising above the surface of the girdle. The mantle cavity is very shallow. There are 8–10 gill plumes at both sides, the hind ones are largest. The gill formation is preanal and merobranchial. The specimen shows similar clothing of the ventral side of the girdle, though I only found few grooved spicules.

HUMMELINCK's specimen is the first record of this species from the Leeward Group of the Lesser Antilles. Just before finishing the manuscript of this paper I received a fine dried specimen, 9.25 × 3.75 mm, with a yellowish brown girdle, collected by Mrs. J. H. BEERMAN in Aruba (Pl. 1 fig. 5).

C. floridanus differs from the two other known *Cryptoconchus* species in the exposed parts of the tegmentum, forming a continuous narrow area from the mucro of the head valve to the mucro of the tail valve. In both other species it is interrupted as the hind half of the jugum in each valve is wholly covered by the girdle.

I examined the spiculae of the ventral side of the girdle of *C. porosus* from Auckland, New Zealand. They are relatively shorter and stouter than in *C. floridanus* and rather abruptly tapering towards the point. The sutural pores are quite distinct and show compact bunches of spiculae.

Distribution. Florida: Key West and Key Largo (HEMPHILL) on the reefs near low water, Dry Tortugas (PALMER), Cape Florida (WURDEMAN), Bonefish Key (KOTO); Bonaire (H.); Aruba (BEERMAN).

Acanthochitona Gray, 1821

(= *Acanthochites* Risso, 1826; *Phakellopleura* Guilding, 1829; *Stectoplax* Dall, 1882; *Anisochiton* P. Fischer, 1885; *Hamachiton* + *Platysemus* Middendorff, 1848).

Shell more or less elongated, valves sculptured with granules, insertion plates large, tail plate generally with 2 slits.

Type species: *Chiton fascicularis* Linnaeus.

KEY TO THE SPECIES OF ACANTHOCHITONA

1a. Girdle very wide and fleshy, only microscopically spiculose, almost separating the valves. Tegmentum of intermediate valves heart-shaped, or subtriangular, jugal tract sharply defined, smooth or nearly so 2
1b. Girdle densely spiculose 4

2a. The tail-valve with some irregular notches between the usual two slits. Tegmentum deep red, sometimes variegated with white . . . . . *A. hemphilli*
2b. Tail-valve with only the usual two slits, insertion plate between the slits smooth-edged 3

3a. Tegmentum deep rose red, inside of the valves also red. Tegmentum of the intermediate valves heart-shaped, only little wider than long . . . . . *A. rhodea*
3b. Tegmentum variegated, greyish-green, inside of valves bluish green. Tegmentum of intermediate valves broad triangular, much wider than long . . . . . *A. bonairensis*

4a. Animal much elongated, more than twice as long as wide, sutural tufts compact. Tegmentum of intermediate valves pentagonal, longer than wide, strongly beaked 5
4b. Animal at best twice as long as wide, sutural tufts exposed. Tegmentum of intermediate valves wider than long, not strongly beaked 6

5a. Jugal tract longitudinally striate, not sharply separated from the latero-pleural areas. Tail-valve with two slits in the insertion plate . . . . . *A. elongata*

5b. Jugal tract somewhat pitted or quite smooth, except for transverse growth lines, sharply defined from the latero-pleural areas by a row of pits at both sides. Tail-valve with three or four slits in the insertion plate . . . . . *A. interfissa*

6a. Sutural tufts very large and dense, spreading over the whole girdle and part of the valves, which are rather depressed, finely granulose, with a narrow, shining, striated jugal tract. Up to 25 mm long . . . . . *A. spiculosa*

6b. Sutural tufts consisting of only few (12–15) long, white spicules, well exposed, valves much elevated, roof-like, wide triangular, roughly pustulose; jugal tract with 5–6 longitudinal granulose riblets. Up to 10 mm long . . . . . *A. pygmaea*

8 **Acanthochitona hemphilli** (Pilsbry, 1893)

Fig. 58–64, Pl. II fig. 1, 2

Acanthochites (*Notoplax*) *hemphilli* Pilsbry, 1893–b, p. 32; 1893–a, p. 34, pl. 13 f. 65–67; Johnson 1934, p. 12.

Acanthochites hemphilli, Dall & Simpson 1901, p. 455; M. Smith 1945, p. 24, pl. 57 f. 16; Salisbury 1953, p. 42; Olsson & McGinty 1958, p. 23.

Acanthochitona hemphilli, Warmke & Abbott 1961, p. 216, f. 32f; de Jong & Kristensen 1968, p. 29; Glynn 1970, p. 18.

Acanthochitona hemphili [*sic!*], Righi 1968, p. 75, f. 73–82.

Florida: *Dry Tortugas*, VII.1925, H. Boschma leg., 1 specimen, RMNH; Dry Tortugas, A. Koto leg., 1 sp., KtB 3696.
Curaçao: Fuik Baai, Duitse Bad, rock, sandy mud, ½–1 m deep, 17.IV.1949, 1 sp. abt. 30 mm long, curled (H. 1038a); Spaansche Water, under *Porites*, K. M. de Jong leg., 1 sp., dry, 34 × 17.5 mm.
Aruba: Lagoen, near Pos Chiquito, Mrs. J. H. Beerman-Paul leg., 4 sp., dry, KtB 4476; Reef W. of Isla d'Oro, Mrs. Beerman leg., 5 sp., dry, KtB 4482; Aruba, Mrs. Beerman leg., 2 sp., dry, KtB 4481.

Pilsbry's excellent description of the species (1893–a, p. 34) reads as follows:

"Elongated, the valves somewhat exceeding one-third the total width in dried specimens. Valves rather elevated, carinated; red, more or less maculated with white. Girdle rust-brown.

The intermediate valves are not beaked, being somewhat produced backwards on each side of the apex; the tegmentum reduced to a heart-shaped area by the encroachment of the girdle at the sutures, leaving the valves in contact by only a small point at the ridge. The dorsal band is very narrow, parallel-sided, slightly elevated, and having a few longitudinal striae. The latero-pleural or side areas are sculptured with fine flattened pustules, those on the posterior portion of each valve being concave. Posterior valve elevated, the tegmentum small, somewhat pear-shaped, narrow in front, longer than wide, mucro at about the posterior third.

Interior light green at the sides, deep rose-red in the middle and at the posterior margin of each valve. Sutural plates light greenish, the slits minute. Posterior valve not bilobed behind, having the usual two slits, and between them a number (6–8) of smaller, irregular unequal slits or nicks; posterior sinus obsolete.

Girdle wide, rusty brown, sparsely clothed with short, microscopic hyaline spicules, having a fringe of longer spicules at the periphery, and 18 rather small tufts of whitish bristles.

Length 24, breadth 11 mm; divergence about 115°."

PILSBRY remarks: "The pustules are rounded, flat-concave topped, crowded and arranged in distinct series. The dorsal area projects anteriorly beyond the latero-pleural areas; it is narrower, elevated and longitudinally striated, the striae mostly rather indistinct and subgranulated. The white and crimson pattern gives an appearance of great elegance to the valves."

The animals I could examine are in good condition. The specimen from Dry Tortugas measures 32 × 18 mm, that from Curaçao (H. 1038a) is still larger though too curled to be measured. All specimens examined agree well with PILSBRY's description to which I have nothing to add.

The red colour of the inside of the valves is caused by the tegmentum showing through. I partly dissected the Curaçao specimen (H. 1038a) and found the tail plate two-slitted, the shallow sinus between the slits showing only 3–4 notches which cannot be regarded as normal slits. The plates of insertion are extraordinarily large and

radially striated, the slits only short but distinct. The specimen has the girdle dark yellowish, in the others the girdle is rust brown. In all specimens the girdle is densely covered with minute spicules, in opposition to PILSBRY's observation ("sparsely clothed," etc.). These spicules are orange, yellowish or brownish, short, stout, abruptly tapering towards the point (Fig. 61). Among them more slender and gradually tapering white, vitrous spicules occur (Fig. 62). Both forms are about 58 μ long.

The sutural tufts consist of bunches of long and slender straight orange or yellowish spicules, very gradually tapering to a sharp point, nearly 2 mm long. At the base they are accompanied by very slender vitreous spicules of about 0.8 mm (Fig. 60). There is a beautiful fringe of two kinds of gradually tapering, slightly curved spines; these are smooth, yellow ones, about 1.5 mm long, some of which are hollow at the tip, where a minute white glassy spicule is emplanted (Fig. 58, 58a); others are about 1 mm long, more slender and vitrous (Fig. 59). The ventral side of the girdle is densely covered with yellowish or whitish blunt spicules or spines, which are 90–130 μ long, 15–20 μ thick (Fig. 64), some of these are more or less branched (Fig. 63).

According to PILSBRY *Notoplax hemphilli* is closely allied to *A. rhodea*, "in the peculiarly narrow dorsal band, the great encroachment of the girdle at the sutures, etc.; but it differs in the less developed side slits, the higher and narrower tail valve and its peculiar multiple-slitting, and in other features."

PILSBRY placed the animal in *Notoplax* which he regarded as a section of *Acanthochites*. His conception of *Notoplax* ("*Acanthochites* in which the posterior valve has the insertion plate grooved outside and denticulate at the edge. Tegmentum reduced in size by the encroachment of the girdle at the sutures, the valves nearly or wholly separated there. Anterior valve not distinctly ribbed radially or lobed around the edge"), however, was false as the type species, *Cryptoplax* (*Notoplax*) *speciosa* H. Adams, as well as two other species the author placed in this group, *N. formosa* (Reeve), and *N. acutirostrata* (Reeve), have a distinctly 5-ribbed and 5-lobed head valve.

This makes PILSBRY's section *Loboplax* ("valves partly covered, the anterior valve having 5 radiating ribs and the same number of lobes along the margin; the posterior valve having the insertion plate grooved outside, notched and slit along the edge, between the usual postero-lateral slits. Girdle leathery, having minute sutural tufts") to a synonym of *Notoplax*, especially where the author not only placed the type species, *L. violacea* (Quoy & Gaimard) in it, but also *L. costata* (H. Adams & Angas) and *L. tridacna* (Rochebrune), the latter two possessing a decidedly spiculose girdle and in all respects congeneric with *N. speciosa* (H. Adams).

The true nature of the genus *Notoplax* was better understood by IREDALE & HULL (1925, p. 89, 90) who defined it thus:

"Shells small to large, elongate oval, tegmentum small, girdle large; coloration brown to pale red. Sculpture bold, with more or less distinct radials separating the lateral from the pleural areas, and similar radials on end valves, sometimes obsolete, at others very prominent; dorsal area represented by a linear ridge, girdle always very broad, sometimes leathery with only sutural tufts present, while others are so densely spiculose that the sutural tufts are difficult to distinguish; insertion plates very large, posterior valve many slit."

THIELE (1929, p. 13) considers *Notoplax* a subgenus of *Cryptoconchus*, in my opinion overestimating the value of the multislit tail valve.

However this may be, the genus *Notoplax* has undoubtedly an artificial character and must be regarded as an unsatisfactory attempt to split up the numerous Acanthochitonoids.

"*Acanthochitona hemphilli* lacks a well-defined seasonal cycle in gonad size, contains mature eggs the year round, and the population structure is not made up of distinct size groups, all evidence of continuous breeding." (GLYNN, 1970, p. 18: Panamá).

Distribution. Florida: Key West (HEMPHILL, type locality), Dry Tortugas (BOSCHMA, KOTO); Culebra (DALL & SIMPSON); Grand Cayman (SALISBURY); Curaçao (H.); Aruba (BEERMAN); Panamá: Atlantic side of Canal Zone (GLYNN). – Only HUMMELINCK gave a description of the habitat: rocky shore of muddy lagoon, limestone rock in sandy mud with some *Thalassia*, near *Rhizophora*, ½–1 m deep.

9 Acanthochitona rhodea (Pilsbry, 1893)

Fig. 65–71

Acanthochites rhodeus PILSBRY, 1893–b, p. 32; 1893–a, p. 26, pl. 12 f. 48–51.
Acanthochiton rhodeus, LELOUP 1941, p. 39, f. 5–7.
Acanthochitona rhodea, KEEN 1958, p. 519.

The species was first described by PILSBRY from an alcohol specimen (which had lost the cuticle of its girdle) collected by the McNEILL Expedition at Panamá. LELOUP had a well preserved specimen dredged by the Belgian school-ship "Mercator" in 28–29 fathoms, 10–12 miles W. of Cabo la Vela, Colombia, and was able to give further specific characters of the girdle elements and aesthetes.

PILSBRY's description reads as follows (the passages in brackets are amplifications borrowed from LELOUP):

"Oblong, the exposed portion of the valves about one-third the entire width of the animal. Valves depressed, obtusely carinated, brown, the eroded apices roseate (or, ground colour creamy white, granules differently coloured: rose, dull white, greenish or black, irregularly disposed).

The intermediate valves (Fig. 66) appear almost separated by the encroachment of the girdle at the sutures; a heart-shaped or subtriangular area remaining exposed. Dorsal band sharply defined and strongly differentiated from the side-areas, very narrow, shining, having slight growth-lines but no longitudinal striae. Latero-pleural or side-areas sculptured with rounded oval concave-topped elevations (pointed at one end. As the points of these granules are directed towards the umbo those near to the jugum are) arranged in rows subparallel to the ridge, becoming radial and then irregular at the sides (more exactly: they are disposed in quincunx converging towards the umbo). Posterior valve (Fig. 65, 67) having the tegmentum drop-shaped, narrower in front, longer than wide; mucro at the posterior fourth (of the tegmentum, but at ½ of the entire valve, the insertion plate and apophyses included, which is clearly shown at the reverse side of the valve being strongly excavated in the centre).

Interior deep rose-red, paler at the edges of each valve. Slits rather deep and narrow, arranged as usual. Insertion plates of all

valves very distinctly rugose outside. Posterior valve normally slit; not noticeably bilobed behind (without intermediate denticulation).

Girdle wide and fleshy in alcohol specimens, having 18 conspicuous tufts. (The colour of the girdle is beige with wide irregular brownish bands; the spicules of the tufts are pellucid, those of the periphery white and mauve; the underground of the tufts blackish. The girdle is armed with numerous very close-set small cylindrical somewhat bent spicules, rounded at the base, pointed at the top, of a more or less deep yellowish colour (Fig. 68a). Among these and not very distant much longer spicules occur which are pointed, slightly bent and of the same colour as the small ones (Fig. 68b). The tufts are composed of only a few solid cylindrical spicules, encircled by much finer and shorter spicules; at the base of these some small greenish-brown spicules are to be found which give the base of the tufts a blackish appearance (Fig. 70). A beautiful fringe of solid white, mauve or yellow spicules adorns the periphery (Fig. 71).

The interior side of the girdle is covered with numerous solid and rather long spicules which are slightly bent, pointed and of a clear yellow colour; they are irregularly disposed (Fig. 69). All girdle elements are sculptured with faint longitudinal ribs).

Gills extending forward two-thirds the length of the foot.

Length 28 mm, breadth 15 mm; (Length 15 mm, breadth 9.5 mm)."

"The salient specific characters are (1) that the girdle encroaches much at the sutures; (2) that the substance of the valves is rose-red; and (3) that the sculpture is altogether peculiar. The insertion plates are uncommonly rugose outside.

The dorsal area is narrow, elevated and smooth except for growth striae. The insertion and sutural plates are distinctly and sharply striated.

It differs from *A. hemphilli* in the normal 2-slit posterior insertion plate."

Distribution. Panamá (McNeill Exp.); Colombia: 10–12 mi. W. of Cabo la Vela, 28–29 fms. ("Mercator").

10 **Acanthochitona bonairensis** sp. n.

Fig. 72–73; Pl. III fig. 1, 2

BONAIRE: North of Punt Vierkant, S. of Kralendijk, rocky shore with limestone debris, some *Turbinaria* and *Sargassum*, mid- and low-tide zone, 9.IX. 1948, 1 specimen 33 × 22 mm; holotype (H. 1059A). – The holotype has been presented to the Rijksmuseum van Natuurlijke Historie, Leiden.

Animal elongated oval, with a wide, fleshy girdle much encroaching at the sutures, almost separating the valves, which are rather flat, not carinated.

Head valve semicircular, tegmentum of the intermediate valves wider than long, broadly triangular, the hind margin almost straight, somewhat concave at both sides of the distinct but not very prominent mucro (width of VI 10.5 mm, length 6.5 mm) (Pl. III fig. 1), tegmentum of the tail valve (Pl. III fig. 2) roundish, as long as wide, the greatest width behind the centre, the mucro slightly swollen, central, the back slope somewhat concave.

Jugal area rather sharply defined, somewhat raised, roundish, and very slightly longitudinally striate, somewhat pitted near the mucro.

All valves are covered with very small, round, close set, clearly cut granules, which are flat topped or somewhat concave; they are very neatly arranged in quincunx.

The insertion plates are wide and solid, head valve with 5, intermediate valves with 1–1, tail valve with two slits, the edge between the slits smooth, narrow, not waved upward.

Colour of the tegmentum greyish green, somewhat mottled with dark grey or brown spots. Inside of the articulamentum light bluish green, dull white near the margins; insertion plates white.

The dorsal side of the girdle is covered with a very thin cuticula, which is easily rubbed off. It is clothed with close-set minute glassy spicules, 85 μ long, 8 μ thick. Among them, scattered without order, occur longer and thicker spicules, 380 μ long, 25 μ thick, fitting into a short sheath embedded in the cuticula (Fig. 73). The usual 18 tufts are present, 7 on each side near the sutures of the valves, 4 around the head valve. They are deeply embedded in pores of the musculous tissue of the girdle and consist of bunches of slender, white, glassy spicules, hardly rising above the surface.

The ventral side of the girdle also bears a thin cuticula, uniformly carpeted with vitreous, straight, sharply pointed, and very finely striated spicules, 100 μ long and 18 μ thick (Fig. 72).

Length 33 mm, width 22 mm.

From a conchological point of view the shell plates are hardly or not to be distinguished from those of the well-known European *A. communis* (Risso). I compared the tail plate and VI with the corresponding valves of an *A. communis* from Concarneau, Bretagne, France, of equal size (Pl. III fig. 3, 4) and was not able to trace any difference in the form, size and arrangement of the pustules, or in the jugal ridge. Only the tegmentum of the tail valve reveals some difference, as it is as long as wide in *A. bonairensis* and somewhat wider than long and more angular in *A. communis*.

The "wings" formed by the insertion plates of the tail valve show sharper angles in *A. communis* than they do in *A. bonairensis*. In VI the slits of the insertion plates are placed more forwardly in *A. bonairensis* than in *A. communis*, and they are more strongly developed.

In the clothing of the girdle, however, the two species differ widely. In *A. communis* the sutural tufts are quite exposed, consisting of long and slender, greenish or whitish spicules, highly rising above the surface. The dorsal side of the girdle in this species is thickly covered with very slender and long spicules, about 1 mm long and 30 μ thick, surrounded by minute glassy spicules of 200 μ long, 6 μ thick.

The clothing of the girdle of *A. bonairensis*, on the contrary, is so delicate that to the naked eye it gives the impression of being naked, except for the small, compact sutural tufts.

The fleshy parts of the animal are of a reddish colour, which may be caused by the way of preservation, though no other animals studied show this feature.

Distribution: Bonaire (H.).

11 Acanthochitona spiculosa (Reeve, 1847)

Fig. 74–81

Chiton spiculosus REEVE, 1847, pl. 9 f. 47.
Phakellopleura (Acanthochites) spiculosa, SHUTTLEWORTH 1853, p. 203.
Phakellopleura spiculosa, PETIT 1856, p. 151.
Acanthochiton spiculosus, DALL 1879–a, p. 299, pl. 4 f. 39; 1889–a, p. 174; LELOUP 1941, p. 9, f. 4, pl. 1 f. 2.
Acanthochites spiculosus, PILSBRY 1893–a, p. 22, pl. 13 f. 60–62; DALL & SIMPSON 1901, p. 455; THIELE 1909, p. 4; CROZIER 1920–b, p. 377; ASHBY 1931, p. 52; JOHNSON 1934, p. 14.
Acanthochitona spiculosa, WARMKE & ABBOTT 1961, p. 215; RIGHI 1968, p. 74, f. 72, 83–92; DE JONG & KRISTENSEN 1968, p. 29.
Chiton astriger REEVE 1847, pl. 18 f. 109.
Phakellopleura (Acanthochites) astrigera, SHUTTLEWORTH 1853, p. 203.
Acanthochiton astriger, DALL 1889–a, p. 174; THIELE 1893, p. 399, pl. 32 f. 31; PEILE 1926, p. 74.
Chiton (Acanthochiton) astriger, E. A. SMITH 1890, p. 496.
Acanthochites spiculosus var. *astriger*, PILSBRY 1893–a, p. 22, pl. 13 f. 55–57; SYKES 1894, p. 136; DALL & SIMPSON 1901, p. 455; NIERSTRASZ 1927, p. 163; JOHNSON 1934, p. 14; AGUAYO & JAUME 1936, p. 116; M. SMITH 1945, p. 24, pl. 57 f. 3.

FLORIDA: *Bonefish Key*, A. Koto leg., 5 specimens, dry, KtB 2852; Gulfport, received from M.C.Z., 5 sp., dry, KtB 3731.
BAHAMAS: *Grand Bahama*, Eight Mile Rock, W. J. Clench leg., 1 sp., dry, KtB 3730.
PUERTO RICO: Parguera, Mata de la Gata, *Rhizophora* and *Thalassia*, 12.X. 1963, 1 sp., 9 × 4 mm, dissected (H. 1419).
BARBUDA: Martello Tower beach, sandy rocks, 1 m deep, 8.VII.1955, 1 sp., 3 × 2 mm, curled (H. 1394).
KLEIN BONAIRE: NE.-coast, sandy reef, 1–3 m, 31.VIII.1948, 2 sp., 8 × 5 and 5 × 2.5 mm (H. s.n.).
CURAÇAO: Knip Baai, limestone cliff, 0–1 m, 8.I.1949, 3 sp., 11 × 6, 4 × 3 and 3 × 2 mm, curled (H. 1017); Boca Lagoen, sand and rock debris, 2–3 m, 27.XI.1948, 1 sp., 3 × 2 mm, curled (H. 1020C); Plaja Hoeloe, sandy reef with *Acropora cervicornis* and *Porites*, ½–1½ m, 28.X.1948, 2 sp., 5 × 3 and 3 × 1½ mm (H. 1023); *do.*, 19.III.1949, 1 sp., 4 × 2 mm (H. 1023a); Piscadera Baai, Boca, sand with pebbles, 1½–2 m, 5.I.1964, 1 sp., 3 × 1.5 mm (H. 1457); *do.*, 1–1½ m, 5.I.1964, 3 sp., 8 × 5, 6 × 5 and 3 × 2 mm, curled, the largest dissected (H. 1458); Curaçao, 2 sp., 6 × 4 and 5 × 4 mm (H. s.n.).
The animals live in the tidal zone, or somewhat deeper, on rocks, coral reefs, etc.

The following description of the shell plates is chiefly borrowed from PILSBRY, that of the girdle elements from LELOUP:

Animal much elongated, rather depressed, not carinated, the

valves distinctly pentagonal, as long as broad, generally more or less encrusted, beaks somewhat eroded (Fig. 75). Jugal area narrow, a little raised at the edges, convex and shining, marked by delicate longitudinal striae and transverse growth lines. Head plate, post-mucronal area of tail plate and latero-pleural areas of intermediate plates very minutely and evenly granulated, the granules rounded, still smaller than in the European *A. communis* (Risso). Posterior valve small, its tegmentum slightly longer than broad, the mucro near the posterior margin (Fig. 74).

Tegmentum variously coloured: blackish brown, grey, green or olive-green, usually tinged with brown on the sides, often marked with rather wide white stripes at the sides.

Interior blue-green, sinus wide, deep and sub-angular; sutural laminae large, blue-green. Insertion plate of the posterior valve visible behind, as well as at the sides of the tegmentum when viewed from above; posterior outline bilobed, having a median sinus, and slits outside of the lobes. [The insertion plates distinctly striate].

The girdle, though not very wide, is wholly covered by the spicules of the tufts, which are quite exposed. All girdle elements are long and narrow. The upper side of the girdle is clothed with straight, pointed, green spicules, arranged in small circles (Fig. 79). The very thick tufts are formed by many spines which are quite long and thin, a little bent and provided with fine longitudinal ribs; they are often of a very pale blue colour (Fig. 78). The underside of the girdle is covered with much shorter and much more crowded cylindrical spicules, which are white, translucent and arranged without order (Fig. 80). Towards the margin they become gradually longer.

There is a beautiful fringe of marginal spicules which are shorter and stouter than those forming the tufts, often bent and longitudinally ribbed (Fig. 81).

Length 20–22 mm; width 9 mm.

DALL (1879–a, p. 299, pl. 4 f. 39) described and figured the radula (Fig. 76): "Minor lateral normal, bi-alate; major lateral and other teeth much as in the last." (= *A. avicula* Cpr.: "major lateral with tridentate cusp; shaft with triangular keel, of which the tip is bent outward; major uncinus short, normal.").

I cannot agree with LELOUP that the granulation of the valves would be still finer than in the European *Acanthochitona communis* (Risso). I found it more or less intermediate between that of *A. communis* and of the other European species, *A. crinita* (Pennant) (see Table 3).

In the dry specimens from Bonefish Key and Gulfport the sutural tufts have worn off for the greater part. Two of the Bonefish Key specimens have the valves of a beautiful uniform brick red, the others are greenish grey, variegated with brown and white. The Bahama specimen is strongly curled up but shows beautiful sutural tufts, consisting of diverging bundles of very many, quite long and slender bluish green spicules; the tegmentum is much eroded.

One of the Curaçao specimens of unknown station is albinotic: tegmentum, girdle and sutural tufts are all milk white, the larger one of this lot has the latero-pleural areas greyish green, the girdle dark greenish, the tufts white to yellowish. Another specimen from Curaçao (H. 1017) is beautifully preserved. The girdle bears very long hairy tufts quite covering the girdle and part of the valves.

E. A. SMITH (1890, p. 496) was the first to unite REEVE's *Chiton spiculosus* and *Ch. astriger*, of which the first is only a dark coloured form.

CROZIER found specimens of about 14 mm long under stones somewhat beneath low water level, in Ely's Harbor and at Spanish Point, Bermuda. Experiments proved them to be decidedly photosensitive:

"The animals orient precisely away from the light. They move faster away from a bright light than from a weak one and come to rest in the shade. It is strongly thigmotactic, tending to settle in the angles at the corners of an aquarium, and once in such a situation is difficult to move by light. Negative geotropism is also fairly well pronounced.

If the intensity of light falling on an *Acanthochites* be suddenly increased, the girdle is depressed into contact with the substratum. Local illumination confined to the girdle leads to a local response of the same character. The shell plates seem not to be sensitive in this respect.

As is the case of most Chitons the body may be strongly curved to one side, the animal pivoting in a circle of short radius. Photic orientation is often accomplished in this way. The "pivoting" of *Acanthochites* ceases instantly when the creature is shaded; orientation is resumed when the light is increased. Since the girdle does not respond to shading of this part alone, I am led to believe that the shell plates are probably responsible for this type of reaction."

Distribution. Florida: Cedar Keys to Key West (SMITH), Gulfport, Bonefish Key (KOTO), Tortugas (DALL); Bermuda (CROZIER); Grand Bahama (CLENCH); Cuba (AGUAYO & JAUME); Puerto Rico (DALL & SIMPSON); St. Thomas (BLAUNER); Barbuda (HUMMELINCK); Guadeloupe (SWIFT); Barbados (REEVE); Curaçao (NIERSTRASZ, H.); Bonaire (KRUMPERMAN); Klein Bonaire (H.); Fernando Noronha (RIDLEY & RAMAGE).

12 **Acanthochitona pygmaea** (Pilsbry, 1893)

Fig. 82–89

Acanthochites pygmaeus PILSBRY, 1893–a, p. 23, pl. 13 f. 58–59; DAUTZENBERG 1900, p. 221; THIELE 1910–a, p. 110; AGUAYO & JAUME 1936, p. 117; M. SMITH 1945, p. 24, pl. 57 f. 5;
Acanthochites pygmaea, JOHNSON 1934, p. 14.
Acanthochiton pygmaeus, LELOUP 1941, p. 37, f. 2, 3, pl. 1 f. 2.
Acanthochitona pygmaea, MCGINTY 1937, p. 141; WARMKE & ABBOTT 1961, p. 214, f. 32c; GLYNN 1970, p. 2. – *Non* DE JONG & KRISTENSEN 1968, p. 29 (= *Chonelax lata*).

BIMINI or ANGUILLA: rocky beach with sandy limestone debris, 18.VIII or 19.VI.1949, 1 specimen (H. 1152 or 1142).
ST. BARTS: S. of Public, near Gustavia, rocky shore, tidal zone, 4.VI.1949, 2 sp. (H. 1121).
SABA: Fort Bay, on dead *Strombus gigas*, from abt. 15 m deep, 6.X.1963, 1 sp. (H. 1431).
ST. EUSTATIUS: Downtown, near Billy Gut, sandy shore with some volcanic rock debris, 13.VII.1949, 1 sp. (H. 1117).

PILSBRY's description (1893–a) reads – with interpolations borrowed from LELOUP (1941):

"Small, oblong, elevated, carinated, the side-slopes flat. Uniform cream-white or olive-green, or variegated (white with small brown spots, the jugum a little roseate).

Intermediate valves broad, somewhat beaked. Dorsal areas wide, triangular, sculptured with longitudinal striae (separating 5–6 sharp and finely granulose riblets). Latero-pleural areas evenly covered with rather large flattened pustules, which are rounded or but slightly ovate, and average one-tenth of a mm in greatest diameter. (They are arranged in quincunx, forming more or less distinct longitudinal series). Posterior valve (Fig. 82–84) having the tegmentum oval, (a little) wider than long; mucro prominent, subcentral.

Interior blue or flesh-white. Posterior valve nearly semicircular in

outline behind, having a (distinct and rather deep) slit on each side and a very slight upward wave behind. The insertion plate is short behind (with many small secondary slits which give the outside of the insertion plate a more or less irregularly pectinated appearance. The sutural laminae are broad and slightly curved inward in the anterior half. Sinus broad, finely festooned by the aesthetes).

Girdle narrow, having 9 small tufts of silver-white (or greenish) spicules on each side and an irregular fringe at the edge.

Length 8, breadth 4 mm, divergence 100°."

LELOUP gave further details of the girdle-covering:

"The upper side is very densely covered with small, sharp, bent, rather thick spicules (Fig. 85). The scales-spicules of the underside are longer and longitudinally grooved (Fig. 86); towards the margin they become longer (Fig. 87). The margin has a beautiful fringe of long, cylindrical, straight, sharp, longitudinally ribbed, white, brown or violet spicules (Fig. 88). The tufts are not thick and composed of fine, long, cylindrical, somewhat bent and longitudinally grooved spicules which are surrounded at their base by finer and shorter spicules of the same form" (Fig. 89).

Of the material I was able to study only the Saba specimen was well preserved, measuring 4.8 mm long, 2.4 mm wide. The ground colour of the tegmentum is light beige, on the latero-pleural areas variegated with brown, the girdle light yellowish with irregular brown patches. The sutural tufts are composed of only few long spicules as described by LELOUP; I seldom counted more than 12–15 of them in one tuft, quite exposed. Among them occur much shorter spicules and their bases are surrounded by very short spiculae.

PILSBRY writes: "It differs from *A. spiculosus* in the smaller size, and high, roof-like form, in the smaller tufts, comparatively much longer tegmenta, and in the shape of the pustules, which are as coarse as in *spiculosus* (see Table 3), although the shell is so much smaller. The posterior valve differs widely from that of *spiculosus*."

Distribution. Florida: Boynton (MCGINTY), Cedar Keys, Key West (HEMPHILL), Dry Tortugas, Bird Key (THIELE); Cuba: Veradero (AGUAYO & JAUME); Puerto Rico (GLYNN); Anguilla or Bimini (H.); St. Barts (H.); Saba (H.); St. Eustatius (H.); Los Testigos (DAUTZENBERG); Colombia (8 mi. W. of Cabo la Vela, in 12–15 fms, LELOUP).

13 **Acanthochitona elongata** sp. n.

Fig. 90–94, Pl. II fig. 3

Acanthochitona balesae PILSBRY, 1940, pl. 12 f. 5 [*nomen nudum*].

FLORIDA: *Bonefish Key*, A. Koto leg., 4 specimens, dry. One of these, the holotype (Pl. II fig. 3), has been deposited in the Rijksmuseum van Natuurlijke Historie at Leiden; the paratypes are in the collection of the author, KtB 2849 (1 sp. disarticulated).

From Mr. A. KOTO I received 4 specimens of an *Acanthochitona* species labelled "*Acanthochitona balesae* Pilsbry," which he collected in Bonefish Key, Florida. The specimens belong to a species new to science, though they agree fairly well with the photograph of *A. balesae* given by PILSBRY (1940). This species, however, was not described. According to the International Rules of Zoological Nomenclature PILSBRY's *Acanthochitona balesae* must be considered a *nomen nudum.*

Animal small and much elongated, more than twice as long as broad, the valves elevated, subcarinated, about pentagonal, narrower in front, decidedly longer than wide, beaked and much imbricating.

The intermediate valves have a rather narrow longitudinally subobsoletely striated jugal band, gradually widening posteriorly, not sharply defined from the latero-pleural areas, which are sculptured with rays of small roundish convex-topped granules or pustules, parallel to the jugal tract.

Tegmentum of the tail valve (Fig. 90, 91) longer than wide, subpentagonal, with the elevated but blunt mucro posterior when viewed from above, the posterior slope steep.

Colour of the tegmentum greenish, sometimes greyish green, the pustules often dark chestnut or whitish, not glossy. Inside of the valves yellowish or brownish, the insertion plates and sutural laminae pale bluish or greenish.

The insertion plate of the head valve is rather long, the outside with five grooves, representing the slits in most other Acanthochitonoids; those of the intermediate valves projecting forward, unslit but

with little excavations where the slits might be expected, the sutural laminae small, a little sinuate, enclosing a rather deep and somewhat angular sinus. Tail valve with two short slits in the insertion plate, posteriorly evenly rounded, not or only very slightly waved upward.

Girdle encroaching at the sutures, clothed with fine greenish spicules, the margin fringed with much longer spicules. The usual 18 tufts are rather thick, compact, long and silky, directed towards the sutures, composed of white, hairy and glossy spicules.

Length 10.25 mm; width 3.75 mm.

This new species at once attracts the attention by its elongated appearance, its valves which are decidedly longer than wide, and its compact sutural tufts (which are quite exposed in *A. spiculosa* and *A. pygmaea*). The pustules on the latero-pleural areas are about the same size as those of an *A. spiculosa* of equal size, but the interstices are much wider.

The diameter of the pustules on the central part of the left latero-pleural area of valve IV in various species of *Acanthochitona* are given in Table 3.

TABLE 3

MEASUREMENTS IN ACANTHOCHITONA

l. = longitudinally t. = transversely

Species of *Acanthochitona*	Total length of specimen	Width of tegmentum valve IV	Diameter pustules	Average distance of surrounding pustules	
				l.	t.
A. communis	17 mm	6.7 mm	110 μ	13 μ	32 μ
A. communis	12 mm	4.1 mm	110 μ	16 μ	20 μ
A. spiculosa	12 mm	4.8 mm	127 μ	35 μ	48μ
A. spiculosa	8 mm	2.3 mm	72 μ	16 μ	27 μ
A. elongata	10 mm	1.5 mm	79 μ	48 μ	63 μ
A. pygmaea	4 mm	0.4 mm	63 μ	3 μ	12 μ
A. crinita	13 mm	4.3 mm	174 μ	44 μ	64 μ
A. crinita	7.4 mm	2.2 mm	158 μ	48 μ	57 μ

From Table 3 it is clear that the granulation of *A. spiculosa* is almost as delicate as in *A. communis*, but in the latter there are nearly 50% more granules to a square mm and they are more clearly cut and more elevated. In *A. crinita* the pustules are much larger than in *A. spiculosa*, but only little more widely separated.

A. pygmaea has the granules only a little smaller than in a twice as large *A. spiculosa*, but they are as close set and as clearly cut as in *A. communis*. *A. elongata* is comparable to *A. crinita* as far as the width of the interstices between the pustules is concerned, though the pustules themselves are more than twice as large in *A. crinita* of the same size.

I found the dorsal side of the girdle in *A. elongata* densely clothed with short, stout, somewhat bent, finely longitudinally striated spicules, which are 245 μ long, 35 μ in diameter (Fig. 93). Ventrally the girdle is covered with much larger spicules, which are still longer towards the margin (Fig. 94). The marginal spicules are about 485 μ long, very slender and slightly bent. The tufts are composed of crowded, compact bundles of spiculae, which are straight, very slender, gradually tapering towards the point, about 560 μ long, 20 μ thick at the base. They are accompanied by much shorter spicules, about 275 μ long, 15 μ thick (Fig. 92).

Distribution. Florida: Bonefish Key (Koto, see p. 13, footnote).

14 **Acanthochitona interfissa** sp. n.

Fig. 95–107

TRINIDAD: *Monos*, Avalon Bay, on large pebbles of metamorphic rock with some sand, 1–1½ m deep, 10.I.1955, 2 specimens (H. 1382). The complete specimen was chosen as the holotype, the dissected one as the paratype. Both are deposited in the Rijksmuseum van Natuurlijke Historie, Leiden.
ARUBA: Malmok, Arasji, rocky beach with sand and dioritic boulders, *Thalassia* flat with *Porites*, ½–1 m, 14.VIII.1955, 3 sp. (H. 1301) Paratypes.

Animal elongately oval, about thrice as long as wide, girdle wide, encroaching at the suture. The tegmentum of the head valve (Fig. 101) is semicircular, almost as long as wide, of the intermediate valves (Fig. 98–100) elongately pentagonal, longer than wide, de-

cidedly beaked, that of the tail valve (Fig. 95–97) elongately oval, longer than wide, at the front margin curved inward, the mucro decidedly behind the centre, the back slope a little concave directly behind the mucro, somewhat convex towards the margin. The valves are moderately arched, not carinated, with a rather wide, triangular jugal area which is rounded at the back, smooth, except for regular transverse lines of growth; in some valves it is pitted near the mucro. It is somewhat raised and accompanied by a row of pits at both sides.

End valves and latero-pleural areas of the tail valve covered with coarse, roundish, clearly cut and fairly distant granules, flat or concave topped, and arranged in rows parallel to the jugal tract, diverging from the mucro.

The insertion plates are wide, that of the head valve with 5 equidistant slits, the intermediate valves with 1 slit on either side, except valves IV–VI which are unslit. Inside the valves there is a strong callus. The central valves have a rather narrow sinus and sutural plates which are strongly directed forward. Beside the normal two side slits the tail plate has a well developed additional central slit, which in no respect is to be compared to the irregular intermediate notches as are found in the tail valve of *A. hemphilli*. The hind margin of the insertion plate is somewhat waved upward.

Colour of the tegmentum greenish grey, speckled or variegated with brown and white; inside bluish green, dark chestnut in the centre caused by the tegmentum shining through.

The girdle is white, very densely clothed with small, elongated, vitreous spicules (Fig. 106); the marginal needles are much longer, up to 190 μ, some of which are strongly bent. They are longitudinally striate or costulate. (Fig. 103, 107).

The sutural tufts are composed of thick bundles of very slender, straight, white spicules, 720 μ long, gradually tapering to a very sharp point (Fig. 102). Ventrally the girdle is armed with small, stout, white spicules, 48 μ long, 10 μ thick, rather blunt and finely striated (Fig. 104, 105).

Length 7.5 mm, width 2.5 mm, dissected (paratype); 5 × 2 mm (holotype).

The species has much the same appearance as *A. elongata* from which it differs in the jugal tract, which is longitudinally striate in *A. elongata*, smooth with only transverse growth striae in *A. interfissa*, and especially in the profile and slitting of the posterior insertion plate.

Just before the manuscript of the present paper was finished I received a lot of 3 specimens from this new species from Aruba, one of which was dissected. The tail valve proved to possess two intermediate slits, close together.

Distribution. Trinidad: Monos (H.); Aruba (H.).

Subfamily CRYPTOPLACINAE

Animals elongated, the valves narrow, the 3d (or 5th)–8th valve sometimes more or less separated. Girdle densely spiculose, tufts present but generally inconspicuous. Head valve with 3 (rarely 5) slits, tail valve unslit.

Choneplax (Carpenter MS) Dall, 1882

Valves connected, the head plate with 5 slits, intermediate valves with 1–1 slits. Mucro of the tail valve posterior, insertion plate directed forward.

Type-species: *Chiton strigatus* Sowerby (= *Chitonellus latus* Guilding).

15 **Choneplax lata** (Guilding, 1829)

Fig. 108–116, Plate II fig. 4

Chitonellus latus Guilding, 1829, p. 28.
Choneplax latus, Pilsbry 1893–a, p. 60, pl. 8 f. 15; Seel 1913, p. 75 + pl.; Bergenhayn 1931, p. 1, pl. 1 f. 1–4.
Choneplax lata, Thiele 1909, p. 52, pl. 6 f. 72–79; 1929, p. 15; Warmke & Abbott 1961, p. 216.
Chiton strigatus Sowerby, 1840, p. 89; 1840–a, f. 63.
Chitonellus strigatus, Reeve 1842, pl. 135 f. 6.

Phakellopleura (*Acanthochites*) *strigatus*, SHUTTLEWORTH 1853, p. 204.
Choneplax strigatus (Carpenter MS) DALL, 1882, p. 285, 288.
Chitoniscus strigatus (Carpenter MS) DALL, 1882, p. 285, 288.
Chitonellus laevis (*non* Lamarck), REEVE 1847, pl. 1 f. 1.
Acanthochitona pygmaea (*non* Pilsbry), DE JONG & KRISTENSEN 1968, p. 29.

ST. JOHN: Bay S. of Cruz Bay, volcanic rock boulders on sandy beach, ½–1 m deep, 19.VI.1955, 1 specimen 9 × 6.5 mm, curled (H. 1408).
TOBAGO: Buccoo Reef, reef flat, high tide zone, 16.I.1955, 1 sp. 11 × 5.8 mm, slightly curled (H. 1387).
BONAIRE: North of Punt Vierkant, sandy reef, 1–2 m, 9.IX.1948, 1 sp. 5 × 3.2 mm, curled (H. 1059B); Paloe Lechi, S. of Salinja, beachrock, low-tide zone, 4.IX.1948, 1 sp. 6 × 2.8 mm (H. 1056B); De Hoop, S. of Kralendijk, sandy reef, 1–3 m, 10.IX.1948, 1 sp. 8 × 4 mm (H. 1058C).
KLEIN BONAIRE: East coast near landing, sandy reef, 1–3 m, 13.IX.1948, 1 sp. 4 × 2 mm (lost) (H. 1049C).
CURAÇAO: Piscadera Baai, swimming pool in outer bay, on fence, 1–1.5 m, 29.I.1949, 1 sp. 6 × 4 mm, curled, partly dissected (H. 1029A); Spaanse Water, in coral, 1.5 m, K. M. de Jong leg., 1 sp. 10.5 × 5 mm, dry (Pl. 2 fig. 6).

Animal elongate oval, girdle broad, encroaching at the sutures, width of the exposed parts of the valves about half the total width. Valves strongly imbricating, moderately elevated, subcarinated, decidedly beaked. Head valve (Fig. 108) a little wider than long, the insertion plate long, with 5 small slits (perhaps reduced to 4 or 3 in full grown specimens?).

Tegmentum of the intermediate valves (Fig. 109) about pentagonal, the posterior margin obtuse-angled, the sides converging, insertion plates short, with 1–1 small but distinct slits near the posterior margin (apparently reduced or totally disappearing in adult specimens), the sutural plates well developed, sinuate, strongly directed forward and much excavated, the sinus narrow and deep. Posterior valve (Fig. 110–112) with the tegmentum subpentagonal, the mucro posterior right over the hind margin, the insertion plate strongly thrown forward, unslit. Posteriorly the insertion plate is a little shorter in the middle, causing a slight sinus in the margin between two hardly visible notches which might represent the much reduced latero-posterior slits common with the *Acanthochitona*-species.

The tegmentum of the valves is sculptured with small, roundish, convex-topped granules on the latero-pleural areas. There is a well

defined and somewhat raised, moderately wide, wedge-shaped jugal tract, longitudinally substriated.

The colour of the tegmentum is dirty white, spotted or variegated with dark greyish brown, the granules white. Inside of the valves greyish or greenish, in the centre darker.

The girdle is wide, velvety, dorsally clothed with much crowded short, club-shaped longitudinally grooved spicules (Fig. 113) and with a beautiful fringe of longer white spicules (Fig. 116). There are 14 intersegmental tufts and 4 more around the head valve, composed of only a few (8–20) moderately long, bent, white, glassy spicules (Fig. 115). Ventral side of the girdle clothed with rather thin, distally narrowing and somewhat truncated spicules (Fig. 114).

Colour of the girdle dirty white, buff, brown, or a beautiful moss-green, often two or more of these colours alternating.

Length about 25 mm (PILSBRY).

The 8 specimens I could examine are small, the largest, from Tobago, 11 mm long, but they are all very well preserved; two of them, the specimen from Piscadera Bay, Curaçao, and that from St. John have eroded valves, the others showing the sculpture as well as possible. The specimen described above is that from De Hoop, Bonaire. It has an alternately buff and green coloured girdle while the valves are dirty white, with brown spots on some of them, the jugal tract always light, somewhat transparent. In the specimen from Paloe Lechi, Bonaire, the girdle is wholly moss-green, in the Piscadera-Bay specimen (Curaçao), brown with green patches.

The characteristics of the insertion plates and inside of the valves are described from the partially dissected Curaçao specimen. The granules on the latero-pleural areas are small along the jugal tract and near the posterior margin, becoming larger anteriorly and towards the sides.

PILSBRY, THIELE and BERGENHAYN found the spicules of the sutural tufts of a brown colour. In the specimens at my disposal they are white, except for the Tobago specimen, which has brown tufts.

PILSBRY (1893–a, p. 60) found the head valve to have 3 slits, the other valves unslit. BERGENHAYN (1931, p. 2) had a specimen with 4 slits in the head valve (5 insertion plates!) and only 1 slit in the left

insertion plate of the 2nd valve, the right insertion plate and the other valves unslit. Only THIELE described the head valve as distinctly 5-slitted (1909, p. 52), the intermediate valves with 1–1 slits, the tail plate unslit.

I had no opportunity to study specimens larger than 11 mm, though according to PILSBRY the species may attain a length of about 25 mm. Therefore I cannot decide whether the slits in the insertion plates of the head valve and intermediate valves are really reduced (or even have disappeared) in adults, or not.

THIELE (1909, p. 52) gave also a description of the radula, which he found to be like that of *Cryptoplax striata*: "The anterior margin of the rhachidian tooth is straight, obtuse-angled, slanting posteriorly, the cusp rather strongly bent forward, the side margins curved inwardly; the minor lateral tooth with an also sideways projecting rest of a cusp at the anterior angle, posterior angle laterally produced and pointed. Major lateral cusp with three equal teeth, cusp of the spatulate uncinus roundish, of moderate size."

Distribution. Puerto Rico (BLAUNER); Vièques (DUNKER); St. Thomas (BLAUNER); St. John (H.); Guadeloupe (SWIFT); St. Vincent (GUILDING, type locality); Tobago (H.); Bonaire (H.); Klein Bonaire (H.); Curaçao (H., DE JONG).

Family **ISCHNOCHITONIDAE**

Shell plates generally with distinct lateral areas. Sculpture different, eaves not porous. Head and tail plate with different number of slits, the intermediate plates generally with 1–1, seldom with more slits, the teeth narrow, usually smooth. The upper side of the girdle is clothed with scales, which are generally striated, grooved or ribbed; when the scales are small there are calcareous spicules among them, when the scales are large the spicules are only found at the margin. The underside of the girdle is clothed with small, narrow scales arranged in radial rows.

KEY TO THE GENERA OF ISCHNOCHITONIDAE

1a. Central areas of intermediate valves sculptured with longitudinal "chain"-like rows of granules, very fine and close

together on the dorsal ridge, more elevated and wider apart towards the sides. Lateral areas and end valves pustulose, or with strong pustulose radiating ribs. Girdle with minute scales and spicules . . . . . *Chaetopleurinae*, 2

1b. Central areas differently sculptured, girdle with imbricating striated scales and at best a fringe of marginal spicules . . . . . *Ischnochitoninae*, 3

2a. Lateral areas and end valves with elevated nodulose or pustulose ribs; girdle with very small sulcate scales and scattered, much longer spicules . . . . . *Calloplax*

2b. Lateral areas and end valves with clearly cut round and elevated granules, apparently arranged without order; girdle with very small, oval, smooth scales, not imbricating, and scattered spicules . . . . . *Chaetopleura*

3a. Girdle scales imbricate, distally smooth, only the basal part distinctly grooved. Valves strongly sculptured *Callistochiton*

3b. Grooves or striae on the girdle scales continuing to the distal end, or scales smooth, not imbricate. Valves finely or moderately sculptured, or, if strongly sculptured, the girdle with two kinds of scales, very small, imbricating ones and groups of much larger, elongated ones . . . . . *Ischnochiton*

Subfamily CHAETOPLEURINAE

Shell plates sculptured with tubercles, on the lateral areas and end plates generally in radial rows or without order, on the central areas arranged in longitudinal rows. Upper side of the girdle clothed with small, scale-like, not imbricating calcareous corpuscules and sometimes large, sometimes small spicules.

Calloplax Thiele, 1909

THIELE 1909, p. 19.

End plates and lateral areas of the median plates with radial rows of strong tubercles. The upper side of the girdle clothed with small,

more or less broad, strongly ribbed scales and solitary, curved, rather long spicules and small spiculae, emplanted in stalked, bowl-shaped chitinous shafts.

Type-species: *Chiton janeirensis* Gray.

16 **Calloplax janeirensis** (Gray, 1828)

Fig. 117–123, Pl. IV fig. 1, 2

Chiton janeirensis GRAY, 1828, p. 6, pl. 3 f. 8; SOWERBY 1839, pl. 40 f. 2; 1840–a, f. 56; REEVE 1847, pl. 19 fig. 116 (not pl. 15 f. 81); GOULD 1852, p. 333, f. 421.
Chiton segmentatus REEVE, 1847, pl. 23 f. 155.
Chiton (Chaetopleura) asper SHUTTLEWORTH, 1856, p. 169.
Chaetopleura janeirensis, DALL 1889–a, p. 172; PILSBRY 1892, p. 37, pl. 13 f. 59, 60; DALL & SIMPSON 1901, p. 451; JOHNSON 1934, p. 13.
Onithochiton margaritiferum ROCHEBRUNE, 1883, p. 35.
Chaetopleura apparata CARPENTER MS, in PILSBRY 1892, p. 38.
Callistochiton ruficostatus CARPENTER MS, in PILSBRY 1892, p. 38.
Calloplax janeirensis, THIELE 1909, p. 19, pl. 2 fig. 57–65; 1910–a, p. 110; 1929, p. 13; WARMKE & ABBOTT 1961, p. 216, f. 33d; RIGHI 1967, p. 92, f. 32–47.

FLORIDA: *Dry Tortugas, Garden Key*, A. Koto leg., 2 specimens, dry, KtB 2846. [Pl. 3 fig. 2].
ST. JOHN: Turner Bay, porfiritic rock boulders with coarse sand, tidal zone, 18.VI.1955, 2 sp. (H. 1407).
ST. MARTIN: Point Blanche Bay, surf swept limestone cliff with rock pools, 5.VI.1955, 1 sp. (H. 1399).
SABA: West of Fort Bay, andesitic rock, 0–1.5 m deep, 21.VII.1949, 2 sp. (H. 1120).
DOMINICA: Prince Rupert Bay, near Portsmouth, boulders of volcanic rock, 0–1 m, 15.VII.1967, 2 sp. (H. 1546).
GRENADA: White Bay at Point Salines, sand with beachrock, 26.I.1955, 1 sp. (H. 1389).
TRINIDAD: Bocas del Dragon, between Paria and Trinidad, – 100 m, G. van Andel leg., 6.V.1953, 1 sp., RMNH.
BRAZIL: Est. do Rio, Niteroí, Boa Viagem, A. de Souza Lopes leg., 22.X.1949, 3 sp., KtB 3163; Cabo Frio, A. de Souza Lopes leg., III. 1951, 2 sp., KtB 3164.

Animal elongate oval, rather narrow, the valves elevated, carinated, somewhat beaked.

The head valve, the lateral areas of the intermediate valves, and the post-mucronal area of the tail valve strongly sculptured with radiating rows of roundish tubercles, about 10–12 on the head-valve,

12 on the tail-valve and 2–4 on the strongly raised lateral areas of the median valves. The number of rows varies considerably as they are often splitting up.

Central areas and ante-mucronal area of the tail valve longitudinally sulcate, the sulci granulose, those on the dorsal ridge very fine, thread-like and close together, becoming much more elevated and wider apart towards the side margins, ± 12–13 on either side of the dorsal ridge. Mucro of the tail valve a little before the centre, not very prominent, the back slope nearly straight.

The insertion plates are short, not exceeding the tegmentum, the teeth smooth, with 7 slits in the head plate, 1–1 in the median plates and 9 in the tail plate; the eaves are solid. The apophyses are rather narrow, evenly arched, the sinus wide, limited by two slight notches in the front margin.

Colour of the tegmentum often variegated, yellowish, greenish, greyish or brown, with pale yellow or milk white dots, sometimes with a light dorsal stripe or with light coloured pustules on the lateral areas, other specimens show beautiful blood-red spots on some of the valves.

Articulamentum bluish grey, the sutural and insertion plates white.

The girdle is rather narrow, the dorsal side densely paved with small, strongly ribbed scales of different forms and sizes, up to 40 μ long. Some of them are as wide as long, others are much longer than wide, distally narrowing, blunt or pointed, always strongly ornamented by 4 or 5 ribs (Fig. 119).

Among them, scattered without any order, occur small, smooth, sharply pointed spicules, emplanted in large, bulbous or bowl-shaped, stalked, chitinous sheaths (length of spicules about 40 μ) and long, smooth, somewhat curved spicules of about 200 μ long (Fig. 118). Marginal spicules 160 μ long, stout, strongly sulcate, surrounded by very small smooth ones in stalked sheaths (Fig. 120, 121). Between the shell plates numerous crowded, smooth spicules are found, which are distally sharply pointed, about 350 μ long.

Ventrally the girdle is covered with small rectangular scales, 25–30 μ long, 15–20 μ wide, arranged in radiating rows (Fig. 122, 123).

Length 19 mm; breadth 10.5 mm.

Both THIELE (1909) and RIGHI (1967) gave a description of the radula (Fig. 117), which has a big rhachidian tooth with a well-developed cusp, its front margin bent, the side margins rather regularly curved, posteriorly the tooth is narrowed, in all longer than wide. The minor lateral has a fully rudimentary cusp, formed by a small angle at the front margin in which the posteriorly strongly widened lamella ends. The major lateral does not possess a wing at the inner side, but is only a little widened, the cusp has three teeth, of which the central one is biggest. The cusp of the spatulate uncinal is a little truncated, rather big, the ultimate uncinus is longer than wide (THIELE).

The sculpture appears to be rather variable, especially in regard to the number of nodulose ribs on the lateral areas and end valves. The diagonal ribs separating the central from the lateral areas are always strongest; less strong but always well developed are the ribs accompanying the front margins of the valves. Between them occur 0–2 intermediate ribs.

The specimen from Grenada measures 17 × 10.5 mm, its colour is yellowish brown with well defined triangular cream coloured patches on the dorsal ridge.

Those of St. John, which are too curled to be measured, but approximately 10 mm long, show the same colour pattern; there is an additional narrow greenish stripe marking the dorsal ridge, dividing the triangular white patches. Also the pustules of the diagonal ribs are clear white. The girdle is alternately greenish and brownish.

The bigger one of the Saba specimens (resp. 9 and 6 mm long) shows the same colours but has also bright blood-red stains on the valves IV–VIII.

The Rio specimens are all light yellowish brown and so are the dried ones from the Dry Tortugas (19 × 10.5 and 18 × 10 mm).

Distribution. Florida: Key West, Dry Tortugas; Culebra (DALL & SIMPSON); St. John (H.); St. Martin (H.); Saba (H.); Guadeloupe (SHUTTLEWORTH, ROCHEBRUNE); Dominica (H.); Grenada (H.); Trinidad: Bocas del Dragon (VAN ANDEL); Brazil: S. to Itanhaém, São Paulo (RIGHI).

Chaetopleura Shuttleworth, 1853

SHUTTLEWORTH 1853, p. 190; DALL 1879, p. 329.

Shell plates pustulate; on the end valves and lateral areas of the median valves the pustules are arranged in radial rows or scattered without order, on the central areas they are arranged in longitudinal rows. Upper side of the girdle clothed with small scale-like or cylindrical calcareous corpuscules, between them spicules of different sizes.

Type-species: *Chiton peruvianus* Lamarck.

17 **Chaetopleura apiculata** (Say, 1830)

Fig. 124–128, Plate IV fig. 3–6

Chiton apiculatus SAY, 1830, p. 231; SOWERBY 1840–a, f. 140; DE KAY 1844, p. 164, pl. 10 f. 201–202; GOULD 1870, p. 258, f. 522.
Chiton labeculatus REEVE, 1847, pl. 18 f. 108.
Chiton (Chaetopleura) candisatus SHUTTLEWORTH, 1856, p. 168.
Chaetopleura apiculata, CARPENTER 1873–a, p. 153; 1874, p. 120; CALKINS 1878, *n.v.*; DALL 1882, p. 410; 1883, p. 337; 1889–a, p. 172, pl. 51 f. 10; PILSBRY 1892, p. 35, pl. 13 f. 75–79; THIELE 1893, p. 380, pl. 31 f. 14 (radula); CROZIER 1921, p. 276 (homing); GRAVE 1922. p. 234 (spawning); 1932, p. 153 (embr., life history); 1937, p. 519 (culture methods); JOHNSON 1934, p. 13; DEXTER 1942, p. 58; M. SMITH 1945, p. 23, pl. 57 f. 6, pl. 70 f. 10; PERRY & SCHWENGEL 1955, p. 26, pl. 1 f. 2.
Chaetopleura candisata, PILSBRY 1892, p. 37.

MASSACHUSETTS: Wood's Hole, H. Boschma leg., VIII. 1924, 9 specimens, RMNH, 2 sp. KtB 3695.
RHODE ISLAND: Off Tiverton, 2–3 fms., R. I. Johnson leg, 2 sp., dry, KtB 2731; 6 mi. S. of Tiverton, 2–3 fms., R. W. Foster leg., 4 sp., dry, KtB 3727.
FLORIDA: ½ mi. off E. end of *Sanibel Id.*, 3 sp., dry, MCZ don., KtB 3728.
GUADELOUPE: Guadeloupe, Beau leg., 1 sp., dry, in Coll. Shuttleworth, holotype of *Chiton candisatus* Shuttl., ZMB.

Animal ovate, rather elevated, carinated, the sides very slightly convex, nearly straight. The valves are not beaked, the mucro of the tail plate is swollen, a little in front of the centre, the hind slope

decidedly concave. The lateral areas of the intermediate plates are distinctly raised, sculptured with rounded, elevated pustules, which are often scattered without order; sometimes, especially in young specimens, they show a tendency to be arranged in radial rows. The head plate and the post-mucronal area of the tail plate show the same sculpture.

On the ante-mucronal area and the central areas of the median plates the pustules are arranged in longitudinal rows. On the dorsal ridge these "chains" of pustules are much more crowded and weaker; the jugum often marked by two converging rows of pustules. In adult specimens there are about 18–20 of such rows on either side of the dorsal ridge; young specimens have only 10–12 of them.

The colour is generally a light greyish or brownish, sometimes with dark brown or black stains. Specimens from Florida are generally more brightly coloured; sometimes entirely milk-white, others variegated with greenish, olive brown, scarlet, purple or pink, but not glossy.

The articulamentum is white, porcelaineous, sometimes with a bluish or greyish shade. The insertion teeth are somewhat crenulated at the edge. Head plate with 11, central plates with 1–1, tail plate with 8–11 slits. The eaves are narrow, solid. Sutural plates roundish, the sinus shallow, somewhat angular, smooth.

The dorsal side of the girdle is densely clothed with very small, ovate, calcareous corpuscules, showing all shades from white to dark chestnut, 25–30 μ long (Fig. 124). Among them, scattered without any order, are found solitary, white, smooth, slightly bent, calcareous spiculae, about 120 μ long, in long chitinous sheaths (Fig. 125, Pl. IV fig. 6). There is a marginal fringe of stout, somewhat club-shaped spicules, which are longitudinally grooved at the distal end, about 120–150 μ long (Fig. 126).

Ventrally the girdle is covered with rectangular scales, arranged in radiating rows, about 50 μ long; they are more or less curved inward at the narrow side facing the outer margin (Fig. 127, Pl. IV fig. 5, 6).

The gills are holobranchial and preanal; there are about 20–24 branchial plumes on each side, gill rows extending forward to the suture of plates II and III.

Length 20 mm; width 13 mm.

SHUTTLEWORTH's type set of *Chaetopleura candisata* proved to contain only one young specimen (6.5 × 4 mm) of *Ch. apiculata* together with a specimen of some *Lepidozona* species and an intermediate plate of some *Ischnochiton* species, the latter two unknown from the Caribbean region. In the glass jar was a label in SHUTTLEWORTH's handwriting, as I take it, reading: "*Chaetopleura. Chiton candisatus* Shuttl. In valv. neopt. C. serrati. Guadeloupe. Beau 1855."

As SHUTTLEWORTH's diagnosis was based upon two specimens attached to a dead valve of *Cardium serratum*, and his measurements indicate a larger specimen ("Long 8–9, latit. 4½–5 mm") later investigators must have mixed the type lot with other sets. Nevertheless it is quite probable that the specimen studied was the smaller one of SHUTTLEWORTH's original set of two; it fits well to his diagnosis of *C. candisatus*: it is of a light sand colour, with a white dorsal stripe. The pustules are white, much elevated, the girdle is alternately lighter and darker yellowish brown. It differs in no way from *Ch. apiculata.*

PILSBRY already remarked that Southern specimens (from Florida) "whilst agreeing with the typical form in sculpture, are smaller and comparatively narrower." From the specimens from Sanibel Id. this statement can only be confirmed; the largest measuring 12 × 7 mm.

Distribution. "It is quite commonly distributed along the Atlantic coast of the United States from Nantucket to Florida, and has also been reported from Haiti." (PILSBRY 1892, p. 36); Guadeloupe (BEAU). In depths from 3–12 fathoms (JOHNSON 1934, p. 13).

Subfamily ISCHNOCHITONINAE

Sometimes the animals are elongate, but generally they are of the common form, about 1.5 or 2 times as long as wide. Valves differently sculptured or unsculptured except for a minute granulation, the intermediate valves differentiated into a wide triangular central area and two narrow triangular lateral areas, which are sometimes hardly or not, sometimes strongly raised. Insertion plates smooth,

not sharply pectinated outside, head and tail valve many-slit, intermediate valves generally with 1–1 slits, the eaves solid. Girdle clothed with imbricating scales, mostly striate or sulcate, seldom smooth. Calcareous spicules are only found at the outer margin.

Ischnochiton Gray, 1847

GRAY 1847, p. 126.

Shell plates smooth or differently sculptured; girdle with imbricate, oval, striated scales.

Type-species: *Chiton textilis* Gray.

It is the largest genus of living Polyplacophora, split up into many subgenera and sections by various workers, such as DALL, PILSBRY and several Australian investigators, but, except in a few cases, they have not been very successful in defining the groups.

THIELE (1929) rearranged all these groups, after his careful study of the radulae, and distinguished only four sub-genera: *Stenoplax* (Carpenter MS) Dall 1878, to which all the American species belong, characterized by a radula of which the minor lateral tooth does not bear a cusp, the major lateral is provided with a tridentate cusp; *Ischnochiton* s.s., to which all Indo-Pacific species belong, characterized by a radula of which the minor lateral tooth bears a distinct cusp, the cusp of the major lateral bi-dentate; *Chondropleura* Thiele, 1906, and *Lepidopleuroides* Thiele, 1928, the latter two for the Northern Atlantic species *I. exaratus* (G. O. Sars) and *I. albus* (Linnaeus), as they do not fit to the foregoing subgenera.

However this may be, THIELE's classification is not satisfactory either, as it does not contribute to a better understanding of the true relationships of the numerous *Ischnochiton* species.

KEY TO THE SPECIES OF ISCHNOCHITON

1a. Lateral areas scarcely defined, the valves evenly covered with small granules, arranged in quincunx, without any stronger sculpture. Length up to 10 mm . . . . . *I. papillosus*

1b. Lateral areas more or less distinctly defined, all valves showing some sculpture or other 2

2a. End valves and lateral areas with radiating sculpture; girdle either with round, smooth, not imbricating scales, or with imbricating striated scales of two types, very small and much larger ones 3

2b. End valves and lateral areas sculptured with wavy or tight, granulose or smooth concentric lines, grooves, ridges or ribs. Girdle with small, imbricating, striated scales of uniform size. 4

3a. Animals elongate, large, up to 4 cm or more, strongly sculptured, mucro of tail valve posterior; girdle with two types of imbricating, striated scales . . . . . *I. pectinatus*

3b. Animals ovate, of medium size (up to 15 mm), rather weakly sculptured; girdle scales round, smooth, not imbricating . . . . . *I. exaratus*

4a. Animals about 2.5–3 times as long as wide 5

4b. Animals at best twice as long as wide 6

5a. Concentrical sculpture of end valves and lateral areas continuous, not cut into granules by radiating lines . *I. purpurascens*

5b. Concentric sculpture of end valves and lateral areas cut into granules by radiating lines . . . . . *I. floridanus*

6a. End valves and lateral areas with sharp concentric grooves or ridges. Central areas not longitudinally striate or sulcate . . 7

6b. End valves and lateral areas with wavy concentric lines or concentric series of granules or scale-like tubercles. Central areas longitudinally striate or sulcate, at least on and immediately before the diagonal ridge, near the side margins . . . 9

7a. Mucro of tail valve posterior . . . . . *I. hartmeyeri*

7b. Mucro of tail valve central or subcentral 8

8a. Animal oblong, small, 4 mm long, valves chalk-white, the sides with striking orange-brown stains, in which clear sky-blue dots occur . . . . . *I. pseudovirgatus*

8b. Animal ovate, of moderate size (about 1 cm long), differently coloured . . . . . *I. boogi*

9a. Central areas evenly granulose, on and directly before the diagonal ridge the granules are arranged in parallel longitudinal rows, so that the sides appear striate . . . . . *I. striolatus*

9b. Central areas longitudinally sulcate, except the dorsal ridge, the interstices finely granulose or pitted . . . . . *I. erythronotus*

18 **Ischnochiton purpurascens** (C. B. Adams, 1845)

Fig. 129–134, Plate V fig. 1

Chiton purpurascens C. B. ADAMS, 1845, p. 9; PETIT DE LA SAUSSAYE 1856, p. 151; CLENCH & TURNER 1950, p. 334, pl. 42 f. 2.
Chiton (Ischnochiton) purpurascens, SHUTTLEWORTH 1853, p. 199.
?Stenoplax purpurascens, THIELE 1893, p. 384, pl. 31 f. 27.
?Chiton productus REEVE, 1847, pl. 17 f. 97.
Ischnochiton productus, THIELE 1909, p. 7; 1910, p. 80, pl. 7 f. 65.
Stenoplax producta, IS. TAKI 1954, p. 74.
Chiton sanguineus REEVE, 1847, pl. 17 f. 98.
Ischnochiton multicostatus (*non* C. B. Adams), DALL 1883, p. 337.
Ischnochiton limaciformis (*non* Sowerby), DALL 1889, p. 415; 1889–a, p. 172; M. SMITH 1945, p. 23, pl. 56 f. 9a–b; OLSSON & MCGINTY 1958, p. 23; WARMKE & ABBOTT 1961, p. 217, f. 32 e.
Ischnochiton (Stenoplax) limaciformis (*non* Sowerby), PILSBRY 1892, p. 57, pl. 16 f. 11–14; DALL & SIMPSON 1901, p. 452; BOONE 1933, p. 199, pl. 125 f. A; JOHNSON 1934, p. 13.
Stenoplax acutilirata (*non* Reeve), THIELE 1893, p. 384.
?Onithochiton pruinosum ROCHEBRUNE, 1883, p. 35.
non: *Ischnochiton purpurascens* of DALL, PILSBRY, THIELE (1910–a, p. 111), JOHNSON, and other American authors [= *I. erythronotus* (C. B. Adams)].

ST. JOHN: Turner Bay, porfiritic boulders with coarse sand, tidal zone, 18.VI. 1955, 2 specimens (H. 1407).
ST. MARTIN: Great Bay, rocky debris with pools, ¼–½ m deep, 11.VI.1949, 1 sp. (H. 1126).
ANTIGUA: Dickinson Bay, N. part, sandy boulders with *Thalassia*, ½–1 m, 19.VII.1967, 5 sp. (H. 1540A).
BARBADOS: Barbados, 1 sp., ZMA.
GRENADA: White Bay at Point Salines, sandy shore with beachrock, 26.I. 1955, 1 sp. disarticulated (H. 1389).
TOBAGO: Buccoo Reef, reef flat, high-tide zone, 16.I.1955, 1 sp. (H. 1387).
ARUBA: Malmok, Arasji, dioritic boulders on sandy beach, 0–1 m, 14.VIII. 1955, 2 sp. (H. 1301); Punta Braboe, West of Oranjestad, sandy reef debris, 0–1 m, 18.VI.1930, 1 sp., ZMA (H. 1001); Lagoen near Pos Chiquito, Mrs. J. H. Beerman-Paul leg., 2 sp., dry, KtB 4477; Aruba, Mrs. Beerman leg., 1 sp., dry, KtB 4484.

Animal narrow, elongated, only little elevated, roundly arched, not carinated. The valves rather long, not beaked, with decidedly but not abruptly raised lateral areas, which are rather separated at the jugum and a little produced at the sides, allowing the girdle to encroach at the sutures.

The sculpture consists of somewhat converging, smooth, flat, wavy, a little imbricating and very slightly serrated longitudinal riblets on the lateral areas, separated by rather deep but narrow grooves. These riblets continue on the pleurae of the central area and become much finer and closer together towards the jugum, which is only finely grooved. The head valve and post-mucronal area of the tail valve with concentrical riblets like those on the lateral areas.

The tail valve large, a little longer than broad, the mucro about central, not elevated, the posterior slope rather flat, slightly concave.

The sutural plates are well developed, somewhat projecting forwardly, separated by a flat, wide sinus. Head valve with 11, intermediate valves with 1–1, the tail valve with 9 slits in the insertion plates, the teeth smooth and sharp, the eaves solid.

The colour is extremely variable, always variegated. The ground colour may be light brownish or grey, sometimes dirty white, speckled or mottled with all shades of green, rose-red or violet; sometimes the lateral parts of some valves may be uniformly crimson, in other specimens the valves are of a vivid green, with a narrow light stripe on the jugum.

The girdle is also variously coloured: often greenish grey, with small groups of dark scales; in other specimens it is alternately greenish and greyish brown or uniformly dark grey. The rather wide girdle is densely clothed with very small, much imbricating, transparent scales, about 120–130 μ long, 80–90 μ broad, sculptured with about 15–16 very delicate riblets, the interstices somewhat punctured (Fig. 129, 132).

Towards the outer margin some of the scales become distally pointed, proximally narrowed and stalked (Fig. 131), forming a transition to the peculiar, angularly bent marginal spicules which are 130–140 μ long (Fig. 130).

The ventral side of the girdle is clothed with elongate, rectangular

scales, 100 μ long, arranged in radiating rows, the terminal ones bear short and slender white spiculae (Fig. 133).

Length 29 mm; width 13 mm (specimen from Tobago).

THIELE (1893, p. 384) described the radula of *Stenoplax acutilirata* (not of REEVE, but = *I. purpurascens*), and figured that of *Stenoplax purpurascens* (C. B. Adams) (pl. 31 f. 27). The rhachidian tooth oblong, with a large cusp at the tip; the minor lateral tooth large, spoon shaped; the major lateral with a tridentate cusp, the teeth blunt; the spatulate uncinus expanded anteriorly in triangular shape (Fig. 134). Is. TAKI (1954, p. 74) compared the radulae of the closely related species *Stenoplax alata* (Sowerby), *S. limaciformis* (Sowerby), *S. venusta* (Is. & Iw. Taki), *S. producta* (Reeve) = *I. purpurascens* (C. B. Adams) and *S. fallax* Carpenter.

The name *Chiton purpurascens* has been misinterpreted for a long time. An accurate reading of C. B. ADAMS's short Latin diagnosis: "*C. t. praelongata, purpureo-rubente, concentrice striata; margine lato, exilissime squamuloso, caerulescente, alternatim pallidore. Long. 1.1 poll., lat. .5 poll.*" already created a doubt to me for the word "*praelongata*" (much protracted), combined with the measurements (ca. 28 × 12.7 mm) and the girdle-characteristics ("*exilissime squamuloso*"), are not at all applicable to the species called *Ischnochiton purpurascens* by PILSBRY and subsequent authors. They indicate a much larger and more elongate, concentrically striated species like *Chiton limaciformis* Sowerby.

The girdle, very minutely scaly, as described by ADAMS, is also a strong indication that the author in point of fact had a specimen before him of the species that two years afterwards was called *Chiton sanguineus* (and perhaps also *Chiton productus*) by REEVE.

This supposition was strengthened when studying SHUTTLEWORTH's paper. SHUTTLEWORTH had a great knowledge of the species described by C. B. ADAMS and after having received two specimens of *Chiton purpurascens* collected by BLAUNER in Puerto Rico he added to ADAMS's original description: "... *Species pulchra facile distinguenda, forma angusta valde elongata, sculptura eximia in areis centralibus et lateralibus continua ...*" (A beautiful species, easily recognizable, of a narrow, very elongate form, sculpture excellent,

continuing across the central and lateral areas). SHUTTLEWORTH's largest specimen measured 29 × 10 mm.

The photograph of the holotype specimen, in CLENCH & TURNER (1950, pl. 42 f. 2), removes all doubts as to the true identity of *Chiton purpurascens*. It shows clearly the species hitherto called "*Ischnochiton limaciformis*." In a letter, dated January 9, 1956, Miss TURNER informs me about the holotype: "The upper part of the girdle is covered with minute scales; there are traces of radiating impressed lines on the lateral areas of the intermediate valves and on the end valves; the longitudinal riblets on the valves are flat and smooth."

After this DALL's remark (1889, p. 416): "*Chiton sanguineus* Reeve is a mere color variety of *limaciformis*, but has generally been referred to as a synonym of *C. purpurascens* C. B. Adams, which from authentic specimens is a totally distinct species from *limaciformis*" is therefore inconceivable to me. It must have caused the confusion which was continued by PILSBRY, who attached the name *purpurascens* to a different species, *Ischnochiton erythronotus* (C. B. Adams).

That *Chiton limaciformis* Sowerby (1832, p. 26), described from the CUMING collection and originating from Inner Lobos Island, Perú, differs from the (closely related) West-Indian form is clearly shown by THIELE (1910, p. 80, pl. 7 f. 64, 65). *Chiton sanguineus*, described by REEVE from St. Vincent, is undoubtedly a synonym of *I. purpurascens*. I cannot decide whether REEVE's *Chiton productus* ("habitat unknown") is referable to the present species or to *I. limaciformis*. The slightly longer posterior valve and roughened lateral areas in the author's detail figures rather point to the latter.

PILSBRY's description of *I. limaciformis* is apparently based on the large series of *I. purpurascens* collected by ROBERT SWIFT in St. Thomas. It is hardly believable that PILSBRY had no eye for the rather striking differences in sculpture between the two species.

In the collection of the Rijksmuseum van Natuurlijke Historie, Leiden, are two dried specimens of *I. limaciformis* (Sowerby), labelled "Lobos Island, Peru. H. CUMING." In the Zoologisch Museum of the Utrecht State University I found another specimen, labelled likewise. The three specimens may have formed part of the original lot from Inner Lobos Island in the Cuming collection described by

SOWERBY. The larger one in the Leiden museum measures 30.5 × 11.5 mm, the smaller one 19 × 7 mm.

These specimens have the lateral areas much more sharply defined and more abruptly raised than in *I. purpurascens*. The riblets on the central areas are still finer and closer, those on the lateral areas not flat, nor imbricating, but much interrupted and becoming roughly granulose, especially near the margin. As a result of the rather abrupt elevation of the side-areas the riblets of these parts are not so distinctly continuous on the sides of the central areas. The tail plate is a little longer, the mucro decidedly before the centre. The colour is yellowish, the larger specimen has large, dark grey blotches, some of the valves wholly grey, the smaller one with only a few small, light brick red spots near the umbones of II, III, IV, and VIII.

Though closely related the two species are easily separable. THIELE found the scales of the perinotum more strongly ribbed in *I. limaciformis* than in *I. purpurascens*, a feature I cannot confirm as the Cumingian specimens have totally lost their girdle scales.

Distribution. ?Bermuda (CROZIER); Florida: Key West (HEMPHILL), Dry Tortugas (PALMER); S.E. Gulf of Mexico, in 37 fms. (DALL); Jamaica (ADAMS, type locality); Puerto Rico (BLAUNER; DALL & SIMPSON); St. Thomas (SWIFT); St. John (H.); St. Martin (H.); Antigua (H.); Guadeloupe (BEAU); St. Vincent (GUILDING); Barbados (THIELE); Grenada (H.); Tobago (H.); Aruba (H.).

19 **Ischnochiton floridanus** Pilsbry 1892

Fig. 135–136, Pl. V fig. 2

Ischnochiton (*Stenoplax*) *floridanus* PILSBRY, 1892, p. 58, pl. 17 f. 19–22; DALL & SIMPSON 1901, p. 452.

Ischnochiton floridanus, THIELE 1910–a, p. 110; JOHNSON 1934, p. 13; AGUAYO & JAUME 1936, p. 117; M. SMITH 1945, p. 23, pl. 56 f. 5a–d; WARMKE & ABBOTT 1961, p. 217.

FLORIDA: *Bonefish Key* (near Key Vaca), A. Koto leg., 3 specimens, dry, KtB 2850. *Craig Key*, J. E. Conkling leg., 2 sp. dry, KtB 2234. *Gasparilla I.*, Boca Grande, 1 sp., dry, MCZ don., KtB 3729.

PILSBRY's description reads:

"Shell elongated, narrow, elevated, the valves roundly arched,

not carinated. Color whitish or delicate green, variously marked and mottled with olive, blackish olive or grey.

The lateral areas are raised, longitudinally costulate, the riblets cut into granules by radiating impressed or incised lines developed over the whole area or over the forward half of it. End valves similarly cut into granules by radiating and concentric lines. Central areas covered with longitudinal riblets which are finer and closer upon the jugum, usually showing a tendency to be a little irregular on either side of it, and are granulous toward the outer angles of the areas. Posterior valve large, rather depressed, the mucro slightly posterior.

Interior pink, blue and white, in various proportions, rarely all roseate or all white. Sutural plates strongly developed, rounded; sinus wide, deep square. Anterior valve having 9, central valves 1, posterior 9 slits; teeth sharp, smooth or very obsoletely lobed. Eaves narrow, solid.

Girdle delicately marbled with bluish and grey, densely clothed with rounded, solid, delicately striated scales.

Length 41, breadth 15 mill.

Length 35, breadth 11.5 mill."

The specimens I was able to study are all dried. The girdle scales closely resemble those of *I. purpurascens* in size and outlines. They are not "solid, delicately striated" as PILSBRY states, but as thin and transparent as in the foregoing species, from which they markedly differ in the rather strong ribbing of the upper surface. On most of them I counted 8 ribs, abruptly ending shortly before the slightly and obtusely pointed top of the scale. The average length amounts to 125–130 μ (Fig. 135). They are always decidedly longer than wide. The margin lacks the peculiar, angularly bent spicules common with *I. purpurascens*. The scales of the ventral side do not differ markedly from those of that species. There is a fringe of short cylindrical, stalked spicules, which are rather blunt and coarsely sulcate, about 115–120 μ long (Fig. 136).

The type specimens originate from Key West and were collected by HENRY HEMPHILL. *I. floridanus* is, as already stated by PILSBRY, closely related to *I. purpurascens* (C. B. Adams) (not of authors!),

but differs principally in the differently sculptured lateral areas and end valves.

The specimen from Boca Grande shows narrow triangular dark chestnut marks on the jugum of II–VIII and a series of small dark points on the diagonal ridges, giving them a pitted appearance. The specimens from Bonefish Key (Plate V fig. 2) are roseate, mottled with brown or grey, one of them is very dark grey, mottled with yellowish white, the two specimens from Craig Key are almost uniform yellowish brown. The Bonefish Key specimens are very large, the largest measuring 41 × 15.5 mm.

Distribution. Florida: Key West (HEMPHILL, type locality), Boca Grande, (MCZ), Bonefish Key (KOTO), Craig Key (CONKLING), Dry Tortugas (THIELE); Cuba: Veradero (AGUAYO & JAUME); Culebra (DALL & SIMPSON).

20 **Ischnochiton boogii** Haddon, 1886

Fig. 137–150

?*Chiton roseus* (*non* Blainville, 1825) SOWERBY, 1832, p. 58; 1840–a, f. 14; REEVE 1847, pl. 25 f. 119; DESHAYES 1836, p. 498; PILSBRY 1892, p. 113, pl. 21 f. 49–50.

Ischnochiton boogii HADDON, 1886, p. 15 (*pars*); LELOUP 1938, p. 10, f. 2–4; THIELE 1910, p. 80, pl. 7 f. 66–68.

Ischnochiton pruinosus (*auct., nec* Gould), DAUTZENBERG 1900, p. 220 (*fide* LELOUP 1938).

Ischnochiton bermudensis DALL & BARTSCH, 1911, p. 287.

non: *Ischnochiton roseus* (*auct., nec* Sowerby), DUPUIS 1917, p. 530 (= *I. striolatus* Gray, *fide* LELOUP 1938).

BERMUDA: Bermuda, Maj. A. Peile, R. A., leg., 6 specimens, BMNH; Bermuda, Haycock leg., 1 sp., dry, partly disarticulated, type of *Ischnochiton bermudensis* Dall & Bartsch 1911, USNM 223354.

Animal oblong-ovate, narrow, rather elevated, the back evenly arched without a trace of a dorsal keel, the valves thin, semitransparant, not beaked.

Lateral areas of the intermediate valves moderately elevated. Sculpture consisting of a fine and close concentric ribbing of the head plate (Fig. 137, 144), the lateral areas of the intermediate plates (Fig. 138, 145, 147) and the post-mucronal area of the tail plate (Fig. 139, 140, 146). On the intermediate valves the riblets form a rather

abrupt angle of about 90° on the diagonal ridge and continue across the central area, though they are very weak here and almost inconspicuous, especially towards the jugum.

The tail plate is half-elliptical, with the mucro a little behind the centre, the posterior slope rather steep, about flat.

The colour is variable; two specimens are of a uniform chalky white, another is light yellowish with a few fine brown lines on the jugum of some of the valves, two specimens are light roseate, mottled all over with small red or reddish brown spots, another again has light violet spots on a milk white ground.

The inside of the valves is whitish, the colour of the tegmentum shining through; the insertion plates are narrow, sharp, white, with 10–11 slits in the head plate, 1–1 in the intermediate plates and 8–10 in the tail plate. The sutural laminae are small, subtriangular, widely separated by a large flat sinus.

The narrow girdle is dorsally clothed with minute imbricating scales, a little longer than broad, about 85 × 80 μ, and sculptured with 11–16 sharp, narrow riblets (Fig. 141, 148). The ventral side is covered with radiating rows of rectangular scales (Fig. 143). There is a marginal fringe of stout, striated, blunt spicules, 175 μ long, many of which are strongly bent near the distal end (Fig. 142, 149, 150).

Length 9 mm; width 4.5 mm.

"There is not the shadow of an excuse for the change of name made by HADDON, as BLAINVILLE's *C. roseus* belongs to a genus universally admitted to be distinct," PILSBRY wrote (1892, p. 113). But LELOUP (1938, p. 10) pointed out that according to the International Rules of Zoological Nomenclature SOWERBY's name, being preoccupied by that of DE BLAINVILLE, has to be abandoned, no matter whether the genus to which it belongs is different or not.

The radula was described by THIELE (1910, p. 81, pl. 7 f. 68). The rhachidian tooth is narrow and has a cusp which is a little broader, not reflected and at the side of the anterior end somewhat pinched; the minor lateral tooth has no cusp, at the side of the anterior end it has an oblong egg-shaped appendix, the posterior lamella is angulate, widening towards the end; the cusp of the major lateral tooth is tridentate.

On account of the rather long, erect girdle scales the species is related to *I. purpurascens* and *I. floridanus*, which also have a decidedly concentric sculpture; it is, however, not so elongate as those much larger species.

Chiton roseus Sowerby was described from specimens in the Museum CUMING, originating from I. Plata, which is an island off the Ecuador shore. It was recorded from Perú (BRADLEY, in Mus. Yale College, fide PILSBRY). Whether specimens from Perú are identical to those from the Caribbean Area needs confirmation, however.

Dr. CLYDE F. E. ROPER, USNM, enabled me to study the unique type specimen of *I. bermudensis* Dall & Bartsch. The specimen, partly dissected, appears to be an *I. boogii* of a beautiful dark crimson colour, mottled with white and still darker red blotches, the girdle yellowish, alternating with red patches; insertion plates with 11–1–8 slits, dimensions 11 × 4 mm. The lateral areas are strongly sculptured with concentric grooves, which become obsolete and hardly visible on the central areas. The perinotum elements are in all respects identical to those of *I. boogii*. The dorsal scales are somewhat longer than wide, 25–60 μ long, sculptured with 11–13 flat ribs, the interstices punctured. There is a fringe of marginal spicules, which are sharply pointed, provided with a few strong longitudinal ribs; most of them, however, were rubbed off or broken. The few that are left agree very well with those pictured by LELOUP (1938, f. F).

Ventrally the girdle is covered with rectangular scales, arranged in radiating rows on different levels: the lowermost are 45 × 30 μ, those directly following them are 45 × 18 μ and the scales of a still deeper layer measure 50 × 12 μ.

LELOUP, who studied the same material, collected in the Bermuda's by PEILE, gave an excellent picture of the girdle scales (Fig. 148). The girdle elements fully agree with those of *I. bermudensis*, which is figured for the first time (Fig. 137–143).

Distribution. Bermuda (PEILE); Los Testigos (40 m deep, DAUTZENBERG); Fernando Noronha (HADDON). – ?Ecuador: I. Plata (CUMING); ?Perú (BRADLEY).

21 **Ischnochiton striolatus** (Gray, 1828)

Fig. 151–166, Plate V fig. 3, 4

Chiton striolatus GRAY, 1828, p. 6; REEVE 1847, p. 22 fig. 144.
Ischnochiton striolatus, PILSBRY 1892, p. 105, pl. 20 f. 20–24; DALL & SIMPSON 1901, p. 452; THIELE 1910–a, p. 110; NIERSTRASZ 1927, p. 163; JOHNSON 1934, p. 13; WARMKE & ABBOTT 1961, p. 217.
Ischnochiton (Rhodoplax) striolatus, THIELE 1929, p. 17.
Ischnochiton (Stenoplax) striolatus, RIGHI 1967, p. 86, f. 2–11.
Rhodoplax striolata, THIELE 1909, p. 3, 7.
Chiton squamulosus C. B. ADAMS, 1845, p. 8; PETIT DE LA SAUSSAYE 1856, p. 151; PILSBRY 1892, p. 106; CLENCH & TURNER 1950, p. 344, pl. 42 f. 1 (lectotype).
Chiton (Ischnochiton) squamulosus, SHUTTLEWORTH 1853, p. 200.
Rhodoplax squamulosa, THIELE 1893, p. 385, pl. 31 f. 28 (radula).
Chiton (Leptochiton) pruinosus GOULD, 1852, p. 316, pl. 27 f. 419a–b.
Ischnochiton pruinosus, PILSBRY 1892, p. 109, pl. 21 f. 27–28; LELOUP 1938, p. 1, f. 1, 5, 6; 1956, p. 43.
Chiton (Ischnochiton) lutulatus SHUTTLEWORTH, 1853, p. 200; PILSBRY 1892, p. 107.
?Lepidopleurus corrosus ROCHEBRUNE, 1883, p. 36; PILSBRY 1893–a, p. 108.
Ischnochiton boogii HADDON, 1886, p. 15 (*pars., fide* LELOUP 1938, p. 11).
Chiton (Ischnochiton) caribbaeorum (Carpenter MS) E. A. SMITH, 1890, p. 496, pl. 30 f. 5, 5a; PILSBRY 1892, p. 107, pl. 20 f. 25, 26.
Ischnochiton (?caribbaeorum var.) *jamaicensis* (Carpenter MS) PILSBRY, 1892, p. 108.
Ischnochiton (?jamaicensis) viridior (Carpenter MS) PILSBRY, 1892, p. 108.
Ischnochiton roseus (*non* Sowerby), DUPUIS 1917, p. 530.
Ischnochiton pseudostriolatus LELOUP, 1961, p. 6, pl. 1 f. 3, pl. 2 f. 3, text f. 5, 6.

non: *Ischnochiton pruinosus*, DAUTZENBERG 1900, p. 220 (= *I. boogii* Haddon).

UNKNOWN LOCALITY: A tablet containing 4 dry specimens from the Cuming Collection, labelled "*Ischnochiton caribbaeorum* Cpr.," BMNH; a tablet containing 4 dried sp., Cuming Coll., labelled "*Ischnochiton striolatus*" by E. LELOUP, BMNH; ?West-Indies, a tablet containing 1 dry sp. from Cuming Coll., labelled "*Ischnochiton caribbaeorum* Cpr. var." by P. P. CARPENTER, a pencil note added by CARPENTER on the back of the tablet reads: "This name must be suppressed for one of Shuttleworth's PPC." BMNH. ?West-Indies, a tablet containing 1 dry sp., from Cuming Collection, labelled "*Ischnochiton ?jamaicensis* var. *viridior*" by CARPENTER, BMNH; ?South America, a tablet containing 1 dry sp., Capt. P. P. King's Collection, marked "*striolatus*" and also "*Ischnochiton pruinosus* Gould" on the back of the tablet, BMNH; South America, a tablet with 2 dry sp., Capt. P. P. King's Coll., marked "*striolatus* Gray," BMNH.

JAMAICA: a tablet containing 1 dry juv. sp., Cuming Coll., obtained from C. B. Adams, labelled "*Ischnochiton jamaicensis*" by P. P. CARPENTER, E. A. SMITH added in pencil: "= *striolatus*," BMNH.

PUERTO RICO: 1 dry sp. collected by Blauner, 1853, labelled by SHUTTLEWORTH: "*Ischnochiton. Chiton lutulatus* Shuttl." (Holotype); J. R. M. BERGEN-

HAYN added two other labels, one reading "*Ischnochiton lutelatus*" [*sic*!], the other "*Ischnochiton dispar* (Sow.)," ZMB.
ST. THOMAS: a tablet with 7 dry sp., Cuming Coll., labelled "*Ischnochiton caribbaeorum* Cpr." by CARPENTER, BMNH; a tablet containing 3 dry sp., Cuming Coll., labelled "*Ischnochiton caribbaeorum* Cpr." by CARPENTER, BMNH; a tablet with 2 dry sp., Cuming Coll., labelled "*Ischnochiton caribbaeorum* Cpr." by CARPENTER, BMNH; a tablet containing 1 dry sp., Cuming Coll., partly disarticulated, labelled "*Ischnochiton caribbaeorum* Cpr." by CARPENTER, BMNH; a tablet with 1 dry sp., Cuming Coll., labelled "*I. caribbaeorum* Cpr." by CARPENTER, BMNH; a tablet containing 5 dry sp., R. Swift leg., MCZ don., KtB 3723.
ST. JOHN: Turner Bay, porfiritic boulders with coarse sand, tidal zone, 18.VI. 1955, 2 sp. (H. 1407).
ST. CROIX: Krausse Lagoon, entrance, canal with tidal flow among *Rhizophora*, 1½ m deep, 15.VI.1955, 2 sp. (H. 1405).
ANTIGUA: Dickinson Bay, N. part, sandy boulders with *Thalassia*, ½–1 m, 19.VII.1967, 24 sp. (H. 1540A).
GUADELOUPE: Rivière Salée, La Manche à Eau, sandy mud with *Thalassia* near *Rhizophora*, 1 m, 16.VII.1967, 1 sp. (H. 1545A).
DOMINICA: Prince Rupert Bay, near Portsmouth, boulders of volcanic rock with sand, 0–1 m, 15.VII.1967, 15 sp. (H. 1546).
MARTINIQUE: Anse de l'Ane near Trois Islets, sandy boulders of volcanic rock, 0–1 m, 10.II.1964, 1 sp. (H. 1439).
BARBADOS: A tablet containing 1 dry sp. Cuming Coll., labelled "*Ischnochiton caribbaeorum* Cpr." by CARPENTER, BMNH.
GRENADA: White Bay, Point Salines, beachrock with sandy pools, some *Thalassia*, tidal zone, 26.I.1955, 2 sp. (H. 1389).
TOBAGO: Buccoo Reef, reef flat, tidal zone, 16.I.1955, 1 sp. (H. 1387).
BONAIRE: Lac. Soerebon (= Sorobon), sandy mud with *Rhizophora*, abt. 1 m, 17.IV.1955, 1 sp. juv. (H. 1062a); Soerebon, *Porites* and *Goniolithon* flat, tidal zone, 17.IV.1955, 7 sp. (H. 1373A); Sorobon, sandpit, up to 3 m deep, 18.IX. 1967, 1 tail valve (H.); Bao di Dam, 500 m SW Cai, among sandy *Acropora* in surf, 1 m, 25.VIII.1967, 1 sp. (H. 1562); Awa Blancu, 400 m NE Sorobon Pt., 1–2 m, 25.VIII.1967, sandy area, 1 sp. (H. 1564); Secu di Sorobon, 250 m N Sorobon Pt, *Porites-Thalassia* flat, ½–1 m, 21.VIII.1967, 1 sp. juv. (H. 1566); Boca, sandy *Acropora* in surf, 1–2 m, 1.X.1948, 1 sp. juv. (H. 1068a); central part of Lac, 500 m W Cai, sandy with *Thalassia*, 3½ m, 11.VIII.1967, 1 sp. (H. 1571); Punta di Palu Calbas, sandy mud, limestone, ½–1 m, 5.IX.1967, 1 sp. (H. 1592B). – Paloe Lechi N of Kralendijk, beach rock with sandy pools, 24.II.1949, 2 sp. (H. 1056Aa); Paloe Lechi, sandy reef, abt 2 m, 30.VIII.1948, 3 sp. disarticulated (H. 1056Ca); Kralendijk, near Pasanggrahan, beachrock with tidal pools, 20.IX.1948, 1 sp. (H. 1057A); Kralendijk, Zeebad, abt. 4 m, 1 sp. (H.); Entrance Harbour, Mrs. M. J. Beerman-Paul, leg., 1 sp., dry, KtB 4487.
KLEIN BONAIRE: East coast at landing place, sandy reef debris, ½–1½ m, 13.IX.1948, 1 sp. juv. (H. 1049B); Southeast coast, sandy limestone debris, tidal zone, J. S. Zaneveld coll., 13.IV.1955 (H. 1372).
CURAÇAO: Fuik Baai, lagoon, W.-wall, rock debris, 0–3 m, Zaneveld coll., 13.III.1955, 2 sp. (H. 1344); Spaansche Water, a tablet containing 2 dry sp.,

C. J. van der Horst coll., 5.V.1920, ZMA don., KtB 1566; Spaansche Water, New Haven, landing, rocks in muddy lagoon, ½–1 m, 10.IV.1949, 11 sp. (H. 1036); *do.* 5.II.1949, 2 sp. (H. 1036a); Spaansche Water, Brakke Put Peninsula, sandy mud with *Rhizophora* and *Thalassia*, 0–1 m, Zaneveld coll., 19. XII.1954, 4 sp. (H. 1342). – Piscadera Baai. Boca, sandy pebbles, 1½–2 m, 5.I.1964, 3 sp. (H. 1457); Boca, sandy area, 1–1½ m, 5.I.1964, 1 sp. (H. 1458); Entrance, near *Rhizophora* 0–1½ m, tidal flow, 14.XII.1963, 4 sp. juv., 1 ad. (H. 1463); Entrance, *Rhizophora*, 0–1 m, 28.IX.1963, 1 sp. (H. 1464); N. part of inner bay, muddy sand, 2 m, 30.X.1963, 2 sp. juv. (H. 1480A). – Southern shore, K. M. de Jong coll., 5 sp., dry.

ARUBA: Malmok, Arasji, diorite boulders with sand, *Thalassia*, 0–1 m, 14. VIII.1955, 8 sp. (H. 1301); Lagoen near Pos Chiquita, 1968, Mrs. Beerman leg., 2 sp., dry, KtB 4478; Aruba, Mrs. Beerman leg., 9 sp., dry, KtB 4486.

FERNANDO NORONHA (Brasil): 4 dry sp., labelled "*Ischnochiton caribbaensis* Cpr." (*sic*!) by E. A. SMITH, in pencil altered into "*striolatus*," possibly also by SMITH, BMNH.

BRASIL (mainland): Rio de Janeiro, a tablet containing 11 sp., dry, Rev. W. Hennah leg., labelled "*Chiton striolatus* Gray" (Gray's original type set?), BMNH; *do.*, a tablet containing 2 sp., dry, Cuming Coll., labelled "*Ischnochiton pruinosus* Gould"; E. A. SMITH added in pencil: "*Chiton striolatus* Gray," BMNH; Boa Viagem, Niteroí, Est. do Rio, H. de Souza Lopes leg., 22.X.1949, 11 sp. (KtB 3161); Cabo Frio, Est. do Rio, H. de Souza Lopes leg., III. 1951, 7 sp. (KtB 3162); Sta. Catarina: Camburiú, H. de Souza Lopes leg. 2.II. 1954, 44 sp., dry, KtB.

Animal oblong-oval, moderately elevated, indistinctly keeled, the sides regularly arched, the intermediate valves with little elevated lateral areas. Head valve, lateral areas of intermediate valves and post-mucronal area of tail valve sculptured with rather close, shallow, concentric zig-zag-grooves. Central areas of intermediate valves minutely granulated in quincunx. Towards the sides the granules are arranged in very fine, close lirulae crossing the pleurae and becoming more distinct as they draw nearer to the diagonal ridge, giving the sides a more or less longitudinally grooved appearance.

Tail valve with a central mucro, the hind slope slightly concave, the intermediate valves not or only weakly beaked.

The colour is very variable; the lecto-type is of a light orange hue, others are olive green, with a pattern of greyish, brownish, white or black spots or stripes, but there are also brown specimens with a white dorsal stripe, white ones with a few small triangular brown spots on the jugum, deep roseate and even violet specimens, with or without a row of dark spots at the sutures.

According to the colour of the tegmentum, the inside of the valves

is light greenish, brownish or roseate, with the sutural plates and insertion teeth white.

The head and tail valves generally have 9–11, the intermediate valves 1–1 slits in the insertion plates; the teeth are short, smooth and sharp, the eaves narrow and solid. The sutural plates are not much projecting, rather broad, the sinus wide and flat.

The girdle is moderately wide, covered with closely imbricating scales (Fig. 154), which have a narrow lozenge-shaped base (Fig. 162) and are strongly curled up; they are much wider than high, about 230 × 110 μ and sculptured with about 12 (9–14) rather flat and wide ribs, converging to the evenly rounded top of the scale (Fig. 155, 163). The marginal scales are somewhat narrower, with fewer ribs. At their base, just over the outer margin very small (± 15 μ long) short, stalked spicules-scales are found (Fig. 164). Ventrally the girdle is covered with radiating rows of rectangular scales, having a small round projection on the short side facing the outer margin; the terminal ones are about twice as long as broad and bear calcareous spicules of about 85 μ long, 15 μ thick, rather blunt and longitudinally striated or ribbed (Fig. 165). Generally the girdle is variegated, but in many specimens it is almost uniformly coloured, or with alternating dark and light patches.

Length 23 mm; width 13 mm.

The synonymy of this variable species is highly confusing. GRAY described his *Chiton striolatus* after specimens from Rio de Janeiro. In the collections of the British Museum (Natural History) in London is a tablet containing 11 specimens collected by the Rev. W. HENNAH at Rio de Janeiro, which is regarded upon as the probable type set.

It is curious, therefore, that PILSBRY in his ample discussion of the species – principally based on the study of CARPENTER's MSS – makes no mention of Rio de Janeiro as the "locus typicus." The author only records St. Thomas and Barbados as the "native soil" of *Ischnochiton striolatus*.

Through the kind intermediation of Dr. H. DE SOUZA LOPES of the Instituto "Oswaldo Cruz," I obtained alcohol specimens from the neighbourhood of Rio de Janeiro. All of these specimens, which are

very variable in colour though fairly constant in sculpture, are specifically identical with those of GRAY's supposed type set.

I am greatly indebted to Dr. KUENZI of the Zoologisches Museum in Bern, Switzerland, and to the late Dr. G. L. WILKINS of the British Museum (N.H.), who favoured me with the loan of material that served R. SHUTTLEWORTH and P. P. CARPENTER for their studies of the Antillean *Ischnochiton* species.

After having examined these sets and also the few lots in the collections of the Rijks Museum, Leiden and the Zoologisch Museum in Amsterdam as well as those in our own collection, and the extensive series collected by Dr. P. WAGENAAR HUMMELINCK throughout the Lesser Antilles, I have no doubt that the Caribbean species described as *Chiton squamulosus* C. B. Adams, *Ischnochiton lutulatus* Shuttleworth, *Ischnochiton caribbaeorum* (Carpenter MS) E. A. Smith, *Ischnochiton jamaicensis* (Carpenter MS) Pilsbry, *Chiton (Leptochiton) pruinosus* Gould, and *Ischnochiton pseudostriolatus* Leloup are all identical with the *Chiton striolatus* Gray from Rio de Janeiro.

The main cause of the confusion is the variability of the species, not only in its colour and sculpture, but also in the slitting of the insertion plates and the ribbing of the girdle scales.

Generally the Rio specimens are only weakly sculptured. As the "lecto-type" I chose a fine, light ochraceous specimen from GRAY's supposed type set (Fig. 151–155).

Specimens from St. Thomas have the girdle scales somewhat more strongly ribbed, while the tegmentum also shows a more prominent sculpture. They are generally dark olive green or light ochraceous, mottled with lighter and darker green, brown or clear white. The sculpture of the lateral areas is often roughly granulose or scaly, so that the concentric zig-zag-grooves become indistinct or disappear.

The juvenile specimen from Jamaica, called *I. jamaicensis* by CARPENTER, has the lateral area evenly granulose (Fig. 159–160), but is no doubt an *I. striolatus* and so is his var. *viridior* (Fig. 158).

SHUTTLEWORTH's unique type specimen of *I. lutulatus* is in all respects identical with the Rio specimens of *striolatus*. It is of a light greenish or ochraceous colour, speckled and dotted all over with white and light brown (Pl. V fig. 4). It has nothing to do with the

Chiton dispar described by SOWERBY from the Gulf of Panama, with which R. BERGENHAYN united it, as appears from his additional label accompanying the type specimen.

Chiton squamulosus C. B. Adams from Jamaica is also a synonym of *I. striolatus*. The original description reads: "C. t. olivacea, linea pallide virente dorsali – ornata; areis lateralibus squamosis inequalibus prostratis – obtectis; areis dorsi mediis sublaevibus, punctostriatis; margine exile squamuloso, alternatim cinereo-virescente viridique. Long. .7 poll.; lat. .4 poll. Jamaica." I have not seen the types, which are in the Museum of Comparative Zoology, but the above diagnosis and the photograph of the lectotype published by CLENCH & TURNER (1950, pl. 42 f. 1) indicate with certainty that it is the strongly sculptured form which is common in the Antilles.

The specimens from Fernando Noronha described as *Ischnochiton caribbaeorum* (Carpenter MS) by E. A. SMITH are strong shells with the central areas nearly smooth; there is only a faint striation directly before the diagonal ridges. Some of the specimens show distinct concentric lines of growth on the valves (Fig. 156, 157). Like the Rio specimens they are more vividly coloured than those from the Antilles.

Specimens from Bonaire and Curaçao are generally strongly sculptured, with the central areas finely lirulate on the pleurae and the lateral areas either roughly granulose, the granules arranged in close, concentric rows, or with fine zig-zag-grooves which give them a somewhat scaly appearance.

About *Lepidopleurus corrosus* Rochebrune which is, judging from the original description, in all probability a synonym of *I. striolatus*, Dr. RANSON of the Laboratoire de Malacologie in Paris kindly informed me that the type was lost. PILSBRY gave a translation of DE ROCHEBRUNE's description. It reads: "Shell ovate, subcarinated, ashen, covered with minute black points. Anterior valve, posterior area of posterior valve and lateral areas of intermediate valves corroded. Central areas with minute rod-like (virguliform) striae. Marginal ligament rather wide, white, ornamented with alternate ashen and orange spots. Length 15, breadth 8 mill. Island Cochino, Guadeloupe. Rare. Mus. Paris."

Ischnochiton funiculatus (Carpenter MS) Pilsbry, regarded by the

author as a variety of *I. striolatus*, proves to be a synonym of *I. erythronotus* (C. B. Adams).

Chiton (Leptochiton) pruinosus Gould, described from near Rio de Janeiro, is also a synonym of this rather variable species, which evoked some misunderstanding, chiefly on account of GOULD's inaccurate figures, which were copied by PILSBRY. His description, however, covers in all respects the characteristics of *I. striolatus*.

A study of the types of LELOUP's *Ischnochiton pseudostriolatus* from Sta. Marta, Colombia, and from Cuba in the Institution Royal des Sciences Naturelles, Bruxelles, bore out my opinion that this is another synonym of *I. striolatus*; I did not see in what respects these animals would be different from young *striolatus*.

The radula was figured by THIELE (1893). [Fig. 166].

Distribution. E. coast of Florida, off Fernandina (in 294 fms., JOHNSON); Key West (DALL); Cuba (LELOUP); Jamaica (ADAMS); Puerto Rico (SHUTTLEWORTH); Culebra (DALL & SIMPSON); Arroyo (DALL & SIMPSON); St. Thomas (SHUTTLEWORTH); St. John (H.); St. Croix (H.); Antigua (H.); Guadeloupe (BEAU); Dominica (H.); Martinique (H.); Barbados (PILSBRY); Grenada (H.); Tobago (H.); Bonaire (H.); Klein Bonaire (H.); Curaçao (NIERSTRASZ, H.); Aruba (H.); Colombia, mainland (LELOUP); Fernando Noronha (E. A. SMITH); Brasil mainland: Ceará (RIGHI); Pernambuco (RIGHI); Alagoas (RIGHI); Espírito Santo (RIGHI); Rio de Janeiro (GRAY); São Paulo (RIGHI); Santa Catarina (DE SOUZA LOPES).

22 **Ischnochiton erythronotus** (C. B. Adams, 1845)

Fig. 167–174, Pl. V fig. 5–8, VI fig. 1–4

Chiton erythronotus C. B. ADAMS, 1845, p. 9; CLENCH & TURNER 1950, p. 278, pl. 42 f. 5.
Chiton (Ischnochiton) erythronotus, SHUTTLEWORTH 1853, p. 200.
Ischnochiton erythronotus, PILSBRY 1892, p. 104; THIELE 1910–a, p. 110, pl. 9 f. 6, 7.
?Rhodoplax erythronotus, THIELE 1892, p. 385, pl. 31 f. 29 (radula); 1909, p. 3.
Chiton (Ischnochiton) lateritius SHUTTLEWORTH, 1853, p. 199.
Ischnochiton lateritius, PILSBRY 1892, p. 105.
Ischnochiton purpurascens (auct., nec C. B. ADAMS), DALL 1889–a, p. 172; PILSBRY 1892, p. 58, pl. 17 f. 23, 24; 1893–a, p. 75; DALL & SIMPSON 1901, p. 452; THIELE 1910–a, p. 111; ?CROZIER 1919–a, p. 359 (use of the foot); ?1920–b, p. 377 (photic sensitivity); JOHNSON 1934, p. 13.
Ischnochiton funiculatus (Carpenter MS) DALL, 1889–a, p. 172 (name only); PILSBRY 1892, p. 108 (description).
?Ischnochiton striolatus funiculatus, JOHNSON 1934, p. 13.

FLORIDA: *Bonefish Key*, B. R. Bales leg., 1 specimen, dry, KtB 3724; *do.*, 1 sp., dry, MCZ don., KtB 3725; *do.*, 1 sp., dry, R. H. Moses don., KtB 729; *Dry Tortugas, Garden Key*, A. Koto leg., 4 sp., dry, KtB 2847.
PUERTO RICO: P. Rico, 1 sp., dry, Blauner, 1853, Coll. Shuttleworth, ZMB, labelled "*Chiton* (*Ischnochiton*) *erythronotus* C. B. Ads." by SHUTTLEWORTH; La Parguera, Mata de la Gata, *Porites* flat with some *Thalassia*, tidal zone, 12.IX.1963, 1 sp. (H. 1419A).
ST. THOMAS: 2 sp., dry, Blauner, 1853, Coll. Shuttleworth ZMB, labelled "*Chiton* (*Ischnochiton*) *erythronotus* C. B. Ads." by SHUTTLEWORTH; 2 sp. dry, Blauner, 1852, Coll. Shuttleworth, ZMB, labelled "*Chiton* (*Ischnochiton*) *lateritius* Shuttl." by SHUTTLEWORTH.
ST. EUSTATIUS: S. Gallows Bay, rocks, 2 m deep, 15.VII.1949, 1 sp. dry, disarticulated (H. 1116B).
GUADELOUPE: 7 sp. dry, Bernardi, 1855, Coll. Shuttleworth, ZMB, labelled "*Chiton* (*Ischnochiton*) *erythronotus* C. B. Ads." by SHUTTLEWORTH; 1 sp. dry, Bernardi, 1855, coll. Shuttleworth, ZMB, labelled "*Chiton* (*Ischnochiton*) *erythronotus* C. B. Ads." by SHUTTLEWORTH; 1 sp. dry, Coll. Cuming, labelled "*Ischnochiton funiculatus* Cpr." by CARPENTER (type), BMNH.

Shell elongated, about parallel-sided, twice as long as broad, generally moderately elevated, though the degree of elevation is rather variable (angle of divergence 95°–120°), the sides only a little angularly bent, the back evenly rounded, not carinated or subcarinated, the valves not or only slightly beaked.

The head plate and post-mucronal area of the tail plate are sculptured with somewhat wavy or irregular concentric grooves, separating rather narrow, little elevated, flat riblets, which are cut into irregular granules by a variable number of radiating grooves. The radial grooves, however, show a tendency to disappear in some specimens.

Central areas of the intermediate valves and ante-mucronal area of the tail valve sculptured with about 12–16 rather narrow and a little granulose longitudinal riblets at both sides of the dorsal ridge, becoming stronger and more elevated towards the side margins and fainter as they approach the dorsal ridge where they are often interrupted. The intervals are minutely pitted.

The jugum is smooth or only indistinctly scratched or punctured; in some specimens this smooth area is rather wide, in others only narrow. The central area of the second valve is for the greater part smooth or nearly so, except for a few riblets directly before the diagonal ridge, near to the side margins. The riblets of the central

areas continue on the lateral areas, where they often dentate the sutures. On this part of the valves the riblets become very irregular and are often cut into flat knobs, warts or tubercles of different forms and sizes by a few radiating impressed lines, though these radials are not always present.

The tail valve is elevated, with a distinct but not very prominent mucro situated a little behind the centre, the posterior slope is decidedly concave.

Colour excessively variable, often pale buff or creamy, mottled or maculated with black, dark grey, blue or olive; sometimes with small dark red spots on or near the dorsal ridge; others are uniformly creamy, reddish brown, or yellow with a few small white spots on the dorsal ridge.

Inside of the valves glossy, the colour of the tegmentum showing through. The intermediate plates and the tail valve are a little porous in the middle, directly behind the flat jugal sinus. The insertion plates are short and sharp, the head valve with 9–10, the intermediate valves with 1–1, and the tail valve with 9–10 inequidistant slits, the slit rays distinct, the eaves narrow and solid. The sutural plates are widely separated, small, sub-trigonal.

The girdle is dorsally clothed with imbricating scales, which are 160 μ broad, 85 μ long, on a very narrow lozenge-shaped base, strongly curled, with an evenly rounded top and about 12 strong, flat ribs, which are as wide as the finely pitted interstices (Fig. 169, 170). The ventral side is covered with rectangular scales, 65 μ long, 16 μ wide, in radiating series (Fig. 171), the terminal ones much shorter, bearing knobs (Fig. 172) or calcareous spicules of about 100 μ long, gradually tapering to a rather blunt point and very slightly striated (Fig. 173).

Length 14.5; width 7 mm.

THIELE described and figured the radula (Fig. 174), but I am not certain that his *Rhodoplax erythronotus* is identical with this species.

It is the *Ischnochiton* (*Stenoplax*) *purpurascens* of DALL, PILSBRY and subsequent authors, but not of C. B. ADAMS. PILSBRY, THIELE, and others, were under the impression that there existed two closely related species in the Caribbean, viz *I. purpurascens auct., nec* C. B.

Adams and *I. erythronotus*. It was THIELE who put the differences between the supposed two species into words (1910–a, p. 111), unaware that he had only two forms of the same species before him. Meanwhile ADAMS's *Chiton purpurascens* proved to be the species generally called *I. limaciformis* (*auct., nec* Sowerby).

A close study of the specimens at my disposal convinced me of the fact that *I. erythronotus* is one of those variable species of which the extreme forms are different enough to make one believe that they belong to separate species, as long as one has not set eyes upon intermediate forms.

The two type specimens of SHUTTLEWORTH's *Chiton* (*Ischnochiton*) *lateritius* from St. Thomas (coll. BLAUNER) (Pl. V fig. 6, 7) are only weakly sculptured forms of *I. erythronotus* of a beautiful reddish brown colour with a few small white spots on the evenly rounded dorsal ridge. The grooves separating the little elevated riblets are decidedly punctured, a character which is not always distinct in other specimens.

I had also the opportunity to study the unique type specimen of CARPENTER's *Ischnochiton funiculatus* on a tablet from the CUMING collection in the British Museum (N.H.) (Fig. 167, 168), of which the original description, as it is published by PILSBRY, reads: "Shell small, strongly oval, subelevated, the jugum little acute; pale ashen, ochraceous or olivaceous variegated; mucro central, moderately prominent. Entire surface wrinkled and minutely pitted; wrinkles subregular, nearly parallel with the dorsal ridge on the central areas, about 18 on each side, obsolete towards the jugum; the moderately distinctly defined lateral areas and the end valves undulated and having subobsolete radiating lirulae. Interior: posterior valve with 7–9, anterior valve 7–10, central valves 1 slit. Teeth acute; eaves moderate; sinus wide, flat. Girdle furnished with very close, deeply striated, flattened scales. Length 10, width 5 mill.; divergence 95°. – Guadeloupe (Mus. Cuming, No. 44)." – "One specimen is of a pale yellowish tint slightly variegated with a brighter color; another is more ashy and with the variegations of pale olive. It has stronger sculpture than *I. caribbaeorum*, the rugulae rising up like close rungs in a ropeladder, and dentating the sutures."

On the back of the tablet (obviously only one specimen has been

left!) is a label marked "*Ischnochiton funiculatus* Cpr." in CARPENTER's writing. A pencil note, also by CARPENTER, reads: "Comp. *striolatus* var." with which species the author at a later date wrongly united it (*fide* PILSBRY). The type is a fine specimen of *I. erythronotus*, 11 × 6 mm, rather elevated, subcarinated, strongly sculptured, with only a narrow smooth dorsal ridge and distinct radial impressed lines on the lateral areas and end valves (Fig. 167, 168).

The original diagnosis of *Chiton erythronotus* C. B. Adams reads: "C. t. parva, subelongata, flavido-albida, irregulariter rubro-maculata; areis lateralibus costatis, costis nodulosis, areis dorsi striatis; margine squamuloso. Long. .55 poll.; lat. .3 poll."

CLENCH & TURNER (1950) gave a not too clear photograph of the unique type specimen from Jamaica. Miss TURNER informed me that "the riblets on the pleurae continue on the lateral areas, where they are cut into granules by low, impressed, radiating lines."

Distribution. Bermuda (GOODE); Florida: Key West (PILSBRY), Bonefish Key (BALES, KOTO), Dry Tortugas (KOTO); Jamaica (C. B. ADAMS); Puerto Rico (BLAUNER); St. Thomas (BLAUNER); Loango (THIELE); St. Eustatius (H.); Guadeloupe (BERNARDI).

23 **Ischnochiton papillosus** (C. B. Adams, 1845)

Fig. 175–178, Plate VI fig. 5

Chiton papillosus C. B. ADAMS, 1845, p. 9; CLENCH & TURNER 1950, p. 322, pl. 42 f. 4.
Chiton (Ischnochiton) papillosus, SHUTTLEWORTH 1853, p. 201.
Ischnochiton papillosus, DALL 1889–a, p. 172; PILSBRY 1892, p. 114, pl. 21 f. 40, 41; DALL & SIMPSON 1901, p. 453; M. SMITH 1945, p. 23, pl. 56 f. 4; PERRY & SCHWENGEL 1955, p. 26, pl. 1 f. 1; WARMKE & ABBOTT 1961, p. 217, fig. 32a.
Ischnochiton (Ischnoplax) papillosus, JOHNSON 1934, p. 13.

non: *Ischnochiton papillosus*, THIELE 1910, p. 77, 78, pl. 7 f. 50.

FLORIDA: *Bonefish Key*, A. Koto leg., 6 specimens, dry. KtB 2851; *do.*, 1 sp., dry, MCZ don., KtB 3726; *Pigeon Key*, L. B. Holthuis leg., 30.I.1965, 1 sp., RMNH.
GUADELOUPE: 3 sp., dry, 1855, Bernardi leg., Coll. Shuttleworth, ZMB.

Animal small, oval or elongate oval, little elevated, weakly carinated, the valves very slightly beaked. Tegmentum evenly granulose lateral areas not raised, only faintly defined by inconspicuous di-

agonal ridges. The granules on both central and lateral areas are arranged in quincunx. The tail plate has a central mucro, which is not much elevated, acute, the hinder slope somewhat concave.

Colour uniformly olive green, sometimes mottled with olive-brown or with the granules whitish. The alcohol specimen from Pigeon Key has a beautiful white dorsal stripe extending from the front margin of II to the mucro of the tail valve. Another specimen has reddish brown stains on the pleurae of some intermediate valves and also on the girdle.

The articulamentum is white, greenish in the centre caused by the tegmentum showing through. The sutural plates are narrow, widely separated, evenly rounded, the sinus shallow and wide. The insertion plates are very narrow and smooth, the head valve with 9–10, the intermediate valves with 1–1, the tail valve with 8–10 slits; the eaves narrow, solid.

The girdle is narrow, pale yellowish alternating with darker patches, clothed with very small and delicate imbricating scales of about 70–75 μ wide, 45–50 μ long, ornamented with 8–10 very coarse ribs, which are a little wider than the slightly punctured interstices, somewhat converging to the evenly rounded top (Fig. 175).

The ventral side of the girdle is covered with radiating rows of rectangular scales, about 60 μ long, 15 μ wide (Fig. 176); towards the outer margin they become much shorter, rounded at the narrow side facing the margin, the terminal ones bearing short, rather abruptly tapering, coarsely ribbed spiculae of about 50 μ long, 15 μ thick (Fig. 177), and fewer smooth, somewhat curved, more slender spicules which are about 60–70 μ long, 10–12 μ thick (Fig. 178).

Length 10.5 mm; breadth 5.5 mm.

The texture of the valves is much like that of the well-known European *Lepidochitona cinerea*, though the valves are less elevated and the lateral areas still more inconspicuously defined.

THIELE (1910, p. 77) described a related species, *I. fraternus* from unknown locality which he compares to the present species. From his remarks, however, it is very doubtful to me whether THIELE ever saw true *I. papillosus*. He studied a specimen of 11 × 6.5 mm which was collected by PÄTEL in St. Thomas and also two smaller ones

from the same island, collected by VERKRÜZEN, which he found to be different, especially in their girdle scales and radulae. That's why THIELE suggested that there might exist two closely related species in the Caribbean Area.

Neither the girdle scales of PÄTEL's specimen, nor those of VERKRÜZEN's specimens agree with the scales of the specimens described above. The former are said to be 160 μ wide, sculptured with about 15 ribs, the latter are 100–150 μ wide, with 18 ribs. In all specimens I could study, also in those from the SHUTTLEWORTH collection, I found only 8 or 9, seldom 10 ribs on the scales, which rarely exceed a width of 75 μ. This also agrees with C. B. ADAMS' original diagnosis of the girdle: *"margine exile squamuloso."*

I. fraternus Thiele, which is very much sculptured like *I. papillosus*, has the girdle scales as small as in the latter species, but they are sculptured with many very fine riblets, quite unlike the scales of *I. papillosus*.

THIELE also described the radula of *"I. papillosus"* but as long as the true identity of the specimens to which the author attached this name is not decided, I think it wiser to neglect it.

Distribution. Florida: West-Florida as North as Tampa, Florida Keys (DALL); Jamaica (ADAMS, type locality); Culebra (DALL & SIMPSON); St. Thomas (DALL); Guadeloupe (BERNARDI).

24 **Ischnochiton pseudovirgatus** sp. n.

Fig. 179–185

CURAÇAO: Boca Lagoen, sandy beach with pebbles, tidal zone, 13.XI.1948, 1 specimen, holotype (H. 1020B).
ARUBA: Malmok, Arasji, rocky beach with sand and dioritic boulders, *Thalassia* flat with *Porites*, 0–1 m deep, 14.VIII.1955, 1 sp., paratype (H. 1301).

Animal small, elongate oval, subcarinated, moderately elevated, the sides somewhat convex, valves nearly smooth. Lateral areas of the intermediate valves narrow, only very slightly raised, weakly foncentrically ribbed or folded, especially near the side margins, the colds faintly denticulating the sutures (Fig. 179).

Head plate with very fine concentric grooves, particularly near the margin, postmucronal area of the tail valve sculptured like the head valve. The mucro of the tail valve a little in front of the centre, not swollen, the hind slope somewhat concave.

The valves are dull chalky white, the pleurae of the central areas with a well defined pattern of yellowish brown spots in which sky blue dots occur. The jugal part only shows a few short irregular lines or dashes. Lateral areas with the same yellowish dashes or spots. On the diagonal ridge, close to the outer margin, a few small blackish spots.

Articulamentum white, the sutural plates evenly rounded, head valve with 9, intermediate valves with 1–1, tail valve with ? slits (not disarticulated).

Girdle narrow, densely clothed with small white imbricating scales, which are very delicate, strongly vaulted, on a narrow yellowish brown base, very short, about 96 μ wide, 32–38 μ long, weakly ribbed with 15–18 (mostly 16) flat ribs, much wider than the shallow interstices, the edges of the ribs somewhat serrate (Fig. 180–182).

The ventral side of the girdle is clothed with short rectangular scales in radiating rows, about 22 μ long, 15 μ wide (Fig. 183). The marginal ones are obtusely pointed (Fig. 184). There is a marginal fringe of short, bluntly pointed spiculae, which are 50 μ long, 10–12 μ wide, ornamented with a few coarse, curved or screw-like ribs. Among them occur very small conical spiculae of about 10–20 μ long and longer, slender, smooth ones, 70 μ long, 8–10 μ thick, which are accompanied by a few very small ones of 8–10 μ long (Fig. 185).

Length 4.2 mm; width 2.1 mm (holotype from Curaçao); 3.6 × 1.9 mm (paratype from Aruba).

I. pseudovirgatus is quite unlike all the other Caribbean Ischnochitons. In form and colour, though not in sculpture, the species closely resembles the Australian *I.* (*Euporoplax*) *virgatus* (Reeve). The blue dots in the brown spots are very peculiar and much like the colour pattern of *I.* (*E.*) *virgatus* and *I.* (*Haploplax*) *lentiginosus* (Sowerby) from Australia. It makes the species easily recognizable.

Distribution. Curaçao (H.); Aruba (H.).

25 **Ischnochiton hartmeyeri** Thiele, 1910

Fig. 186–194

Ischnochiton hartmeyeri THIELE, 1910–a, p. 111, pl. 9 f. 8–16.

There is no material of this species available. The following lines are a translation of THIELE's original description of a single specimen from Bird Key Reef, Tortugas:

The length of the animal is about 5.5 mill., the width 3.5 mill. The shell is transparant, whitish with chalk-white spots near the margin and small brown ones in the median parts. It is rather regularly and flatly arched, without a median keel, egg-shaped. On the anterior valve (Fig. 186) and on the lateral areas a very fine and concentrical furrowing is perceptible, causing a fine denticulation of the hind margins. The sides of the central areas are inconspicuously granulated, likewise the tail valve (Fig. 189) whose apex is situated only a little before the hind margin by which the hind slope is very steep. The anterior margins of the valves are rather straight and distinctly bent outward at the small sutural plates (Fig. 187, 188). The anterior and posterior margins have 8 slits, the intermediate plates 1–1.

The scales on the upper side of the girdle are thin and rather narrow, about 45 μ broad, with about 16 narrow riblets (Fig. 190); over the proper marginal corpuscules there are larger spicules of about 75 μ long (Fig. 191) and smaller ones, about half as long; the chitinous cups at the base of the latter are covered by minute calcareous scales (Fig. 192).

On the under side the scales are differentiated toward the margin into narrow and broader ones alternating rather regularly (Fig. 193).

Obviously the species resembles *I. pseudovirgatus*, especially in form and sculpture and also in the number of ribs on the girdle scales, but they differ largely in the shape of the posterior valve and also in colour and in the shape of the scales.

THIELE also described the radula: The rhachidian tooth of the radula is posteriorly roundish, pinched more anteriorly and gradually widening again forwardly, with a forwardly bent cusp; the minor lateral tooth is rather long and narrow, without a cusp but

with a pointed appendix at the anterior external angle, in the anterior half distinctly curved inward at one side; the major lateral tooth has a simple pointed cusp and at the inner side a wing-shaped distally widened appendix; the spatulate uncinus is broad, smooth-edged (Fig. 194).

In spite of its minute size the species is very interesting and different from all other species, the posterior position of the apex, the girdle scales and the radula make it easily recognizable (THIELE).

Distribution. Dry Tortugas (HARTMEYER).

26 **Ischnochiton exaratus** (G. O. Sars, 1878)

Fig. 195–199, Plate VI fig. 9

Lophyrus exaratus G. O. SARS, 1878, p. 113, pl. 8 f. 1, pl. II f. 1.
Trachydermon exaratus, VERRILL 1882, p. 365; 1884, p. 208, pl. 30 f. 2, 2a, 2b; DALL 1889–a, p. 172, pl. 45 f. 2, 2a, 2b.
Ischnochiton (*Trachydermon*) *exaratus*, PILSBRY 1892, p. 71, pl. 7 f. 39–49.
Ischnochiton (*Lepidozona*) *exaratus*, THIELE 1902, p. 286, pl. 21 f. 63.
Ischnochiton (*Chondropleura*) *exaratus*, THIELE 1906, p. 325; 1929, p. 18.
Lepidochiton exarata (*-us*), JOHNSON 1934, p. 12; ÓSKARSSON 1961, p. 176.

NORWAY: Hardangerfjord, T. A. Verkrüzen leg., 2 specimens, dry, RMNH; Bergen, T. A. Verkrüzen leg., 1 sp., dry, RMNH; Bergen, T. Soot-Ryen leg., 1 sp., dry, KtB 3125.
GRÖNLAND: 3 sp., dry, RMNH.

Animal elongate-oval, moderately elevated, somewhat carinated, the sides only little convex, the valves not or only very slightly beaked. Anterior valve with fine radiating and concentrical grooves giving it a granulose appearance; the radiating grooves somewhat wider, predominating over the shallow and narrow concentric furrows.

The intermediate valves have the lateral areas distinctly raised, sculptured like the head valve, with 6–7 radiating grooves crossed by narrower concentric grooves, cutting the ribs into coarse squarish granules, becoming rectangular towards the margin where the concentric grooves are wider separated. The concentric grooves continue on the lateral areas, where they are decidedly pitted. Towards the

jugum they become obsolete leaving the dorsal ridge smooth, except for a fine and even granulation.

The tail valve has the mucro a little in front of the centre, not swollen, somewhat acute, the hind slope straight. The ante-mucronal area is sculptured like the central areas of the intermediate valves, the post-mucronal area like the head valve.

The colour of the tegmentum is uniformly whitish, dirty white or yellowish, not glossy.

The inside is white, porcelaineous, the sutural laminae separated by a very wide, flat sinus; they are evenly arched, not projecting much, the insertion plates narrow, smooth, with distinct slit rays and short, sharply cut slits. Anterior valve with about 10, intermediate valves with 1–1, tail valve with about 12 inequidistant slits, the eaves narrow, solid.

The girdle is dorsally covered with erect, elongate, somewhat curbed calcareous corpuscules of about 220 μ long and a diameter of about 120 μ (Fig. 195–197). They are deeply emplanted in the girdle tissue, without chitinous cups or sheaths, only the rounded "heads" sticking out of the surface, regularly arranged in quincunx, so that the girdle looks as if it is paved with round, not imbricating scales. Towards the margin they become more elongate, the terminal ones obtusely pointed, forming a fringe of very short, smooth, stout and blunt spiculae (Fig. 199).

Ventrally the girdle is covered with elongate rectangular scales of about 50 μ long, 10 μ wide, arranged in radiating rows (Fig. 198).

Length 14 mm; width 7.5 mm (specimen from Bergen); "Length 17 mm, breadth 8 mm" (VERRILL).

On account of the peculiar girdle covering and the radula THIELE (1906) created the subgenus *Chondropleura* for it, with *I.* (*C.*) *exaratus* as the only species.

The latter also described the radula (1902, p. 72): The rhachidian tooth has a distinct cusp, the sides distinctly arcuate, posteriorly incised; the minor lateral tooth has a small cusp with an angular widening at the outside behind it which is possibly comparable to the wing of related species; the major lateral tooth possesses a

simple pointed cusp and a wing at the inside obliquely directed toward the front and distally widened.

Distribution. Norway: from Bergen Northward (SARS); Iceland (ÓSKARSSON); Grönland (RMNH); Atlantic coast of North-America: off Martha's Vineyard, 101–194 fms.; Florida: off Fernandina, 294 fms. (DALL).

27 **Ischnochiton pectinatus** (Sowerby, 1840)

Fig. 200–206, Plate VI fig. 6–8

Chiton pectinatus SOWERBY, 1840, p. 288, pl. 16 f. 3; 1840–a, f. 146; REEVE 1847, pl. 26 f. 133; PETIT DE LA SAUSSAYE 1856, p. 151.
Ischnoplax pectinatus, CARPENTER 1873, *n.v.*; DALL 1879, p. 297, pl. 3 f. 23 (radula); THIELE 1909, p. 3 (*pectinata*).
Chiton (*Ischnochiton*) *pectinatus*, SHUTTLEWORTH 1853, p. 201; E. A. SMITH 1890, p. 496.
Ischnochiton pectinatus, THIELE 1910–a, p. 110; DALL 1883, p. 337; OLSSON & MCGINTY 1958, p. 23.
Ischnochiton (*Ischnoplax*) *pectinatus*, PILSBRY 1892, p. 64, pl. 17 f. 25–30; THIELE 1929, p. 17; JOHNSON 1934, p. 13.
Callistochiton pectinatus, RIGHI 1967, p. 88, f. 1 (radula).
Chiton multicostatus C. B. ADAMS, 1845, p. 8; CLENCH & TURNER 1950, p. 312, pl. 42 f. 3; DALL 1883, p. 337.
Stereoplax multicosiata [*sic*], THIELE 1893, p. 384, pl. 31 f. 25 (radula).
Chiton acutiliratus REEVE, 1847, pl. 8 f. 46.
Gymnoplax spiciferus ROCHEBRUNE, 1883, p. 36; PILSBRY 1893–a, p. 109.
Callistochiton incurvatus LELOUP, 1953, p. 9, f. 6, 7.

non: *Ischnochiton* (*Lepidopleurus*) *pectinatus*, CARPENTER 1864, p. 612; 1866, p. 211 [= *Ischnochiton californiensis* Berry].
non: *Ischnoplax pectinatus*, THIELE 1893, p. 376, pl. 31 f. 1 [= *Lepidozona clathrata* (Reeve)].

ST. EUSTATIUS: Gallows Bay, volcanic rocks, 2 m deep, 15.VII.1949, 7 specimens (H. 1116B).
ARUBA: Malmok, Arasji, dioritic boulders on sandy beach, 0–1 m, 14.VIII. 1955, 1 sp. (H. 1301).
WEST INDIES: 1 sp., dry, ZMA.

PILSBRY (1892, p. 64–65) gave an excellent description:

"Shell elongated, narrow, elevated; gray, mottled and dotted over with black, more or less stained in places with pink.

The valves are strongly convex; end valves radiately coarsely granose-ribbed; umbo of posterior valve elevated, situated behind

the centre. Lateral areas much raised, having radiating granose riblets; central areas having smaller cords, which are close and longitudinal on the jugum, but become more spaced, coarser, and diverging on the pleurae or sides of the central areas.

Interior bright pink. Anterior valve with 10–12, intermediate valves 1, posterior valve 8–11 slits. Teeth sharp, frequently bifid; eaves unusually wide, solid, scalloped by the sculpture of the outside. Sutural plates high, rounded. Sinus deep, square.

Girdle covered with extremely fine scales among which larger, long flat scales are irregularly scattered.

Length 40, breadth 17 mm."

The author adds to it: "Readily known from other West India Chitons by its elongated form, speckled and mottled coloring, and especially by the very peculiar girdle. The large scales are distinctly but finely striated. The ground-color of the girdle is pale buff, with patches of olive green. The large scales are mingled white and buff on the light tracts, and are a dark blue-green on the dark patches."

DALL (1879, p. 296, pl. 3 f. 23) described and figured the radula: "Minor lateral with a broad, stout, cusped shaft, inner wing expanded, outer wing reduced to a rudiment, with a linguiform process; major lateral with a simple rounded cusp, shaft with a triangular keel but no projecting process." The radula was also described by THIELE (1893) and RIGHI (1967) who added nothing new to DALL's observations.

The species is rather constant in its characteristics. The beautiful specimens from St. Eustatius (Pl. VI fig. 6) and Aruba enable me to give some additional particulars.

The colour varies only little; most of the specimens show bright green spots on the tegmentum, some of them are more or less stained with violet, but there is always that striking black and buff speckling all over the valves.

The lateral areas have 5–8 radial cords, much interrupted towards the side margins and often cut into granules or short bars by concentric grooves and growth-striae continuing over the whole of the valves; one of the specimens has the cords neatly pustulose.

The valves are never umbonated; therefore the lateral areas are not connected on top of the valve, but rather widely separated. The jugal area shows 4–6 (or a few more by splitting) close and fine cords, the pleural sides 8 much coarser and more elevated ones. The mucro of the tail valve is situated nearly right over the hind margin, the posterior slope is steep and decidedly convex. The post-mucronal area shows 16–20 radiating riblets, splitting or branching toward the margin, antemucronal area with 16 riblets. The anterior slope of the head plate is also convex; this valve has 20–25 riblets.

The largest specimen I saw, from St. Eustatius, measures 39 × 17 mm, the smallest 24 × 11 mm. The Aruba specimen measures 24 × 10 mm, but is slightly curled. Slitting: 9/11–1–9/10. The gill formation is holobranchial and preanal.

The armature of the girdle is very peculiar as there are two kinds of scales, as is the case in the Australian section *Heterozona* Dall.

Dorsally the girdle is covered with much crowded, small, delicate, bluntly rounded scales, 130 μ wide, 80 μ long, strongly ribbed with 9–11 flat ribs, which are somewhat serrate at the edges, separated by much narrower grooves (Fig. 201). Among them, scattered without order, much larger scales are found, 520 μ long, 320 μ wide, not curved nor vaulted, distally evenly rounded, with 16–18 very fine flat, somewhat serrate ribs, the interstices much narrower, the base more or less bilobed (Fig. 200). Towards the margin smaller and relatively shorter scales of this type are found, about 315 μ long, 270 μ broad. There is a marginal fringe of small, blunt, calcareous spicules, about 100–110 μ long, 12–15 μ thick, rather strongly ribbed or sulcate, placed in chitinous cups (Fig. 204, 205).

The ventral side of the girdle is covered with radiating rows of rectangular, yellowish, articulating scales, about 75 μ long, 16 μ wide, the terminal ones much shorter and distally obtusely pointed or rounded (Fig. 202). In some places I found two layers of scales, the innermost layer consisting of much shorter and wider, colourless ones, which have the sides more rounded, 30 μ long, 22 μ wide (Fig. 203); in other places alternating rows of both types of scales were found.

REEVE's picture of *Chiton acutiliratus* shows the typical form of

I. pectinatus. Chiton multicostatus, described by C. B. ADAMS, is also a synonym as is plainly shown by the photograph of the lectotype (in the Museum of Comparative Zoology, Harvard College) in CLENCH & TURNER (1950, pl. 42 f. 3).

Dr. GILBERT RANSON of the Laboratoire de Malacologie in Paris was so kind as to send me photographs of the two specimens of DE ROCHEBRUNE's *Gymnoplax spiciferus* (Plate VI fig 7, 8) from Ile Cochino (presumably Ilet à Cochons), Guadeloupe, from which it is evident that the name is a mere synonym of *I. pectinatus*.

LELOUP's *Callistochiton incurvatus*, described after two young animals from the neighbourhood of Pernambuco in the British Museum (N.H.), is another synonym of the present species, as was shown by RIGHI (1967, p. 89).

I do not see any reason why *I. pectinatus* should be placed in the genus *Callistochiton* as the insertion plates are typically of the Ischnochitonoid type.

CARPENTER (1873) created the genus *Ischnoplax* for it, which was characterized by DALL (1878, p. 330): "Body elongated, elevated, the valves having high sutural plates and strongly elevated lateral areas; mucro posterior, elevated; girdle clothed with very minute imbricating scales and having larger conspicuous striated scales among them."

Distribution. Florida Strait (JOHNSON); Cuba (CUMING); Jamaica (ADAMS); St. Eustatius (H.); Guadeloupe (SWIFT, ROCHEBRUNE); Barbados (REEVE); Aruba (H.); Fernando Noronha (SMITH); Brasil mainland: Ceará (RIGHI), Pernambuco (LELOUP), Algoas, Espírito Santo (RIGHI).

Callistochiton (Carpenter MS) Dall, 1882

The genus is thus characterized by PILSBRY (1893, p. 260): "Valves conspicuously sculptured; the insertion-plates short, smooth or nearly so, festooned, being curved outward at the ribs and slit there, thickened outside at the edges of the slits, the latter corresponding in position to the ribs of the outer surface. Sinus squared. Mucro medi-

an or post-median, generally depressed. Girdle poreless, densely clothed with minute striated or smooth scales."

Type-species: *Chiton pulchellus* Gray.

28 **Callistochiton shuttleworthianus** Pilsbry, 1893

Fig. 207–211, Plate VII fig. 1, 2

Callistochiton shuttleworthianus PILSBRY, 1893, p. 273, pl. 21 f. 42–46; PILSBRY & AGUAYO 1933, p. 121; JOHNSON 1934, p. 13; ?BERGENHAYN 1937, p. 284, text f. 3 f–g; REHDER 1943, p. 32; WARMKE & ABBOTT 1961, p. 217.
Ischnochiton shuttleworthianus, OLSSON & MCGINTY 1958, p. 23.
Chiton (*Ischnochiton*) *reticulatus* (*non* Reeve), SHUTTLEWORTH 1853, p. 201.

FLORIDA: *Pigeon Key*, L. B. Holthuis leg., 20.I.1965, 1 specimen, RMNH.
PUERTO RICO: Blauner leg., 1 sp. dry, Coll. Shuttleworth, labelled "*Chiton* (*Ischnochiton*) *reticulatus*," probably by SHUTTLEWORTH, ZMB.
CURAÇAO: Boca Playa Canoa, under stone, 0.1 m deep, Kees M. de Jong leg., 1 sp., dry, Coll. K. M. de Jong.

PILSBRY's original description reads:

"Shell oval, depressed but dorsally carinated, the side-slopes nearly straight; lateral areas strongly raised, bicostate, the ribs nodose; central areas having a coarse raised net-work in the middle, and longitudinally ribbed toward the sides. Girdle broad. Color of both shell and girdle intense orange yellow.

The lateral areas bear two strong ribs which bear stout transverse tubercles, the intervening spaces being closely granulate. The central areas have coarse net-like sculpture, which becomes much finer toward the beaks, and is transformed into a longitudinal costulation at the sides. The front valve has 16 or 17 strong, tuberculate radiating ribs, the whole covered by a fine granulation. The posterior valve is depressed, having a rather low but acute and slightly posterior mucro, the slope back of it being concave. It is sculptured similar to the head valve, except that the concentric sculpture predominates over the radiating.

The interior is flesh-colored; anterior valve with 10, central 1 slit, sutural plates low and rounded; sinus shallow, flat.

Girdle wide, compact, very densely clothed with closely imbri-

cating scales, the terminations of which are not striated, although the basal portions are distinctly grooved.

Length 14, breadth 9 mm."

"This handsome species constitutes one of the links between *Callistochiton* and *Ischnochiton*, agreeing in the teeth with the latter genus. The sculpture, however, is much more like *Callistochiton pulchellus* than like any *Ischnochiton* known to me; but, on the other hand, the profile of the tail valve differs utterly from that West Coast species." PILSBRY believes it to be near *Ischnochiton lateritius* (Shuttleworth), but that is a form of *I. erythronotus* (C. B. Adams), as has been shown before.

I had the opportunity to study three specimens. That from Florida is well preserved in alcohol, and larger than the type described by PILSBRY, measuring 17 × 12 mm (a little curled). The valves as well as the girdle are of a uniform clear orange colour; they are rather depressed, not or hardly carinated, not beaked. The head valve has about 16–17 nodulous ribs, which split up toward the margin, the tubercles arranged in distinct concentric rows. The lateral areas of the intermediate valves have two very strong ribs, extending from the mucro to the side-margin, one forming the diagonal ridge, the other more or less accompanying the hind margin. There are two much weaker ribs with finer granulations between them.

The jugal part of the central area shows a fine raised network pattern becoming roughly tuberculate towards the front-margin and the pleurae. Close to the side-margins the tubercles are more or less arranged in longitudinal rows.

The tail valve has a central mucro, which is somewhat swollen, curved downward, acute, the back slope concave, the sculpture exactly as described by PILSBRY.

All parts of the valves are covered with a minute granulation. The insertion plates of the intermediate valves are waved upward toward the slits, the edges of the slits somewhat thickened, corresponding in position with the diagonal ridge. Slits 11–1–9, the teeth somewhat rugose outside.

The girdle is rather wide, covered with large imbricating scales,

the largest of which are about 250 μ wide, 200 μ long, strongly ribbed with some 18 narrow ribs, abruptly ending halfway the upper surface of the scale, the interstices wider than the ribs; the distal half is smooth or somewhat pustulose (Fig. 207, 208).

Ventrally the girdle is covered with small elongate scales arranged in radiating rows. There is a marginal fringe of small, slender, pointed spiculae, about 70 μ long, and stout, curved spiculae, which are distally finely striate, 100 μ long, 30 μ thick (Fig. 209).

The specimen from the SHUTTLEWORTH collection, collected by BLAUNER in Puerto Rico, proves to be a fine specimen of *C. shuttleworthianus*, neatly dried and stretched (Pl. VII fig. 2). The whole shell, including the girdle, is covered with a dull coal-black crust; slits 10–1–9; length 13.5, breadth 8.25 mm. It was labelled "*Ischnochiton. Chiton reticulatus* Reeve."

DALL & SIMPSON (1901, p. 43) also recorded "*Chiton reticulatus* Reeve" from Eastern Puerto-Rico (GUNDLACH), but did not describe it.

Chiton reticulatus Reeve is probably a synonym of *Ischnochiton* (*Radsiella*) *tigrinus* (Krauss), originating from South-Africa.

The Curaçao specimen, collected by KEES M. DE JONG, measuring 14.3 × 8.1 mm, is of a light yellowish colour, the girdle somewhat darker, ochraceous; it is neatly dried and stretched and differs in no way from the others I have seen (Pl. VII fig. 1).

BERGENHAYN (1937) described and figured the armature of the girdle after a specimen from Floreana, Galápagos Islands (Fig. 210, 211), but I am not sure that this specimen was specifically identical with PILSBRY's *C. shuttleworthianus*. This specimen, 4.5 mm long, differs in several respects from PILSBRY's type specimen. The head plate shows only 12 radiating ribs, the colour of the tegmentum and perinotum is white with only a faint shade of yellowish. The slitting is 11–1–8, the inside of the valves white.

BERGENHAYN described the girdle scales as squarish, much flattened, curbed, colourless; the basal two thirds strongly ribbed, the distal part very minutely pustulose. His figure of one of the girdle scales does not at all agree with PILSBRY's figures (1893, pl. 21 f. 46). These minor differences as well as the localities advocate specific sepa-

ration, though not conclusively. Only the examination and comparison of the actual specimens would justify a decision whether they are identical or not.

Distribution. Florida: Key West (HEMPHILL, type locality), Pigeon Key (HOLTHUIS), Missouri Key (BALES, *fide* REHDER); Cuba: Matanzas, Veradera Peninsula (single valve, BERMÚDEZ, *fide* PILSBRY & AGUAYO); Puerto Rico (BLAUNER); Curaçao (DE JONG). – Galápagos: Floreana (BERGENHAYN).

Family **CHITONIDAE**

Lateral areas generally decidedly raised, valves sculptured, rarely smooth. Insertion plates sharply pectinated outside, slit-rays porous. Girdle covered with imbricating scales, calcareous spines, or very minute spicules. Valves sometimes with extrapigmental "eyes."

Subfamily CHITONINAE

Valves without extra-pigmental "eyes," girdle covered with rather large, imbricating scales.

Chiton Linnaeus, 1758

Central and lateral areas of the valves generally differently sculptured, seldom smooth; girdle scales large, smooth, rarely ribbed; sutural sinus denticulate.

Type-species: *Chiton tuberculatus* Linnaeus, 1758.

KEY TO THE CARIBBEAN SPECIES OF CHITON

1a. Valves smooth, glossy, reddish or purplish brown, flammulated or marmorated with dark chestnut or purplish black . . . . . *C. marmoratus*

1b. Valves decidedly sculptured 2

2a. Central areas smooth; lateral areas with 5–7 low, radiating, pustulose riblets, and a row of blackish dots along the hind margin . . . . . *C. squamosus*

2b. Central areas with longitudinal sculpture 3

3a. Central areas nearly smooth, except for a few short S-shaped grooves along the diagonal ridge, close to the side-margin; lateral areas strongly raised, with about 4 smooth ribs which are scarcely pustulose, the hind margin dentated by rather sharply pointed pustules . . . . . *C. viridis*

3b. Central areas with narrow, curved, longitudinal riblets, except on the jugal part, which is smooth; lateral areas with 4–5 interrupted, nodulous lirae . . . . . *C. tuberculatus*

29 **Chiton tuberculatus** Linnaeus, 1758

Fig. 212–221, Plate VIII fig. 2, 3

Chiton tuberculatus Linnaeus, 1758, p. 667; 1767, p. 1106; Hanley 1855, p. 12; Dall 1879, p. 297, 300; Pilsbry 1893, p. 153, pl. 33 f. 58–60; Dautzenberg 1900, p. 220; Dall & Simpson 1901, p. 453; Nierstrasz 1905, p. 151; 1927, p. 162; Thiele 1909, p. 2; 1910–a, p. 112; 1929, p. 19; Parker 1914, p. 31; Crozier 1918, p. 322 (growth, duration of life); 1918–a, p. 325 (growth); 1919, p. 278 (coalescence of shell-plates); 1920, p. 30 (sex correlated coloration); 1920–a, p. 84 (coloration); 1920–b, p. 376 (photic sensitivity); 1921, p. 276 ("homing" behaviour); 1922, p. 466 (cluster formation of sperms); 1922–a, p. 189 (colour variation); Arey & Crozier 1918, p. 157 (sensority responses); Crozier & Arey 1918, p. 487 (reaction to shading); 1919, p. 496 (ethology); Remington 1922, p. 121; Oliver 1923, p. 361; Pelseneer 1926, p. 9; Nierstrasz 1927, p. 167; Hoffmann 1931, p. 719; Johnson 1934, p. 13; Leloup 1937, p. 141, f. 8, 9, 12; Southwick 1939, p. 157, pl. 1; M. Smith 1945, p. 23, pl. 56 f. 1; Dodge 1952, p. 19; Olsson & McGinty 1958, p. 23; Warmke & Abbott 1961, p. 219, f. 33a; Glynn 1970, p. 1.

Chiton squamosus (*non* Linnaeus, 1764) Born 1780, p. 5, pl. 1 f. 1; Chemnitz 1785, p. 788–790; Guilding 1829, p. 27; Reeve 1847, pl. 3 f. 16; Petit de la Saussaye 1851, p. 426; Haddon 1886, p. 20; Heilprin 1889, p. 176.

Chiton (*Lophurus*) *squamosus* (*non* Linnaeus, 1764) Shuttleworth 1853, p. 196.

Chiton squamosus (*non* Linnaeus, 1764) var. *similis*, Petit de la Saussaye, 1856, p. 155.

Chiton undatus Spengler, 1797, p. 68; Thiele 1893, p. 362, pl. 30 f. 2 (radula).

Chiton bistriatus Wood, 1815, p. 7.

?*Chiton tessellatus* Wood, 1815, p. 23.

Chiton assimilis Reeve, 1847, pl. 14 f. 76 (right hand fig.), 77b; Dall, 1879, p. 297, pl. 3 f. 26 (radula); Petit de la Saussaye 1851, p. 426.

Chiton (Lophurus) assimilis, SHUTTLEWORTH 1853, p. 196.
Chiton tuberculatus var. *assimilis*, PILSBRY 1893, p. 155, pl. 33 f. 61, 62; WARMKE & ABBOTT 1961, p. 219.
Chiton tuberculatus var. *ater* PILSBRY, 1893, p. 155, pl. 33 f. 63.

non: *Chiton tuberculatus*, SCHROETER 1786, p. 494, pl. 9 f. 19 [= *Acanthopleura granulata* (Gmelin)]; LEACH 1852, p. 230 [= *Lepidopleurus cancellatus* (Sowerby) ?].

CUBA: Matanzas, Plaja Bellamar, 2 specimens, dry, P. Viglino don., KtB 3085.
HISPANIOLA: Haïti, Saltrou, Dépt. de l'Ouest, C. Orcutt leg., 2 sp. dry, KtB 3733.
ST. THOMAS: St. Thomas, 1866, F. von Calker leg., 1 sp. dry, RMNH.
ST. JOHN: Bay S. of Cruz Bay, boulders of volcanic rock on sandy beach, abt. 1 m deep, 19.VI.1955, 2 sp. dry (H. 1408); Turner Bay, boulders of porfiritic rock, coarse sand, 18.VI.1955, 7 sp., (H. 1407).
ANGUILLA: Sandy Ground, beach rock, reef debris, abt. ½ m, 19.VI.1949, 2 sp. juv. (H. 1142).
SABA: Fort Bay, exposed andesitic rock, tidal zone, 21.VII.1949, 26 sp. (H. 1120); *do*, 6.X.1963, 1 sp. (H. 1120A); Cove Bay at Flat Point, andesitic rock, tidal zone, 5.X.1963, 6 sp. (H. 1432); Spring Bay, andesitic rock, tidal zone, 28.VII.1949, 6 sp. + 3 juv. (H. s.n.).
ST. EUSTATIUS: Gallows Bay, andesitic boulders, mid-tide zone, 15.VII.1949, 9 sp. (H. 1116).
ST. KITTS: St. Thomas Pt. near Basseterre, andesitic rock, tidal zone, 30.VI. 1955, 20 sp. (H. 1398).
DOMINICA: Prince Rupert Bay near Portsmouth, boulders of volcanic rock, coarse sand, 0–1 m, 15.VII.1967, 20 sp. juv. (H. 1546).
TOBAGO: Red Point, SW of Scarborough, volcanic rock, tidal zone, pools, 14.I.1955, 28 sp. (H. 1388); *do*. 1 m deep, 1 sp. (H. 1388); *Little Tobago*, landing, volcanic rock, tidal zone, 18.I.1955, 1 sp. (H. s.n.).
BONAIRE: Kralendijk, beach rock, mid-tide zone, 20.IX.1948, 1 sp. (H. 1057B); Boca Washikemba, limestone rock, low-tide zone, 7.IV.1955, 1 sp. (H. 1375).
KLEIN BONAIRE: Southeastern shore, limestone debris, tidal zone, J. S. Zaneveld coll., 13.IV.1955, 7 sp. (H. 1372).
CURAÇAO: Boca Bartool, limestone cliff with muddy sand, under stones, with *Halimeda* and scanty *Thalassia*, ½–1 m, 12.II.1955, 3 sp. juv. (H. 1361); Plaja Frankie, Spaanse Put, limestone shore with sandy beach, below low-water mark, 27.II.1955, 1 sp. (H. 1317); Cape Santa Marta, limestone cliff with boulders, low-water zone, 24.II.1955, 1 sp. (H. 1324).
ARUBA: Lagoen near Pos Chiquito, Mrs. J. H. Beerman-Paul leg., 1 sp. juv., dry, KtB 4479; Aruba, Mrs. Beerman leg., 3 sp., dry, KtB 4485.
VENEZUELA-mainland: D.F., Catia de la Mar, A. N. Ch. ten Broek leg., XII. 1947, 2 sp. dry, KtB 2052; Naiguatá, E. of La Guaira, C. Beets leg., 1953/54, 4 sp. dry, RMNH.

Animal oblong-oval, moderately elevated, carinated, the side slopes only a little convex, nearly straight. The intermediate valves

decidedly beaked, especially in young specimens; in older ones the mucrones are often worn off. Tail valve with the mucro anterior, the ante-mucronal area very narrow, the hind slope almost straight, only slightly concave directly behind the mucro.

The head valve and the post-mucronal area of the tail valve are strongly sculptured with smooth tubercles arranged in two crossing systems of rows radiating from the mucro, and curved in opposite directions. Sometimes two or three tubercles are fused, forming short, interrupted riblets.

The distinctly raised lateral areas of the intermediate valves are likewise sculptured with interrupted radiating ribs or rows of tubercles, 4 or 5 in number, but never clearly separated from each other as they are much broken up, sometimes branching. The hind margins of the valves are somewhat dentated by a series of small tubercles accompanying them.

The pleurae of the central areas are sculptured with longitudinal riblets, which are forwardly curving towards the dorsal ridge, abruptly ending at both sides of the smooth jugum. The number of these riblets is rather variable in specimens of the same size. The valves are very finely granulose all over.

Inside of the valves greenish grey or bluish. The sutural laminae are rather short, wide, and much separated, the sinus wide and deep, dentate, the teeth pectinated outside; insertion plates with 12–14 slits in the anterior valve, 1–1 in the intermediate valves and 14–16 in the posterior valve; the slits inequidistant, the slitrays distinct, punctate, the teeth sharply pectinated outside, the eaves porous.

The colour of the tegmentum is also rather variable, though specimens from the same habitat are always uniformly coloured. They are mostly dark olive brown or blackish, sometimes bluish grey, others are lighter, olive-green or yellowish green, often with a dark stripe on the dorsal ridge, the tubercles on the end valves and lateral areas of the intermediate valves sometimes lighter, bluish or yellowish, the central areas sometimes clouded with dark brown or black.

The girdle shows the same colour as the tegmentum, but there are always alternating darker and lighter patches. It is clothed with large, imbricating, smooth but lusterless scales of almost equal size,

only those near the outer margin and the sutural ones are smaller. All scales have a diamond-shaped base, are strongly curved, weakly carinated, distally obtusely pointed (Fig. 212–216).

There is a marginal fringe of much smaller, blunt, somewhat curved and slightly striate spicules, which are surrounded by still smaller ones, about half their length (Fig. 217–219). Ventral side of the girdle covered with narrow, rectangular scales arranged in radiating rows (Fig. 220).

Length 90 mm, width 55 mm (specimens from Bermuda and Bahamas); in the Antilles they grow smaller, up to 76 × 46 mm (specimen from Klein Bonaire).

"Numbers of *Chiton tuberculatus* may almost always be discovered in any intertidal situation where the substratum is hard and firm, not too greatly exposed to wind and waves, free from muddy silt, the water not too stagnant nor the growth of algae too vigorous." (AREY & CROZIER, 1919, p. 160).

CROZIER (1918, p. 322) found that the age of an individual may be estimated by counting the "growth-lines" on the central area of the tegmentum of the intermediate valves. From a growth-curve, based upon the examination of 881 specimens from Bermuda of which the age could be estimated, it appears that one year old individuals are about 1.2 cm long, two-year-old ones about 3.2 cm, three-year-old ones about 3.8 and four-year-old ones 4.6 cm. Mature specimens are about 3.5 cm long. The average age is less than eight years; then they are about 7.5 cm long. The oldest individuals may attain a length of 9–10 cm; they are about 12 years old then" (p. 325).

From the material I could dispose of it was not possible to decide the age of the individuals as the lines of growth are too irregularly marked, or are totally lacking, or in a bad condition as a result of erosion.

"Young specimens (less than 2 cm) are almost always located under loose piles, flat stones, in relatively dark surroundings, at about the upper limit of the tides. Still younger ones (less than 1 cm) are commonly found beneath low-water level. After they attain a length of 6 cm they commonly frequent more exposed situations. Chitons of the largest size (8–9 cm) are most usually found freely exposed upon the intertidal zone of the shore-rocks, although they also inhabit crevices, semi-concealed depressions" (CROZIER & AREY, 1918, p. 488). – "Characteristically, however, the young chitons are found in dark situations, while the oldest ones live in light" (p. 489).

"The young chiton is photonegative, the old chiton photopositive to sunlight. Chitons of intermediate age are positive to weak light, negative to strong" (AREY & CROZIER, 1919, p. 256).

"The progressive inversion in the sense of chitons's phototropism is due to the elimination of the shell photoreceptors by erosion, thus conditioning in the older individuals a lower specific stimulating power of the light" (CROZIER & AREY, 1919, p. 497).

"In adult chitons of this species there is noticeable what appears at first sight to be a considerable diversity in the degree to which pigment, of a salmon-pink hue, is

developed upon the foot and other soft parts exposed in ventral view. Somewhat less than half of the individuals have the foot, ctenidia, and other soft parts of a pale buff color; in the remainder, the foot, head, ctenidia and mantle are to various degrees tinged with salmon-pink or orange-red pigment, the color being in some cases startingly vivid. The difference is most pronounced during late spring, but persists to some extent throughout the year. ... Individuals of any length from 3.4 to 9.2 cm may be either pale buff or salmon-pink on the ventral surface; nor does the intensity of reddish pigmentation, when present, depend upon size (CROZIER, 1920–a, p. 84)." – "The soft parts of male chitons are never colored pink; whereas those of maturing females invariably are, the intensity of the pigmentation depending to a large extent upon the state of maturity of the ovary, to a lesser extent, it seems probable, upon the quantity and the kind of the algal food available in different environments" (p. 85). The same author (p. 86) also notices "that the blood of female chitons is mahogany-red or deep orange in color (that of males being dull yellow)." The pigment was isolated and proved to belong to the "lipochromes." [These ecological data are in no way in accordance with GLYNN's, recent investigations, 1970.]

"In the gill-chambers and under the girdle considerable numbers of a commensal isopod, *Sphaeroma crenulatum* Richardson, were found, especially on sunlit shores, where *Enteromorpha* are growing in a felted covering over the rock, even 20 individuals under one 8 cm long chiton" (AREY & CROZIER, 1919, p. 167).

The radula (Fig. 221) was described by DALL (1879, p. 297, pl. 3 f. 26): "Minor lateral; shaft with small or nearly abortive wings, base long and recurved; major lateral with a simple rounded cusp, a keel on the shaft bearing a spatulate process; major uncinus feather shaped, the vane on the inner side."

REEVE's *Chiton assimilis* is often considered to be a variety of *C. tuberculatus*, characterized by its colour (light brown, with white dots on the lateral areas) and much finer, more numerous riblets on the pleurae.

These characteristics, however, are by no means constant. On the end valves and lateral areas the tubercles are almost always of a light colour. The number of riblets on the pleurae varies widely. Specimens from Venezuela and Bonaire have the pleurae of the central areas finely ribbed (20–30 riblets on either side of the dorsal ridge), whereas specimens from more northern habitats are more coarsely ribbed (10–24 riblets) (Plate VIII fig. 3). In specimens from Saba (Plate VIII fig. 2) the riblets are often very short, confined to the part directly before the diagonal ridge, so that the greater part of the central area is smooth, except for irregularly distributed transverse lines of growth.

The colour variety *ater* described and figured by PILSBRY (1893, p. 155, pl. 33 f. 63) has no significance at all; it is a blackish form of the densely ribbed type.

LINNAEUS' *Chiton tuberculatus* was for a long time misinterpreted and erroneously called *Chiton squamosus* (*non* LINNAEUS) by such authors as BORN, CHEMNITZ, REEVE, GUILDING, SHUTTLEWORTH, HADDON, and others. The error was caused by the incorrect references LINNAEUS added in the 12th edition of his Systema Naturae.

Distribution. Widespread from the Florida Keys to Texas, in Bermuda and throughout the Caribbean region.

30 **Chiton squamosus** Linnaeus, 1764

Fig. 222–227, Plate VII fig. 4

Chiton squamosus LINNAEUS, 1764, p. 465; 1767, p. 1107; SPENGLER 1797, p. 67, pl. 6 f. 2; HANLEY 1855, p. 15; DALL 1889–a, p. 172; THIELE, 1893, p. 361, pl. 30 f. 1 (radula); PILSBRY 1893, p. 155, pl. 35 f. 80–82; 1893–a, p. 88; DALL & SIMPSON 1901, p. 453; THIELE 1909, p. 2; REMINGTON 1922, p. 121; NIERSTRASZ 1927, p. 162; JOHNSON 1934, p. 13; DODGE 1952, p. 21; WARMKE & ABBOTT 1961, p. 219, f. 33b; GLYNN 1970, p. 2.
Chiton scaber variegatus CHEMNITZ, 1784, p. 31, pl. 1 f. 3; 1785, p. 276, pl. 94 f. 792, 793.
Chiton tigris SPENGLER, 1797, p. 68.
Chiton fasciatus WOOD, 1815, p. 10, pl. 1 f. 4, 5; SOWERBY 1840–a, f. 153; PETIT DE LA SAUSSAYE 1856, p. 155.
Chiton (*Lophurus*) *fasciatus*, SHUTTLEWORTH 1853, p. 198.
Chiton spengleri BLAINVILLE, 1825, p. 538.
Chiton pictus BLAINVILLE, 1825, p. 541.
Chiton cymbium BLAINVILLE, 1825, p. 542.
Chiton chemnitzii PFEIFFER, 1840, p. 78.
Chiton marmoreus (*non* Chemnitz), REEVE 1847, pl. 12 f. 64; PETIT DE LA SAUSSAYE 1851, p. 426 (*var.*).

non: *Chiton squamosus*, BORN *et al.* (= *Chiton tuberculatus* L.).

NAVASSA (W. of Hispaniola), 2 specimens dry, W. J. Clench don., KtB 2730.
ST. JOHN: Turner Bay, surf-swept porfiritic rock, tidal zone, 18.VI.1955, 1 sp. dry (H. 1407).
ST. MARTIN: Point Blanche Bay, surf-swept limestone with rock pools, 5.VI. 1955, 14 sp. (H. 1399); *Pelican Cay*, tuffoid rock, mid-tide zone, 3.VIII.1949, 1 sp. (H. s.n.).

ST. BARTS: Public, near Gustavia, andesitic rock, tidal zone, 4.VI.1949, 1 sp. dry (H. 1121).
SABA: Fort Bay, andesitic rock, tidal zone, 6.X.1963, 24 sp. (H. 1120A); Cove Bay at Flat Point, boulders of andesitic rock, tidal zone, 5.X.1963, 14 sp. (H. 1432); Spring Bay, andesite, tidal zone, 28.VII.1949, 13 sp. dry (H. s.n.).
ST. EUSTATIUS: Concordia Bay, NW corner, surf swept andesitic cliff, 10.X. 1963, 8 sp. (H. 1433); Back-off Bay, volcanic rock, tidal zone, 15.VII.1949, 24 sp. dry (H. s.n.).
BONAIRE: De Hoop, S. of Kralendijk, limestone cliff with sandy reef, tidal zone, 10.IX.1948, 15 sp. dry (H. 1058B); Punt Vierkant, as before, 9.IX.1948. 8 sp. (H. 1059A); Boca Washikemba, limestone rock, low-tide zone, 7.IV, 1955, 3 sp. (H. 1375).
KLEIN-BONAIRE: Northwest Point, low limestone cliff with sandy reef, tidal zone, 28.III.1955, 2 sp. (H. 1368).
CURAÇAO: Knip Baai, limestone cliff, tidal zone, 8.I.1949, 3 sp. dry (H. 1017); *do*, 30.IV.1949, 3 sp. (H. 1018A); Boca Lagoen, limestone, tidal zone, 30.XI. 1948, 5 sp. dry (H. 1020B); Plaja Frankie, Spaanse Put, limestone, tidal zone, 27.II.1955, 3 sp. (H. 1317); Cape Santa Marta, limestone cliff, tidal zone, 24. II.1955, 1 sp. (H. 1324); Santa Marta, in surf, J. S. Zaneveld coll., 1.XI.1954, 2 sp.; Boca Grandi di San Juan, limestone boulders, J. S. Zaneveld coll., 6.II. 1955, 1 sp. dry (H. 1330); Piscadera Baai, outer bay, limestone rock with sand, tidal zone, 29.I.1949, 3 sp. dry (H. 1029); St. Joris Baai, entrance, limestone cliff with debris, 250 m from sea, tidal zone, 20.II.1955, 10 sp. (H. 1354); Boca Bartool, entrance, limestone cliff with muddy sand, with *Halimeda* and scanty *Thalassia*, tidal zone, 12.II.1955, 1 sp. (H. 1361).
ARUBA: Boca Andicuri, surf-swept non-calcareous rock near sandy beach, 11.V.1955, 13 sp. dry (H. 1311); *do.*, limestone, 14 sp. dry (H. 1312).

All H. samples from more or less exposed localities in the mid- and low-tide zone, often preferring sunny places. Not found in inner bays.

Animal elongate-oval, moderately elevated, carinated, the side slopes only little convex, the valves with a distinct, small, pointed mucro. Head valve semi-circular, with more than 30 radiating rows of very small, roundish granules; lateral areas of the intermediate valves with 6–8 of such rows, one of which accompanying the diagonal ridge, the hind one at some distance from the smooth posterior margin. Tail valve with the mucro anterior at one third the total length of the valve, the back slope concave, at least directly behind the mucro, the post-mucronal area likewise sculptured with granules arranged in quincunx. Central areas of the intermediate valves and ante-mucronal area of the tail-valve smooth, except for very fine and regular, close-set transverse lines of growth.

Colour of the tegmentum rather constant: it is always dull, the ground colour is of a pale yellowish, olive, greenish or bluish grey, on

the central areas marked with broad longitudinal dark greenish, bluish grey or blackish stripes of which those on either side of the carina are almost always somewhat wider and darker, often accompanied by very light yellowish stripes. In many specimens the dorsal ridge is also marked by a dark stripe. The side-areas are always uniformly coloured, except for a narrow smooth area between the hind row of pustules and the posterior margin, which always shows three or four dark greenish, bluish or blackish spots on either side.

The articulamentum is always more or less dark bluish green; the sutural plates somewhat lighter in colour, wide apart, rather narrow, the front margin slightly curved inward, the sinus wide and deep, dentate, the teeth pectinated outside, the central ones shortest, the outermost longest, separated from the sutural plates by deep notches. Insertion plates pectinated outside, with (11–13)–1–(13–16) inequidistant slits, the slit rays porous, the eaves solid.

The girdle is moderately wide, clothed with large, smooth, imbricating scales arranged in quincunx, coloured like the tegmentum, with alternating light and dark patches (Fig. 222–224). Close to the margin three or four alternating rows of calcareous spicules are found, which are slightly striated, irregularly tapering to a sharp point, some of them more or less curved. In a 6 cm long specimen from St. Martin (H. 1399) they are $\pm$ 250 μ long. Among them much smaller solitary spicules are found, about 50 μ long, surrounded by a variable number of very small spicules, about 10 μ long, distally abruptly tapering (Fig. 225). The ventral side of the girdle is paved with radiating rows of rectangular scales, about 75 μ long, 15 μ broad (Fig. 226).

Length 66 mm; width 39 mm (specimen from Curaçao, H. 1317).

This species is also rather common in the Caribbean area though it is more limited in its distribution than the foregoing one. It has not yet been reported from the South American mainland, nor from Bermuda.

The animals live in the tidal zone, in company of *Chiton tuberculatus*, *C. marmoratus* and *Acanthopleura granulata*.

The colour pattern resembles that of *Chiton marmoratus*, but the

colour differs widely from that species from which it is easily recognized by its dull appearance (*C. marmoratus* is always glossy) and by the striking row of dark spots along the posterior margins of the valves.

Old specimens are often much eroded, due to the fact that they generally live on rocks exposed to heavy surf.

The radula (Fig. 227) was described and pictured by THIELE (1893 p. 361, pl. 30 f. 1): The base of the rhachidian tooth is rather small, forwardly pointed, the sheath narrow at the back, with a rounded point, forwardly wider, the cusp broad, rectilinear. The minor lateral tooth is wide, with a somewhat concave front margin and a wider cusp of which the edge is curved in the form of an S, a strong impression of the rhachidian tooth is present; the outward continuation is situated behind the middle, it is rather long and narrow, the wing-formed appendix on the outward front-angle is small, roundish; the sheath of the major lateral tooth is inwardly widened before the hind end, more forwardly provided with a distinct covering lamella, outwardly strongly curved inward in the middle, behind the cusp with a projecting angle; the wing has a rounded anterior angle, the thin, sharp hind angle separated from it by a ridge. The cusp is very broad, rounded. The first marginal tooth has an oblique depression rather far from the anterior margin; the cusp of the spatulate uncinal tooth is wide, rounded, posteriorly somewhat angular. The ultimate uncinal teeth are provided with distinct supporting membranes; they are very thin in the middle.

Chiton squamosus is rather constant in its characteristics, though there is some variation in the degree of elevation.

Distribution. East-Florida; Florida Keys; Cuba, Jamaica, Hispaniola, Puerto-Rico, Vieques, St. Thomas, St. John, St. Croix, St. Martin, St. Barts, Saba, St. Eustatius, Guadeloupe, Bonaire, Klein Bonaire, Curaçao, Aruba.

31 **Chiton marmoratus** Gmelin, 1791

Fig. 228–234, Plate VII fig. 3

Chiton marmoreus (non Fabricius, 1780) CHEMNITZ, 1785, p. 282, pl. 95 f. 803–805.
Chiton marmoratus GMELIN, 1791, p. 3205; WOOD 1815, p. 10; SOWERBY 1840–a,

f. 148–150; REEVE 1847, pl. 1 f. 6; PETIT DE LA SAUSSAYE 1856, p. 151; DALL 1879, p. 291; 1889–a, p. 172; THIELE 1893, p. 362, pl. 30 f. 3 (radula); PILSBRY 1893, p. 158, pl. 34 f. 72–76; DAUTZENBERG 1900, p. 220; DALL & SIMPSON 1901, p. 454; THIELE 1909, p. 2; 1910–a, p. 112; NIERSTRASZ 1927, p. 162; JOHNSON 1934, p. 13; LELOUP 1937, p. 137, f. 7, 11; SMITH, M. 1945, p. 23, pl. 57, f. 2; OLSSON & MCGINTY 1958, p. 23; WARMKE & ABBOTT 1961, p. 219, f. 33e; GLYNN 1970, p. 2.

Chiton (*Lophurus*) *marmoratus*, SHUTTLEWORTH 1853, p. 198.

Chiton (*Tonicia*) *marmoratus*, TENISON WOODS 1888, p. 131.

Chiton scarabaeus REEVE, 1847, p. 12 f. 66.

ST. JOHN: Turner Bay, porfiritic rock, 18.VI.1955, 4 specimens (H. 1407).

ST. MARTIN: Point Blanche Bay, limestone with rock pools, 5.VI.1955, 4 sp. (H. 1399).

SABA: Fort Bay, 21.VII.1949, 26 sp. dry (H. 1120); Fort Bay, 6.X.1963, 11 sp. (H. 1120A); Cove Bay at Flat Point, 5.X.1963, 18 sp. (H. 1432); Spring Bay, 21.VIII.1949, 6 sp. + 1 juv. (H. s.n.). – All on andesitic rock.

ST. EUSTATIUS: Tumble Down Dick Bay, andesite shore, 10.VII.1949, 2 sp. + 1 juv. (H. 1119); Back-off Bay, volcanic rock, 15.VII.1949, 8 sp. dry (H. s.n.).

ANTIGUA: Deep Bay, near Fort Barrington, tuffoid rock with coarse sand, 17.VII.1955, 11 sp. (H. 1393).

MONTSERRAT: Foxes Bay, andesite boulders, 20.VII.1967, 30 sp. (H. 1542).

BARBADOS: Salt Bay of Marley Vale, St. Philip, limestone cliff, 6.VII.1967, 3 sp. (H. 1552); Conset Bay, St. John, limestone cliff, 7.VII.1967, 3 sp. (H. 1553); Barbados, 1 sp. dry, ex Geol. Mus. Wageningen, RMNH 490.

GRENADA: White Bay at Point Salines, beach rock, 26.I.1955, 10 sp. (H. 1389).

TOBAGO: Red Point near Scarborough, volcanic rock, 14.I.1955, 11 sp. (H. 1388). *Little Tobago*, landing, volcanic rock debris, 18.I.1955, 2 sp. (H. s.n.).

TRINIDAD: Western side of Maracas Bay, Ingvar Kristensen leg., 17.VI.1961, 10 sp., RMNH 1767.

BONAIRE: De Hoop, S. of Kralendijk, limestone cliff with sandy reef, 10.IX. 1948, 5 sp. dry (H. 1058B); Punt Vierkant, as before, in surf notch, 26.III. 1955, 4 sp. dry (H. 1059a); *do.*, 9.IX.1948, 4 sp. dry (H. 1059A); Boca Washikemba, limestone, 7.IV.1955, 12 sp. (H. 1375); Lagoen, Northeastern coast, diabase rock with coarse debris, 2.IV.1955, 6 sp. (H. 1376); Boca Spelonk in cavern, J. S. Zaneveld coll., 14.IV.1955, 5 sp. (H. 1378).

KLEIN BONAIRE: East coast N. of old landing, low limestone cliff, in surf notch, 30.III.1955, 2 sp. (H. 1049Aa); Southeast coast, beach rock, J. S. Zaneveld coll., 18.IV.1955, 2 sp. (H. 1372).

CURAÇAO: Plaja Frankie, Spaanse Put, 27.II.1955, 2 sp. dry (H. 1317); Cape Santa Marta, upper side of surf notch and in *Ulva*-zone, 24.II.1955, 8 sp. + 1 juv. (H. 1324); Boca Grandi di San Juan, Zaneveld coll., 6.II.1955, 2 sp. (H. 1330); Piscadera Baai, outer bay, 12.XII.1936, 1 sp. (H. s.n.); Caracas Baai, washed ashore, Zaneveld coll., 3.II.1955, 1 sp. dry; Fuik Baai, sea-side, Zaneveld coll., 13.II.1955, 4 sp. (H. 1344a); Plaja Grandi, Zaneveld coll. 30.I. 1955, 1 sp. (valves only) (H. 1359); Boca Bartol, entrance, 12.II.1955, 6 sp. dry (H. 1361). – All on limestone.

ARUBA: Seroe Colorado, surf-swept rocky shore, Zaneveld coll., 2.V.1955, 5 sp. (H. 1308); N. of Seroe Colorado, surf-swept limestone cliff with pools,

2.V.1955, 6 sp. (H. 1309); Boca Andicuri, surf-swept non-calcareous rock, 11.V.1955, 15 sp. (H. 1311); *do.* limestone, 13 sp., dry (H. 1312).
VENEZUELA-mainland: La Guaira, P. Buitendijk leg., 2 sp., RMNH 619; Naiguatá, E. of La Guaira, C. Beets leg., 1953/54, 20 sp., RMNH 1250.

All H. samples from more or less exposed localities in the mid- and low-tide zone, mostly in shady places, below boulders and in rock-fissures. Not in inner bays.

Animal elongate oval, more or less elevated, slightly or not carinated, the side slopes convex, the valves somewhat beaked. Valves smooth, polished, except for very fine, concentric lines of growth; tail valve with the mucro anterior, one fourth the length of the valve, the hind slope slightly concave directly behind the mucro, straight or convex towards the margin. Lateral areas of the intermediate valves only slightly but distinctly raised. The tegmentum, when not eroded, is always shining, the ground colour light brownish, reddish, roseate or pale ashen, variously marked with longitudinal broad chestnut bands or flames on the pleurae of the central areas and the ante-mucronal area of the tail valve, generally continuous across the lateral areas, always more or less diverging. The jugal area is often marked with fine, dark, sometimes interrupted stripes, at least on one or more of the valves.

In some specimens the ground colour is of a dark chestnut, the bands still darker, hardly visible, or the whole shell is of a blackish brown; others are maculated with reddish brown or blackish.

The articulamentum is greenish blue, the sutural plates somewhat lighter, in the second and third valves they are broad triangular, in the others more regularly rounded, rather narrow, somewhat curved inward in the middle, wide apart; the sinus is broad, shallow, dentate, with about 8 or 9 teeth, pectinated outside, the area directly behind it very porous, transversely grooved. Insertion plates sharply pectinated outside. Head plate generally with 12 (11–15) slits, intermediate plates with 1–1 slits, sometimes with an additional slit on one side of one of the valves, tail-valve with 14 (13–19) slits; the slit rays distinct, with transverse, linear perforations, the eaves porous. The surface is minutely granulate, only visible under a lens.

Girdle moderately wide, clothed with large, smooth, shining, imbricating scales arranged in quincunx, greenish, greyish or light brown, with alternating light and dark patches (Fig. 228–230). Ven-

tral side paved with close set radiating rows of rectangular scales, which are slightly curved, somewhat striate, about 60 μ long, 20 μ wide (Fig. 232–233). At the margin there are four alternating rows of calcareous spicules, thick at the base, somewhat pinched in the middle, regularly tapering to a blunt point, irregularly longitudinally striate, about 185 μ long, 40 μ thick. Near their base one much smaller, cylindrical, blunt spicule is found, 35 μ long, 8 μ thick, which is surrounded by 6–10 still smaller, pointed spicules of about 10–12 μ long (Fig. 231).

Length 66 mm; width 37 mm (largest specimen from Santa Marta Baai, Curaçao; H. 1324).

The species is closely related to *Chiton squamosus*, especially in the armature of the girdle, which is almost identical. Both species are longitudinally flammulate or zebra-like striate. They are easily separated, however, by the total absence of any schulpture on the valves of *C. marmoratus*, by the always polished appearance of the latter, whereas *C. squamosus* has a dull dorsal surface, and by their colour.

C. marmoratus is rather variable with regard to the angle of divergence: there are highly elevated, non-carinated specimens which have the valves regularly arched, whilst others are rather flat, decidedly carinated, with the side-slopes almost straight.

Some specimens are very dark, almost uniformly blackish-brown (specimens from Saba, W. of Fort Bay; H. 1120A); this form was described by REEVE (1847, p. 12 f. 66) as *Chiton scarabaeus*.

The radula (Fig. 234) was described and pictured by THIELE (1893, p. 362, pl. 30 f. 3): The rhachidian tooth is bidentate at the back, the base rounded in front, the sheath narrowing at first, then widening somewhat, the rather broad cusp rounded in the middle. The minor lateral tooth is rather long and narrow, rounded in front, the cusp short, the outward extension large, about in the middle of the tooth. The major lateral has a shaft quite like that of the foregoing species (*Chiton undatus* Spengler = *C. tuberculatus L.*: at the inner side, before the posterior end roundly widened, otherwise rectilinear, the wing and the outward part like *Chiton squamosus* L., the cusp decidedly smaller), and also an identical wing, the cusp is regu-

larly rounded, moderately large. The first marginal tooth has a rectangular anterior angle on its supporting lamella, the ultimate one is like that of the foregoing species (= *C. tuberculatus* L.), though without an impression, the penultimate one is just alike, only the third one has such an impression. The cusp of the spatulate uncinal is broad, rounded.

Chiton marmoratus lives on rocks in the tidal zone, feeding on algae, and is also found on shores exposed to heavy surf, generally in company of *C. tuberculatus*, *C. squamosus* and *Acanthopleura granulata*. "*Chiton marmoratus* occurs only sporadically on the rubble shores of coral reefs" (GLYNN 1970, p. 2). Old specimens are often much eroded.

Distribution. Throughout the Caribbean region, from the Florida Keys, Texas and Bermuda to the Latin American mainland.

32 **Chiton viridis** Spengler, 1797

Fig. 235–238, Plate VIII fig. 1

Chiton squamosus denticularis CHEMNITZ, 1788, p. 373, pl. 173 f. 1689.
?*Chiton squamosus testa septen-valvi-striata* CHEMNITZ, 1788, p. 374, pl. 173 f. 1690.
Chiton viridis SPENGLER, 1797, p. 70, pl. 6 f. 5; WOOD 1815, p. 15; PILSBRY 1893, p. 156, pl. 33 f. 64–67; DALL & SIMPSON 1901, p. 453; THIELE 1910–a, p. 112; NIERSTRASZ 1927, p. 162; OLSSON & MCGINTY 1958, p. 23; WARMKE & ABBOTT 1961, p. 219.
?*Chiton tessellatus* WOOD, 1815, p. 23.
Chiton foveolatus SOWERBY II, 1840, p. 290; 1840–a, f. 60; REEVE 1847, pl. 6 f. 28.
?*Chiton excavatus* (Gray MS) SOWERBY II, 1840–a, f. 131 (*nomen nudum*).
Chiton (*Lophurus*) *excavatus*, SHUTTLEWORTH 1853, p. 197.
Chiton (*Lophurus*) *gemmulatus* SHUTTLEWORTH, 1853, p. 199.
Chiton costatus C. B. ADAMS, 1845, p. 8; CLENCH & TURNER 1950, p. 268, pl. 42 f. 8.
Chaetopleura reesi SALISBURY, 1953, p. 41, pl. 7.

BAHAMAS: *North-Bimini*, Entrance Point, beach rock with tidal pools, 18. VIII.1949, 1 specimen dry (H. 1152).
GRAND CAYMAN: Jackson's Point, Univ. of Oxford Exp., 23.IV.1938, type of *Chaetopleura reesi* Salisbury, 1 sp., BMNH.
JAMAICA: 2 sp. dry, ZMA.
ST. THOMAS: R. Swift leg., 1 sp. dry, KtB 3722.
ST. JOHN: Turner Bay, porfiritic rock debris, tidal zone, 18.VI.1955, 1 sp. (H. 1407).
ST. MARTIN: Point Blanche Bay, rock pool in surf-swept limestone cliff, 5.VI. 1955, 1 sp. dry, curled, 3 interm. valves (H. 1399); Great Bay, rocky shore, abt. 1 m deep, 26.VI.1949, 2 interm. valves (H. 1125A).

St. Barts: Public, near Gustavia, andesitic rock debris, tidal zone, 4.VI. 1949, 2 sp. dry, curled (H. 1121).
Barbuda: Two Feet Bay, surf-swept coral limestone with tidal pools, 10.VII. 1955, 2 sp. dry, curled (H. 1395).
Bonaire: Boca Washikemba, coral limestone, low-tide zone, 7.IV.1955, 1 sp., dissected (H. 1375); Boca Spelonk, cavern in limestone cliff, J. S. Zaneveld coll., 14.VI.1955, 1 sp. dry, curled (H. 1378).
Klein Curaçao: W. shore, limestone debris and sand, tidal zone, 1.X.1948, 2 interm. valves (H. 1046).
Curaçao: Spaanse Baai, on stones, C. J. van der Horst leg., 11.IV.1920, 1 sp. juv., ZMA.
Aruba: Seroe Colorado, rocky shore, Zaneveld coll., 2.V.1955, 1 sp. dry (H. 1308).

Animal oval, moderately elevated, slightly carinated, side slopes a little convex, valves obtusely beaked, lateral areas strongly raised, especially in valve II, gradually becoming less prominent in the next valves, with 3–4 (5) radiating ribs, the rib separating the lateral from the central area not included. The ribs are irregularly granulose, pustulose or scaly, sometimes they are quite obsolete or almost wanting.

The hind margin of the valves is more or less strongly denticulated, stronger in strongly ribbed specimens than in weaker ribbed ones. Central areas smooth, except for a row of deep grooves perpendicular to the ribs separating the lateral areas from the central area; sometimes these grooves are slightly bent in the shape of a reversed S. Head valve and post-mucronal area of the tail valve with 15–20 radiating granulose, pustulose or scaly ribs, sometimes without ribs but then there are always some irregular pustules, more or less arranged in radiating rows. The tail valve has the mucro decidedly in front of the centre, the back slope steep, concave directly behind the mucro, slightly convex towards the margin.

The colour of the tegmentum varies from light greenish grey to dark olive-green or blackish brown, sometimes with whitish longitudinal bands or stripes on the central areas, or the lateral areas of some valves whitish or light greenish.

Inside of the valves bluish green or bluish white, often with a red or brownish red mark near the mucro. Head valve with about 10, intermediate valves with 1–1, tail valve with about 12 inequidistant slits, the teeth of the insertion plates sharply pectinated outside, the slit rays punctured, for the greater part covered by a strong

valve callus; the eaves very porous. Sutural plates highly arched, the sinus wide, denticulate, the area directly behind it porous.

Dorsal side of the girdle covered with imbricating, convex, rounded, smooth scales, 0.75 mm wide, 0.5 mm long (Fig. 235, 236), showing alternately greenish and dark brown patches. Ventral side of the girdle clothed with very narrow cylindrical spicules-scales, arranged in rows perpendicular to the outer margin (Fig. 237). There is a marginal fringe of short, lengthwise ribbed, conical spicules, which are shortly stalked, 90 μ long, at their base accompanied by a few very small, stalked, smooth spicules, about 15 μ long (Fig. 238).

Length: 39 mm, breadth: 25 mm (specimen from Bonaire, H. 1375).

The species is easily recognizable by the short S-shaped grooves on the central areas along the diagonal ridges, and also by its colour. It was never collected in numbers, which makes it likely that it is a rather solitary species, though it is almost as widely distributed throughout the Caribbean Region as the foregoing *Chiton* species are; like those it lives in the tidal zone, on rocks, etc.

Chaetopleura reesi Salisbury is from the photograph alone (1953, pl. 7) to be recognized as a young *C. viridis*, a supposition which was confirmed by an examination of the unique type-specimen from Grand Cayman Island.

Distribution. Bahamas, Cuba, Cayman Ids., Jamaica, Puerto Rico, St. Thomas, St. John, St. Croix, Anguilla, Saba, St. Eustatius, Antigua, Montserrat, Guadeloupe, Martinique, Barbados, Grenada, Tobago, Trinidad, Bonaire, Klein Bonaire, Curaçao, Aruba, W. Venezuela, Panamá.

Subfamily ACANTHOPLEURINAE

Valves with extrapigmental "eyes." Girdle clothed with more or less isolated scales, and small needles, or with longer or shorter calcareous spines.

Acanthopleura Guilding, 1829

(= *Francisia* Dall, 1881).

Insertion plate of the tail valve with slits; dorsal side of the girdle with calcareous spines.

Type species: *Chiton spinosus* Bruiguière.

33 Acanthopleura granulata (Gmelin, 1791)

Fig. 239–244, Plate IX fig. 1–3

Chiton magellanicus CHEMNITZ, 1785, p. 279, pl. 95 f. 797, 798; GMELIN 1791, p. 3204; WOOD 1815, p. 18, pl. 3 f. 6.
Chiton piceus granulatus CHEMNITZ, 1785, p. 284, 285, pl. 96 f. 806–810.
Chiton piceus GMELIN, 1791, p. 3205; SOWERBY II 1840–a, f. 147; PETIT DE LA SAUSSAYE 1853, p. 416; SCHIFF 1858, p. 12, pl. 1, 2.
Chiton (*Acanthopleura*) *piceus*, SHUTTLEWORTH 1853, p. 202.
Acanthopleura picea, DALL 1889–a, p. 174; *non* THIELE 1893, p. 373, pl. 30 f. 32 (= *Chiton spiniger* Sowerby?).
Chiton granulatus GMELIN, 1791, p. 3205; WOOD 1815, p. 9; D'ORBIGNY 1853, p. 209.
Acanthopleura granulata, HAMILTON 1903, p. 138; NIERSTRASZ 1905, p. 152; 1906, p. 511; THIELE 1910–a, p. 112; REMINGTON 1922, p. 121; BERRY 1925, p. 173 text f., pl. 12; NIERSTRASZ 1927, p. 163; WAGENAAR HUMMELINCK 1933, p. 303, 306; LELOUP 1937, p. 146, f. 13–15a; 1941, p. 44, pl. 1 f. 1; M. SMITH 1945, p. 24, pl. 56 f. 2; SALISBURY 1953, p. 42; HIDALGO 1956, p. 1; OLSSON & MCGINTY 1958, p. 23; WARMKE & ABBOTT 1961, p. 220, f. 33f; VAN REGTEREN ALTENA 1969, p. 37; GLYNN 1970, p. 1.
Acanthopleura (*Maugeria*) *granulata*, PILSBRY 1893, p. 227, pl. 50; DAUTZENBERG 1900, p. 220; DALL & SIMPSON 1901, p. 454; THIELE 1909, p. 2; 1929, p. 21; JOHNSON 1934, p. 14.
Chiton tuberculatus (*non* LINNAEUS), SCHROETER 1786, p. 494, pl. 9 f. 19.
Chiton salamander SPENGLER, 1797, p. 80.
Acanthopleura salamander, THIELE 1893, p. 373, pl. 30 f. 35 (radula).
Chiton unguiculatus BLAINVILLE, 1825, p. 544.
Chiton convexus BLAINVILLE, 1825, p. 544.
Chiton occidentalis REEVE, 1847, pl. 14 sp. 76, f. 77a; PETIT DE LA SAUSSAYE 1853, p. 416; THIELE 1893, p. 373 (in synonymy of *A. salamander* Spengler).
Chiton (*Acanthopleura*) *mucronulatus* SHUTTLEWORTH, 1853, p. 203.
Chiton (*Acanthopleura*) *blauneri* SHUTTLEWORTH, 1856, p. 170.

non: *Acanthopleura granulata*, SUTER 1905, p. 70 [= *Plaxiphora biramosa* (Q. & G.)]; HUTTON 1904, p. 86 [= *Plaxiphora biramosa* (Q. & G.)]; ?*Acanthopleura granulata*, SUTER 1913, p. 44, pl. 2 f. 21, pl. 5 f. 2 (possibly *Pl. biramosa*).

FLORIDA: *East Sister Keys*, A. S. Koto leg., 1947, 2 specimens, dry, KtB 760; *Key West*, J. E. Conkling leg., 2 sp. dry, KtB 2430.
BAHAMAS: *North Bimini*, Entrance Point, beach rock, 18.VIII.1949, 16 sp. (H. 1152).
SWAN ISLAND: Swan Island, G. Nelson leg., 1 sp. dry, KtB 4423.
NAVASSA (W. of Hispaniola): Navassa, W. J. Clench leg., 1 sp. dry, KtB.
PUERTO RICO: La Parguera, Mata de la Gata, *Porites* flat with some *Thalassia* 12.IX.1963, 2 sp. (H. 1419A).
ST. JOHN: Turner Bay, porfiritic rock, 18.VI. 1955, 10 sp. (H. 1407); Bay S. of Cruz Bay, 19.VI.1955, 1 sp., dry (H. 1408).
ST. CROIX: Frederiksted, rock debris, 11.VI.1955, 3 sp. (H. s.n.).
ANGUILLA: Sandy Ground, beach rock, reef debris, 19.VI.1949, 6 sp. (H. 1142).
ST. MARTIN: Point Blanche Bay, sandstone, 5.VI.1955, 14 sp. (H. 1399); Great Bay near Point Blanche, limestone, 26.VI.1949, 2 sp. (H. 1125); Lay Bay, 27.V.1949, 6 sp. (H. s.n.). *Pelican Cay*, tuffoid rock, 3.VIII.1949, 4 sp. (H. s.n.).
LA FOURCHE (W. of St. Barts): Five Island bay, andesite debris, 2.VI.1949, 8 sp. (H. 1124).
ST. BARTS: Public, near Gustavia, rock, sand, tidal zone, 4.VI.1949, 4 sp. (H. 1121).
SABA: Fort Bay, 21.VII.1949, 5 sp. (H. 1120); *do.*, 6.X.1963, 3 sp. (H. 1120A); Cove Bay at Flat Point, 5.X.1963, 6 sp., (H. 1432); Spring Bay, 28.VII.1949, 4 sp., dry (H. s.n.). – All on exposed andesitic rock.
ST. EUSTATIUS: Gallows Bay, andesitic rock debris, 15.VII.1949, 6 sp. (H. 1116); Tumble Down Dick Bay, andesite rock, 10.VII.1949, 1 sp. (H. 1119); Back-off Bay, volcanic rock, 15.VII.1949, 2 sp. (H. s.n.).
ST. KITTS: St. Thomas Pt. near Basseterre, andesitic rock, 30.VI.1955, 2 sp. (H. 1398); Frigate Bay, boulders of volcanic tuff, 20.VII.1955, 3 sp. (H. 1397).
BARBUDA: Two Feet Bay, coral limestone, 10.VII.1955, 8 sp. (H. 1395).
ANTIGUA: Deep Bay, tuffoid rock, 17.VII.1955, 2 sp. (H. 1393); Dickinson Bay, limestone, boulders, 0–½ m deep, 19.VII.1967, 10 sp. (H. 1540); *do.* 1 m, 1 sp. (H. 1540A).
LA DÉSIRADE (E. of Guadeloupe): West point, 15.I.1964, 4 sp. (H. s.n.).
BARBADOS: Salt Bay of Marley Vale, St. Philip, 6.VII.1967, 2 sp. (H. 1552); Kitridge Bay, St. Philip, 6.VII.1967, 2 sp. (H. s.n.); Conset Bay, St. John, 7.VII.1967, 3 sp. (H. s.n.). – All on exposed limestone.
GRENADA: White Bay at Point Salines, beach rock, 26.I.1955, 4 sp. (H. 1389).
TOBAGO: Red Point near Scarborough, volcanic rock, 14.I.1955, 4 sp. dry (H. 1388). *Little Tobago*, landing, rock debris, 18.I.1955, 4 sp. (H. s.n.).
TRINIDAD: *Gasparo Grande*, SW. shore, limestone, 11.I.1955, 4 sp. (H. s.n.).
BONAIRE: Paloe Lechi, beach rock, 27.II.1949, 19 sp. (H. 1056Ba); *do.*, 25.IX. 1968, 3 sp. (H. 1646); Kralendijk, Pasanggrahan, 20.IX.1948, 4 sp. dry (H. 1057A); *do.* 20.IX.1948, 13 sp. dry (H. 1057C); De Hoop, S. of Kralendijk, 10.IX.1948, 4 sp. dry (H. 1058B); N. of Punt Vierkant, limestone cliff, 9.IX.1948, 1 sp. dry (H. 1059); *do.*, 9.IX.1948, 10 sp. dry (H. 1059A); Punt Vierkant, upper-tide zone, limestone cliff, 26.III.1955, 10 sp.; *do.*, surf notch, 1 sp. (H. 1059a); Lac, Soerebon Pt., limestone, 17.IV.1955, 3 sp. (H. 1373); Boca Washikemba, 7.IV.1955, 14 sp. (H. 1375); Boca Spelonk, J. S. Zaneveld coll., 14.IV.1955, 1 sp. dry (H. 1378); Boca Onima, 19.IX.1948,

6 sp. (H. 1071); Slagbaai, 3.IV.1955, 6 sp. (H. 1380). All on more or less exposed limestone rock. – Lagoen, N. shore, diabase rock, 2.IV.1955, 5 sp. (H. 1376); *do.*, 3 sp. (H. 1377). Lac, Dam, 9.III.1970, sev. sp. (H.1651).
KLEIN-BONAIRE: East coast, near old landing, 13.IX.1948, 11 sp. (H. 1049A); *do.*, 30.III.1955, 23 sp. (H. 1049Aa); West Pt., 28.III.1955, 5 sp. (H. 1367); Northwest Pt., 28.III.1955, 8 sp. (H. 1368); Northern shore, epilitoral, 30.III. 1955, 10 sp. (H. 1369); Northeast coast, 13.IV.1955, 1 sp. (H. 1371); Southeastern shore, 18.IV.1955, 8 sp. (H. 1372); – All on limestone or beach rock.
KLEIN-CURAÇAO: East shore, beach rock, 1.X.1948, 1 sp. dry (H. s.n.).
CURAÇAO: Knip Baai, 8.I.1949, 1 sp. dry (H. 1017); *do.*, 6.II.1949, 12 sp. dry (H. 1018); Boca Lagoen, 13.XI.1948, 4 sp. dry (H. 1020); *do.*, 3 sp. dry (H. 1020B); Plaja Hoeloe, 2.IV.1949, 12 sp. (H. 1024); Plaja Frankie, Spaanse Put, 27.II.1955, 13 sp. (H. 1317); Cape Santa Marta, 24.II.1956, 6 sp. (H. 1324); Boca Santa Marta, Zaneveld coll., 12.XII.1954, 1 sp.; Boca Grandi di San Juan, Zaneveld coll., 6.II.1955, 1 sp. dry (H. 1330); Piscadera outer bay, limestone, 29.I.1949, 6 sp. (H. 1029); Piscadera Bay, A. N. Ch. ten Broek leg., 16.IV.1953, 14 sp., KtB 3408); Piscadera Inner Bay, SE part, NW, low limestone cliff, in surf notch, 18.XII.1963, 8 sp. (H. 1469B); Piscadera inner bay, central part, SW, limestone rock with scanty *Rhizophora*, 13.XII.1963, 3 sp. (H. 1473A); Spaanse Water, lagoon near Kabrietenberg, 21.IV.1949, 5 sp. (H. 1037); Spaanse Water, N. part at Brakke Put, muddy limestone rock near some *Thalassia*, Zaneveld coll., 19.I.1955, 2 sp. (H. 1340); Spaanse Water at Vredenberg, on muddy rock, 20.V.1955, 1 sp. (H. s.n.); Fuik Baai, Duitse Bad, limestone debris in sandy mud, 2.III.1949, 3 sp. (H. 1038); Fuik Baai, Newport Bath, limestone rock in sandy mud, 20.XI.1948, 4 sp. (H. 1039); Fuik Baai, sea side of W. wall, coral debris, Zaneveld coll., 11.I.1955, 1 sp. dry (H. 1343); Fuik Baai, pool in W. wall, coral debris, Zaneveld coll., 11.I.1955, 5 sp. dry (H. 1345); St. Jorisbaai, entrance, 20.II.1955, 27 sp. (H. 1354); Santa-Catharinabaai [= Boca Labadera], C. van Leeuwen leg., 13.X. 1937, 1 sp., RMNH 372; Boca Labadera, recent deposit of valves from thousands of sp. eaten by man, 29.III.1970 (H.); W. of Boca Playa Canoa, 15.IX. 1968, 1 sp. dry (H.); Boca Bartool, entrance, 12.II.1955, 19 sp. (H. 1361). – All on limestone, more or less exposed.
ARUBA: Punta Braboe, near Oranjestad, 3.I.1949, 4 sp. (H. 1002); Lagoen Boekoeti, coral rock in sandy mud, 29.XII.1948, 3 sp. (H. 1004); Reef Boekoeti, reef debris, 6.V.1955, 1 sp. (H. 1006b); Paardenbaai reef, sandy debris, 28.IV.1955, 1 sp. (H. 1303); Seroe Colorado, surf-swept limestone cliff with pools, 2.V.1955, 2 sp. + 1 juv. (H. 1309); *do.*, Zaneveld coll., 2.V.1955, 8 sp. (H. 1308); Rincón, beach rock, 7.V.1955, 4 sp. (H. 1310); Rincón flat, Zaneveld coll., 7.V.1955, 1 sp. dry (H. 1310A); Boca Prins, from shell heap near dunes, 26.VIII.1949, single valves only (H. s.n.); Boca Andicuri, 11.V. 1955, 11 sp. (H. 1312). – All on limestone or beach rock. – Boca Andicuri, noncalcareous rock, 11.V.1955, 10 sp. dry (H. 1311). – Aruba, Neervoort van de Poll leg., 5 sp., RMNH.
SURINAME: Suriname, C. J. Hering leg., 1 sp., RMNH; doubtful, according to VAN REGTEREN ALTENA (1969, p. 37).

All H. samples from the upper or mid-tide zone; very common on more or less exposed places of the open shore, more rarely on exposed localities of inner bays.

Animal elongate-oval, moderately elevated, obtusely carinated, the side slopes a little convex, the valves decidedly beaked, though full-grown specimens are always so much eroded that the mucrones have worn off. The lateral areas are hardly raised. Tail valve with the blunt, slightly swollen mucro behind the centre, about three fifths the length of the valve, the back slope steep, a little convex.

Tegmentum of the head valve, the lateral areas of the intermediate valves and the post-mucronal area of the tail valve sculptured with rather coarse, roundish, smooth granules arranged in quincunx. In the interstices small black intrapigmental "eyes" are irregularly scattered, especially towards the margin. The central areas and the ante-mucronal area of the tail valve have a triangular slightly raised jugal part which is transversely wrinkled, the wrinkles finely granulose; the pleurae show a coarse network sculpture. The sculpture is to be observed in juvenile specimens only; in adult specimens only the parts near the girdle and along the front margin, where they are covered and thus protected by the foregoing valve, show some sculpture.

The ground colour is deep blackish brown or of a lighter brown, with oblique white bands between the jugal and pleural parts of the valves, enclosing a reversed V-shaped blackish brown jugal mark. The white bands are almost always distinguishable, even in strongly eroded specimens. The eroded parts are generally dull greyish, brownish or blackish.

The articulamentum is very strongly developed; there is a thick valve callus covering the inner posterior margin; the inside is bluish green, the tract between the jugal sinus and the mucro deep purplish brown. The sutural plates are projecting forwardly, the margin strongly but regularly S-like curved, the sinus widely U-shaped; they are longitudinally striate and connected by an extension of the articulamentum which considerably exceeds the tegmentum. This sinual plate is only finely striate, not pectinated nor slitted, dark brown or greenish, sometimes whitish.

The insertion plate of the head valve is rather long, brownish, greenish or whitish, sharply pectinated outside, with a variable number of inequidistant slits (8–16); the insertion plates of the intermediate valves with 1–1 slits, the tail valve with a rather short

insertion plate, directed forwardly, with 8–15 slits. The eaves are porous.

The girdle is rather wide, musculous, dorsally clothed with numerous calcareous spines of different forms and sizes (Fig. 239, 240). The largest are brown and more or less conical, curved, roughly granulose, abruptly tapering to a rather sharp point; others are more slender, cylindrical, white, more or less strongly curved and longitudinally striate. To the naked eye the girdle is whitish, with alternating dark brown patches, irregularly disposed. The ventral side is clothed with small calcareous scales arranged in radiating series (Fig. 241, 242); these are only little longer than wide, their bases squarish, the top, directed towards the outer margin, rounded and provided with 6–8 strong ribs. Towards the margin they become gradually longer, the terminal ones forming a fringe of longitudinally ribbed, stalked spicules (Fig. 243).

Length 76 mm; width 55 mm (specimen from Punt Vierkant, Bonaire, H. 1059a).

The radula (Fig. 244) was described and pictured by THIELE (1893' p. 373, pl. 30 f. 35: *A. salamander* Spengler): The rhachidian tooth is narrow and elongate, somewhat narrowed in the middle, with a concave cusp; the minor lateral with a rather small continuation situated behind the centre, the cusp of the major lateral tooth is broadly rounded, the wing only little widened. The lamella of the first marginal tooth is angular, the ultimate one somewhat longer than wide.

On account of its unslit sinual plate, and its short, forwardly directed, posterior insertion plate, GRAY (1857) created a subgenus *Maugeria* for it.

It is highly probable that the *Chiton magellanicus* described and figured by CHEMNITZ was identical to *A. granulata*, but this cannot be proved and furthermore the name is hardly acceptable, as PILSBRY pointed out, for no species of *Acanthopleura* has ever been collected in the Magellan Province.

I saw some dried specimens in the Leiden Museum which were labelled "Magellan Straits," but they were presented to the Museum by collectors whose labels are not at all reliable.

HUTTON, and afterwards H. SUTER, reported it from New Zealand, but IREDALE & HULL proved it to be *Plaxiphora biramosa* (Quoy & Gaimard).

As to the *C.* (*Acanthopleura*) *mucronulatus* Shuttleworth, collected in Puerto Rico by BLAUNER, this is, from the type, a juvenile specimen of *A. granulata* and SHUTTLEWORTH's *C.* (*A.*) *blauneri*, also from Puerto-Rico, is likewise identical with the present species.

A. granulata is extremely abundant in the whole Caribbean Area. It was reported from the Mexican East coast by HIDALGO, and from Bermuda by PEILE.

A. granulata lives in the tidal zone on exposed rocks covered by algae. A full account of its ecology is to be found in GLYNN's interesting article (1970) which came to my hands after the present paper had been sent to the printers'.

Distribution. From Florida: Charlotte Harbor, Texas and Bermuda, southward throughout the Caribbean area and the South American mainland as far as ?Suriname.

Tonicia Gray, 1847

Girdle apparently naked, clothed with microscopic short needles.

Type-species: *Chiton elegans* Frembly.

34 **Tonicia schrammi** (Shuttleworth, 1853)

Fig. 245–247, Plate VIII fig. 4.

Chiton schrammi PETIT DE LA SAUSSAYE, 1853, p. 151 (*nom. nud.*).
Chiton (*Tonicia*) *schrammi* SHUTTLEWORTH, 1853, p. 171, pl. 6 f. 9.
Tonicia schrammi, HEILPRIN 1889, p. 176; DALL 1889–a, p. 174; PILSBRY 1893, p. 205, pl. 34 f. 54–56; NIERSTRASZ 1927, p. 162; JOHNSON 1934, p. 14; WARMKE & ABBOTT 1961, p. 220, f. 32d; GLYNN 1970, p. 2.

CURAÇAO: Curaçao, C. J. van der Horst leg., 2 specimens, RMNH; San Juan, or Vaersenbaai, 3 m deep, under *Porites*, Coll. K. M. de Jong, 1 sp., dry. ARUBA: Lagoen near Pos Chiquito, Mrs. M. J. Beerman-Paul leg., 2 sp., dry, KtB 4475; Aruba, 1969/70, Mrs. Beerman leg., 1 sp., dry, KtB 4483.

Shell elongate-oval, rather elevated, subcarinated, the side slopes slightly convex, the intermediate valves decidedly beaked; lateral areas strongly raised, separated from the central areas by a curved diagonal rib which is either smooth or pustulose, the pustules rather

wide apart. Another, weaker rib, also more or less pustulose, accompanies the hind margin, which is somewhat inflected and crenulated. The space between these ribs is smooth and so are the central areas, except for a few faint radiating striae on some valves in some specimens, especially on the pleural parts. Concentric growth striae are also visible.

The posterior valve, when seen from above, has the mucro far posterior, though the slightly convex steep hind slope is almost as long as the distance between the mucro and the jugal sinus. The post-mucronal area is sharply defined from the antemucronal area by a finely pustulose, sharp ridge. Both the head valve and the post-mucronal area of the tail valve show a few ill-marked radiating striae. The extra-pigmental eyes, under a weak lens appearing as small black dots, are numerous and arranged in 7 or 8 broad radial bands, separated by very narrow eyeless areas. On the lateral areas the shell-eyes are arranged in V-shaped rows, converging towards the mucro.

The tegmentum is waxy, shining, of a reddish or crimson colour, variously marked with pale buff or yellowish white, especially on the jugal parts; in other specimens the light parts predominate.

The articulamentum is white or bluish white, generally with deep red stains in the jugal tract; the sutural plates are moderately wide, regularly arched, white or roseate, separated by a shallow sinus which is finely pectinated outside, unslit, or with only a faint indication of dentation. The insertion plates are rather short, sharply pectinated outside and on the edge, with 8–10 subequidistant slits in the head valve, 1–1 slits in the intermediate valves and 10–11 slits in the tail valve, which has the teeth very short in the middle, where the tegmentum is decidedly waved upward.

The girdle is wide, leathery, encroaching a little at the sutures, tawny or flesh-coloured and naked to the eye. Dorsally it bears slender, weakly ribbed, calcareous needles, emplanted in long, chitinous, threadlike shafts, rising from a cupule in the derm. Sometimes the needles are longer than the shaft, sometimes shorter; together they attain a length of 130 μ. They are rather sparingly distributed and arranged without order (Fig. 245). The ventral side is paved with flat, smooth scales in radiating rows; the scales have a

rectangular base, are slightly narrowed in the middle and evenly rounded at the top, which is directed towards the outer margin and covers the base of the next scale. They are about 40 μ long, 25 μ wide. Towards the margin they become a little longer (Fig. 247). The outer margin bears a fringe of short, cylindrical spicules, gradually tapering to a blunt point, faintly longitudinally ribbed, about 65 μ long, 25 μ thick (Fig. 246).

Length 37 mm; width 22 mm (specimen from Curaçao, Boca Plaja Canoa).

T. schrammi is the only *Tonicia* species in the Caribbean Area; all the other members of the genus are found on the Pacific coast of South-America, S. to Magellan Strait. From these it differs by its smooth central areas and the upward wave of the hind margin of the tail valve, features which are only found in *T. rubridens* Pilsbry from Callao and Chili, though in that species the lateral areas are not perceptibly raised.

"Bimonthly analysis of gonads in *Tonicia schrammi* over a three-year period revealed a pronounced seasonal pattern with greatest activity in August through October. Winter and spring breeding may also occur since young chitons were plentiful in the field in spring and summer." (GLYNN 1970, p. 17).

In my opinion the species is far more common than it appears to be, due to its habitat below low water mark. It is never found in the tidal zone.

Distribution. Florida: Key West (DALL); Bermuda (HEILPRIN); Puerto Rico (GLYNN); Guadeloupe (SHUTTLEWORTH, type locality); Curaçao (VAN DER HORST, DE JONG); Aruba (BEERMAN).

REFERENCES

ADAMS, C. B., 1845. Specierum novarum conchyliorum in Jamaica repertorum, synopsis. *Proc. Boston Soc. Nat. Hist. 2*, p. 1–17.

ADAMS, H. & ADAMS, A., 1854. *The Genera of Recent Mollusca. 1.*

AGUAYO, G. G. & JAUME, M. L., 1936. Sobre algunos moluscos marinos de Cuba. *Mem. Soc. Cubana Hist. Nat. 10* (2), p. 115–122, fig. 1–3.

ALTENA, C. O. VAN REGTEREN, 1969. The marine Mollusca of Suriname ... 1. *Zool. Verhandel. 101*, p. 1–49, pl. 1–4.

AREY, L. B., & CROZIER, W. J., 1919. The sensority responses of Chiton. *J. Exp. Zool. 29* (2), p. 157–260.

ASHBY, E., 1931. Monograph of the South African Polyplacophora (Chitons). *Ann. S. Afr. Mus. 30* (1), p. 1–59, figs., pl. 1–7.

BERGENHAYN, J. R. M., 1931. Über die Morphologie und Phylogenie der Gattung Choneplax Carpenter (Ordo Loricata sive Polyplacophora). *Ark. Zool. 22* (A–16), p. 1–6.

BERGENHAYN, J. R. M., 1937. Polyplacophoren von den Galapagos Inseln. *Nytt. Mag. Naturv. 76*, p. 273–286, figs.

BERRY, S. S., 1925. On an abnormal specimen of the Chiton Acanthopleura granulata. *Ann. Mag. Nat. Hist.* (9) *16*, p. 173–175, fig., pl. 12.

BLAINVILLE, H. M. D. DE, 1825. *Dictionnaire des Sciences Naturelles 36.*

BOONE, L., 1928. Mollusca from tropical East American seas. Scientific Results of the ... "Pawnee," 1925. *Bull. Bingham Oceanogr. Coll. 1* (3), p. 1–20, fig. 1–4.

BOONE, L., 1933. Coelenterata, Echinodermata and Mollusca. Scientific results of ... "Eagle" and "Ara," 1921–1928. *Bull. Vanderbilt Mar. Mus. 4.*

BORN, I., 1780. *Testacei Musei Caesarei Vindobonensis.*

CALKINS, W. W., 1878. Catalogue of the marine shells of Florida, with notes and descriptions of several new species. *Proc. Davenport Acad. Nat. Sci. 2*, p. 232–252, pl. 8.

CARPENTER, P. P., 1864. Supplementary report on the present state of our knowledge with regard to the Mollusca of the West coast of North America. *Rep. Brit. Ass. Adv. Sci. 1863*, p. 517–686.

CARPENTER, P. P., 1866. Descriptions of new marine shells from the coast of California. III. *Proc. Cal. Acad. Nat. Sci. 3*, p. 207–224.

CARPENTER, P. P., 1873. *Table of regular Chitons*. Smiths. Inst.

CARPENTER, P. P., 1873–a. On the generic affinities of the New England Chitons. *Bull. Essex Inst., Boston, 5* (9), p. 152–155. (Reprinted 1874 in: *Ann. Mag. Nat. Hist. (4) 13*, p. 119–123).

CHEMNITZ, J. H., 1784. *Von einem Geschlechte vielschalichter Conchylien mit sichtbaren Gelenken ... Chitons heiszen.*

CHEMNITZ, J. H., 1785. In MARTINI & CHEMNITZ: *Neues Systematisches Conchylien-cabinet, 8.*

CHEMNITZ, J. H., 1788. *do., 10.*

CLENCH, W. J. & TURNER, R. D., 1950. The Western Atlantic marine mollusks described by C. B. Adams. *Occ. Pap. on Mollusks 1* (15), p. 233–403, pl. 29–49.

CROZIER, W. J., 1918. Growth and duration of life of Chiton tuberculatus. *Proc. Nat. Acad. Sci., Cambridge, 4*, p. 322–325.

CROZIER, W. J., 1918–a. Growth of Chiton tuberculatus in different environments. *Proc. Nat. Acad. Sci. 4*, p. 325–328.

CROZIER, W. J., 1919. Coalescens of the shell-plates in Chiton. *Amer. Naturalist 53*, p. 278–279.

CROZIER, W. J., 1919–a. On the use of the foot in some Molluscs. *Journ. Exp. Zool. 27*, p. 359–366.

CROZIER, W. J., 1920. Sex-correlated coloration in Chiton tuberculatus. *Nautilus 34*, p. 30.

CROZIER, W. J., 1920–a. Sex-correlated coloration in Chiton tuberculatus. *Amer. Naturalist 54*, p. 84–88.

CROZIER, W. J., 1920–b. Note on the photic sensitivity of the Chitons. *Amer. Naturalist 54*, p. 376–380.

CROZIER, W. J., 1921. "Homing" behavior in Chiton. *Amer. Naturalist 55*, p. 276–281.

CROZIER, W. J., 1922. An observation on the cluster formation of the sperms of Chiton. *Amer. Naturalist 56*, p. 478–480.

CROZIER, W. J., 1922–a. On color variations in Chitons. *Amer. Naturalist 56*, p. 189–191.

CROZIER, W. J. & AREY, L. B., 1918. On the significance of the reaction to shading in Chiton. *Amer. J. Physiol. 46*, p. 487–492.

CROZIER, W. J. & AREY, L. B., 1919. On the ethology of Chiton tuberculatus. *Proc. Acad. Sci. Washington 5*, p. 496–498.

DALL, W. H., 1879. Report on the limpets and chitons of the Alaskan and arctic regions, with descriptions of genera and species believed to be new. *Proc. U.S. Nat. Mus. 1*, p. 281–344, fig. A–D, pl. 1–5.

DALL, W. H., 1881. Preliminary report on the Mollusca. Reports on the results of dredging ... in the Gulf of Mexico and in the Caribbean Sea, 1877–79, by the ... "Blake" ... 15. *Bull. Mus. Comp. Zool. Harvard 9* (2), p. 33–144.

DALL, W. H., 1882. On certain limpets and chitons from deep waters off the Eastern coast of the United States. *Proc. U.S. Nat. Mus. 4*, p. 400–414.

DALL, W. H., 1882–a. On the genera of Chitons. *Proc. U.S. Nat. Mus. 4* (1881), p. 279–291.

DALL, W. H., 1883. On a collection of shells sent from Florida by Mr. Henry Hemphill. *Proc. U.S. Nat. Mus. 6*, p. 318–342, pl. 10.

DALL, W. H., 1889. Report on the Mollusca, part 2. Gastropoda and Scaphopoda. Reports on the results of dredging ... 29. *Bull. Mus. Comp. Zool. Harvard 18*, p. 1–492, pl. 10–40.

DALL, W. H., 1889–a. A preliminary catalogue of the shellbearing marine mollusks and brachiopods of the southeastern coast of the United States. *Bull. U.S. Nat. Mus. 37*, p. 1–221, pl. 1–74.

DALL, W. H., 1910. Report on a collection of shells from Peru, with a summary of the littoral marine Mollusca of the Peruvian zoological province. *Proc. U.S. Nat. Mus. 37*, p. 147–294, pl. 20–28.

DALL, W. H. & BARTSCH, P., 1911. New species of shells from Bermuda. *Proc. U.S. Nat. Mus. 40*, p. 277–288, pl. 35.

DALL, W. H. & SIMPSON, C. T., 1901. The Mollusca of Porto-Rico. *Bull. U.S. Fish Comm. for 1900, 20* (1), p. 351–524, pl. 53–58.

DAUTZENBERG, P., 1900. Croisières du yacht "Chazalie" dans l'Atlantique. *Mém. Soc. Zool. France 13*, p. 220.

DE KAY, J. E., 1843/1844. Mollusca. *Zoology of New York, or the New York fauna 5*, Albany.

DESHAYES, G. P., 1836. In LAMARCK, J. P. B. A. DE: *Histoire Naturelle des Animaux sans Vertèbres*, 2me éd., *7*.

DEXTER, R. W., 1942. Notes on the marine mollusks of Cape Ann, Massachusetts. *Nautilus 56*, p. 57–61.

DODGE, H., 1952. A historical review of the mollusks of Linnaeus. Pt. 1, The Classes Loricata and Pelecypoda. *Bull. Amer. Mus. Nat. Hist. 100* (1), p. 1–263.

DUPUIS, P., 1917. Notes prises au cours de l'examen de la collection de Polyplacophores du Muséum de Paris. *Bull. Mus. Hist. Nat. Paris 23* (7), p. 533–538.

GLYNN, P. W., 1970. On the ecology of the Caribbean chitons Acanthopleura granulata Gmelin and Chiton tuberculatus Linné ... *Smiths. Contr. Zool. 66*, p. 1–21.

GMELIN, J. F., 1791. *C. von Linnaeus' Systema Naturae, ed. 13, I 6*. Vermes [1790].

GOULD, A. A., 1852. Mollusca and shells. *United States Exploring Expedition* ... 1838–42, ... *12*. p. i–xv + 1-510 + atlas.

GOULD, A. A., 1870. *Report on the Invertebrata of Massachusetts, 2nd ed., comprising the Mollusca* (ed. by W. G. BINNEY). viii + 524 pp., 405 figs., pl. 16–27.

GRAVE, B. H., 1922. An analysis of the spawning habits of Chaetopleura apiculata (Say). *Biol. Bull. Wood's Hole 42*, p. 234–256.

GRAVE, B. H., 1932. Embryology and life history of Chaetopleura apiculata. *J. Morph., Philadelphia, 54*, p. 153–160, figs.

GRAVE, B. H., 1937. In GALTSOFF: *Culture methods for invertebrate animals*. Chaetopleura apiculata, p. 519–520.

GRAY, J. E., 1828. *Spicilegia Zoologica 1*.

GRAY, J. E., 1847. On the genera of the family Chitonidae. *Proc. Zool. Soc. London 15*, p. 63–70.

GRAY, J. E., 1857. *Guide to the systematic distribution of Mollusca in the British Museum, 1*.

GUILDING, L., 1829. Observations on the Chitonidae. *Zool. Journ. 5*, p. 25–35.

HADDON, A. C., 1886. Report on the Polyplacophora. *Challenger Reports 15 (43)*, p. 1–50, pl. 1–3.

HAMILTON, S. H., 1903. Habits of Acanthopleura granulata. *Nautilus 16*, p. 138.

HANLEY, S., 1855. *Ipsa Linnaei Conchylia*.

HEILPRIN, A., 1889. *The Bermuda Islands* (Philadelphia, published by the author), 231 pp., 19 pls.

HIDALGO, E., 1956. Algunas Moluscos de la Isla de Cozumel, Quintana Roo, México, *Acta Zool. Mexicana 1* (10), p. 1–12, 6 pls.

HOFFMANN, H., 1931. Beiträge zur Kenntnis der Chitonen. I. Über die Fortpflanzung und Entwicklung von Trachydermon cinereus L. *Ztschr. Morph. Ökol. Tiere 20*, p. 719–732, figs.

HUTTON, F. W., 1904. *Index faunae Novae Zealandiae* [Moll. p. 57–95, 348–349].

IREDALE, T. & HULL, A. F. B., 1925. A Monograph of the Australian Loricates, 5. *Austr. Zool. 4*, p. 75–111, pl. 9–12.

JOHNSON, C. W., 1934. List of marine Mollusca of the Atlantic coast from Labrador to Texas. *Proc. Bost. Soc. Nat. Hist. 40* (1), p. 1–204.

JONG, K. M. DE & KRISTENSEN, I., 1968. Gegevens over de Mollusken van Curaçao, uitgezonderd de mariene gastropoden. *Corr. Bl. Ned. Malac. Ver. Suppl. 1968*, p. 1–38, pl. 1–4.

KEEN, M., 1958. *Sea shells of tropical West-America.* xi + 624 p., ill.

LELOUP, E., 1937. Polyplacophora. Résultats scientifiques ... "Mercator," *1* (7). *Mém. Mus. Roy. Hist. Nat. Belg. (2) 9*, p. 129–151, figs. 1–15.

LELOUP, E. 1938. A propos de deux Ischnochitons de l'Atlantique occidental: I. boogii Haddon, 1886 et I. pruinosus (Gould, 1846). *Bull. Mus. Roy. Hist. Nat. Belg. 14* (*51*), p. 1–11, fig. 1–6.

LELOUP, E., 1941. A propos de quelques Acanthochitons peu connues ou nouveaux, II. Région Atlantique. *Bull. Mus. Roy. Hist. Nat. Belg. 17* (*43*), p. 1–15, figs.

LELOUP, E., 1941–a. Résultats scientifiques ... "Mercator" (2), Polyplacophora. *Mém. Mus. Roy. Hist. Nat. Belg. (2) 21* p. 35–45, fig. 1–8, pl. 1.

LELOUP, E., 1942. Contributions à la connaisance des Polyplacophores. 1. Fam. Mopaliidae Pilsbry 1892. *Mém. Mus. Roy. Hist. Nat. Belg. (2) 25*, p. 1–64, fig. 1–27, pl. 1–6.

LELOUP, E., 1956. Polyplacophora. Reports Lund University Chile Expedition 1948–1949, 27. *Acta Univ. Lundensis, Andra Avd. (n.s.) 52*, p. 1–94, 53 figs.

LELOUP, E., 1961. Ischnochiton adamsii (Carpenter, 1863), I. dispar (Sowerby, 1832) et I. pseudostriolatus sp. nov. *Bull. Inst. Roy. Sci. Nat. Belg. 37* (*18*), p. 1–8, fig. 1–6, pl. 1–2.

LINNAEUS, C., 1758. *Systema Naturae. Regnum Animale, ed. decima.*

LINNAEUS, C., 1764. *Museum S:ae R:ae M:tis Ludovicae Ulricae Reginae ....*

LINNAEUS, C., 1767. *Systema Naturae, editio duodecima reformata. 1* (*2*).

MCGINTY, L., 1937. Acanthochitona pygmaea (Pilsbry). *Nautilus 50* (*4*), p. 141.

NIERSTRASZ, H. F., 1905. Bemerkungen über die Chitonen-Sammlung im Zoologischen Museum in Leiden. *Notes Leyden Museum 25*, p. 141–159, pl. 9–10.

NIERSTRASZ, H. F., 1906. Beiträge zur Kenntnis der Fauna von Süd-Afrika VI, Chitonen aus der Kapkolonie und Natal. *Zool. Jahrb. (Syst.) 23*, p. 487–520, 2 pls.

NIERSTRASZ, H. F., 1927. Chitonida. Bijdrage tot de kennis der fauna van Curaçao. *Bijdr. Dierk. Amsterdam 25*, p. 162–163.

NOWELL-USTICKE, 1959. *A check list of the marine shells of St. Croix* ... Christiansted, St. Croix, V.I., 90 pp., 4 pls. [Amphineura on p. 89–90; not discussed in this paper.]

OLIVER, W. R. B., 1923. Variation in Amphineura. *Trans. Proc. New Zealand Inst. 53*, p. 361.

OLSSON, A. A. & MCGINTY, T. L., 1958. Recent marine mollusks from the Caribbean coast of Panamá with descriptions of some new genera and species. *Bull. Amer. Paleontology 39* (177), p. 1–58, pl. 1–5.

ORBIGNY, A. D', 1853. Mollusques. In RAMÓN DE LA SAGRA: *Histoire physique, politique et naturelle de l'île de Cuba*, Vol. *2*.

ÓSKARSSON, I., 1961. Note on some rare and new species ot Mollusca off the coast of Iceland. *Náttúrafraedingurinn 30*, p. 176–187, 9 figs.

PARKER, G. H., 1914. The locomotion of Chiton. *Contr. Bermuda Biol. Stat. 3*, p. 1–2.

PEILE, A. J., 1926. The Mollusca of Bermuda. *Proc. Malac. Soc. London 17*, p. 71–98.

PERRY, L. M. & SCHWENGEL, J. S., 1955. *Marine shells of the Western coast of Florida.* Paleont. Research Inst. Ithaca, N. York, 318 pp., 55 pls.

P. [PETIT DE LA SAUSSAYE, S.], 1851. Catalogue des coquilles trouvées à l'île de la Guadeloupe, par M. Beau. *Journ. Conchiol. 2*, p. 422–430.

P. [PETIT DE LA SAUSSAYE, S.], 1853. Supplément au catalogue des coquilles trouvées à l'île de la Guadeloupe, par M. Beau. *Journ. Conchiol. 4*, p. 413–419.

P. [PETIT DE LA SAUSSAYE, S.], 1856. Deuxième supplément au catalogue des coquilles trouvées à la Guadeloupe. *Journ. Conchiol. 5*, p. 149–158.

PFEIFFER, L., 1840. *Kritisches Register zu Martini und Chemnitz.*

PILSBRY, H. A., 1892. Polyplacophora. In TRYON: *Manual of Conchology 14*, p. I–XXXIV + 1–128, pl. 1–30.

PILSBRY, H. A., 1893. *Do. 14*, p. 129–350, pl. 31–68.

PILSBRY, H. A., 1893–a. *Do. 15*, p. 1–133, pl. 1–17.

PILSBRY, H. A., 1893–b. Notes on the Acanthochitidae with descriptions of new American species. *Nautilus 7*, p. 31–32.

PILSBRY, H. A., 1940. *Nautilus 53*, pl. 12 f. 4, 5 (no text).

PILSBRY, H. A. & AGUAYO, C. G., 1933. Marine and fresh water mollusks new to the fauna of Cuba. *Nautilus 46*, p. 116–123.

REEVE, L., 1842. *Conchologia Systematica 2.*

REEVE, L., 1847. *Conchologia Iconica, or illustrations of the shells of molluscous animals 4.*

REHDER, H. A., 1943. Corrections and ecological notes on some recently described Florida marine shells. *Nautilus 57*, p. 32–33.

REMINGTON, P. S., 1922. Rambles of a midshipman, I. *Nautilus 35*, p. 118–121.

RIGHI, G., 1967. Sobre Polyplacophora do litoral Brasileiro. *Papéis Avulsos Zoologia S. Paolo 20* (9), p. 85–98, fig. 1–47.

RIGHI, G., 1968. On the radulae and spines of some Polyplacophora and Archaeogastropoda from Curaçao. *Studies Fauna Curaçao 25*, p. 73–82, fig. 71–103.

ROCHEBRUNE, A. T. DE, 1884. Diagnoses d'espèces nouvelles de la famille des Chitonidae (2me supplément). *Bull. Soc. Philomath. Paris* (7) *8*, p. 32–39.

SALISBURY, A. E., 1953. Mollusca of the University of Oxford Expedition to the Cayman Islands in 1938. *Proc. Malac. Soc. London 30*, p. 39–54, pl. 7–8.

SARS, G. O., 1878. *Bidrag til Kundskaben om Norges Arktiske Fauna.* I. *Mollusca Regionis Arcticae Norvegiae, Blöddyr.*

SAY, T., 1830/1832. *American Concholgy or descriptions of shells of North-America 1–4.*

SCHIFF, M., 1858. Beiträge zur Anatomie von Chiton piceus. *Ztschr. Wiss. Zool. 9*, p. 12–47, pl. 1–2.

SCHROETER, J. S., 1786. *Einleitung in die Conchylienkenntnis nach Linné 3.*

SEEL, O., 1913. Beiträge zur Anatomie und Phylogenie der Chitonen. *Zool. Jahrb. Suppl. 13* (= *Fauna Chilensis 4*), p. 175–206, 2 pls.

SHUTTLEWORTH, R., 1853. Über den Bau der Chitoniden, mit Aufzählung der die Antillen und die Canarischen Inseln bewohnenden Arten. *Mitth. Naturf. Ges. Bern 286–291*, p. 169–207.

SHUTTLEWORTH, R., 1856. Description de nouvelles espèces. Première décade: Espèces nouvelles pour la faune des Antilles. *Journ. Conchiol. 5*, p. 168–175, pl. 6 fig. 9.

SMITH, E. A., 1890. Mollusca. In H. N. RIDLEY: Notes on the Zoology of Fernando Noronha. *J. Linn. Soc. (Zool.) 20*, p. 483–503, pl. 30.

SMITH, M., 1945. *East coast marine shells*, 3d ed., 150 p., 77 pls., map.

SNYDER, H. L. & CROZIER, W. J., 1922. Notes on some problems of adaptation: 9. Ctenidial variation in Chiton. *Biol. Bull. Wood's Hole 43*, p. 246–252.

SOUTHWICK, W. E., 1939. The "Agglutination" phenomenon with spermatozoa of Chiton tuberculatus. *Biol. Bull. Wood's Hole 77*, p. 157–165, pl. 1.

SOWERBY, G. B., 1839. *Zoology of Beechey's Voyage of H.M.S. "Blossom."*

SOWERBY, G. B., 1840. *The Magazine of Natural History*, conducted by Edw. Charlesworth (n.s.) *4*.

SOWERBY, G. B. (Jr.), 1840–a. *The Conchological Illustrations*. Genus Chiton.

SPENGLER, L., 1797. Udförlig Beskrivelse over det mengeskallede Konkylieslaegt af Linnaeus kaldet Chiton met endeel nye Arter og Varieteter. *Skrivt. Naturhist. Selsk. Kjöbenhavn 4*, p. 62–103.

SUTER, H., 1905. Supplement to the revision of the New Zealand Polyplacophora, with descriptions of new species. *Journ. Malac. 12*, p. 65–71, pl. 9.

SUTER, H., 1913. *Manual of the New Zealand Mollusca*. 23 + 1210 pp.; atlas.

SYKES, E. R., 1894. On the South-African Polyplacophora. *Proc. Malac. Soc. London 1*, p. 132–136.

TAKI, Is., 1954. Fauna of Chitons around Japanese Islands. Stenoplax of Japan. *Bull. Nat. Sci. Mus. Tokyo (n.s.) 1*, (2) p. 72–78, pl. 20–23.

TENISON-WOODS, J. E., 1888. *Proc. Roy. Soc. N.S. Wales 22*, p. 252.

THIELE, J., 1893. Polyplacophora. In TROSCHEL, F. H.: *Das Gebiss der Schnecken, 2*, p. 353–401, pl. 30–32.

THIELE, J., 1902. Die systematische Stellung der Solenogastren und die Phylogenie der Mollusken. Zur Systematik und Phylogenie der Chitoniden. *Ztschr. Wiss. Zool. 72*, p. 249.

THIELE, J., 1906. Über die Chitonen der deutschen Tiefsee-Expedition. *Wiss. Ergebn. Deutsch. Tiefsee Exp. 9* (2), p. 325–336, 1 pl.

THIELE, J., 1909. Revision des Systems der Chitonen. Teil I. *Chun's Zoologica 22 (56)*, p. 1–70, fig. A–E, pl. 1–6.

THIELE, J., 1910. *Do*, II. *Ibid.*, p. 71–132, pl. 7–10.

THIELE, J., 1910–a. Molluskenfauna Westindiens. *Zool. Jahrb. Suppl. 11*, p. 109–132, pl. 1.

THIELE, J., 1929. *Handbuch der systematischen Weichtierkunde, 1*.

VERRILL, A. E., 1884. Second catalogue of Mollusca, recently added to the fauna of the New England coast and the adjacent parts of the Atlantic .... *Trans. Connect. Acad. Sci. 6*, p. 139–294, pl. 28–32.

WAGENAAR HUMMELINCK, P., 1933. Reisebericht. Zool. Ergebn. einer Reise nach Bonaire, Curaçao und Aruba im Jahre 1930, 1. *Zool. Jahrb. (Syst.) 64* (4/5), p. 289–326, figs.

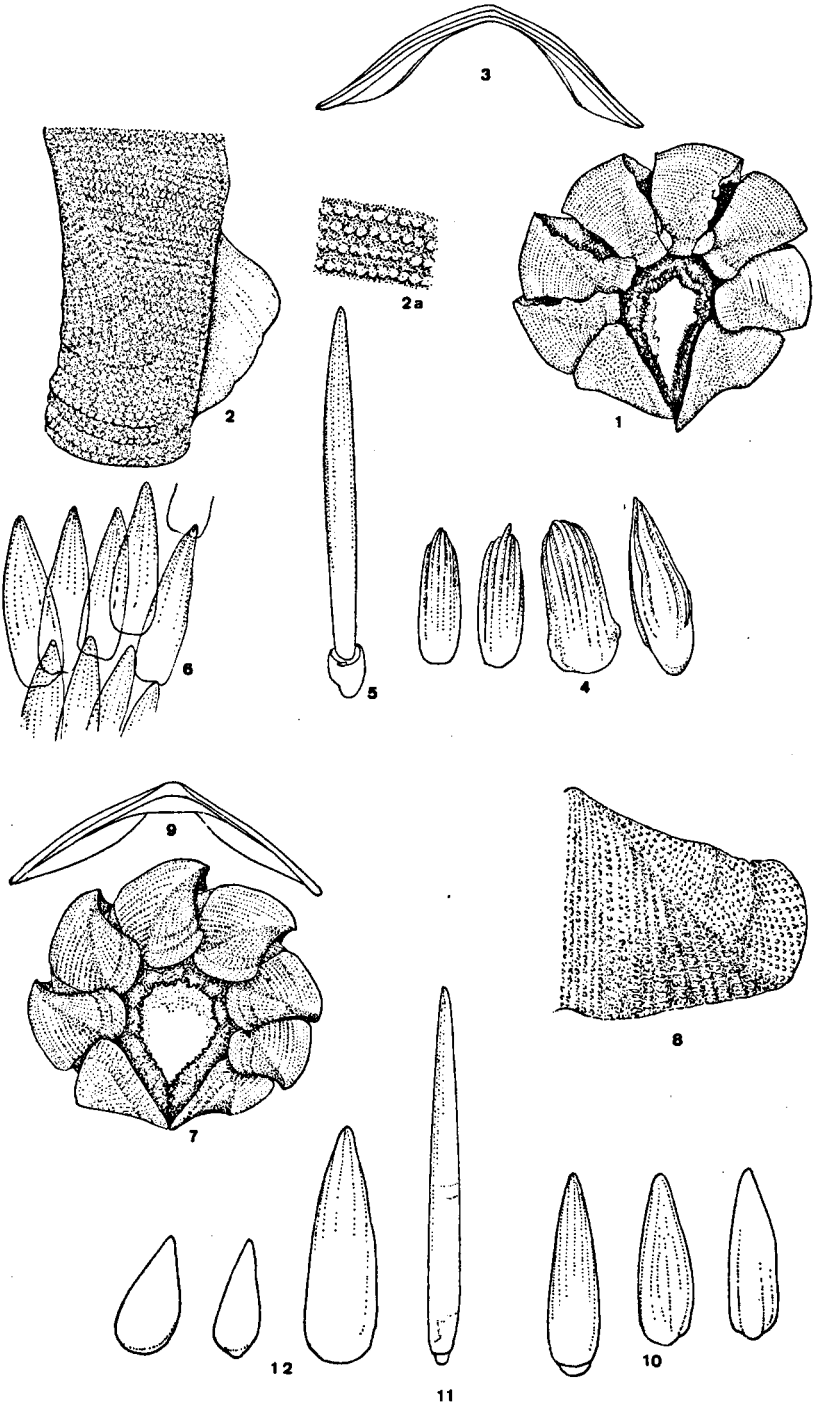
WAGENAAR HUMMELINCK, P., 1953. Description of new localities. *Stud. Fauna Curaçao 4*, p. 1–90, 8 pl.

WARMKE, G. L. & ABBOTT, R. TUCKER, 1961. *Caribbean seashells*, 346 pp., figs., 44 pls., maps.

WOOD, W., 1815. *General Conchology*.

WORK, R.C., 1969. Systematics, ecology, and distribution of the mollusks of Los Roques, Venezuela. *Bull. Mar. Sci. 19*, p. 615–711.

FIGURES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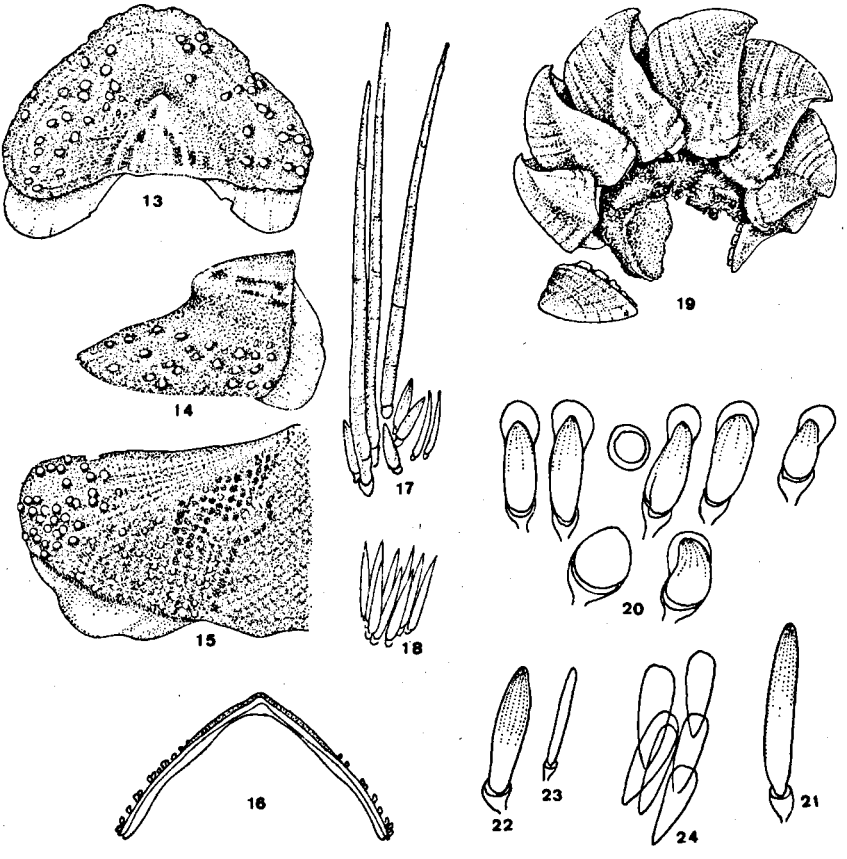
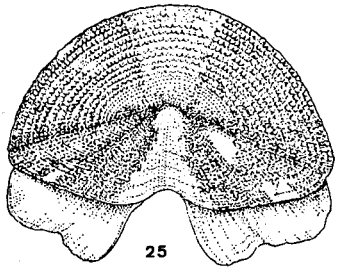


Fig. 1–6. *Lepidopleurus pergranatus* (Dall). – Off Dominica, 192–138 fms., Blake Coll., Smithsonian Inst.: 1, Lectotype (× 6); 2, part of 4th valve (× 15); 3, elevation of 4th valve; 4, dorsal girdle scales l. 50–65 μ; 5, spicules of the dorsal side l. 180 μ; 6, ventral spicules l. 80 μ.

Fig. 7–12. *Lepidopleurus binghami* Boone. – N. of Glover Reef, off British Honduras 484 fms., 20.IV.1925, "Pawnee" Exp. Holotype, in Yale-Peabody Museum, reg. nr. 15636: 7, whole animal (× 5½); 8, part of valve IV (× 8½); 9, elevation of valve IV; 10, spicules of the dorsal side of the girdle 50 μ long; 11, *do.* l. 200 μ; 12, scales-spicules of the ventral side of the girdle 30 μ and 85 μ long resp.

Fig. 13–18. *Hanleya tropicalis* (Dall). – Sand Key: Pourtalès, Florida, U.S.A., 128 fms., Blake Coll., Smithsonian Inst., reg.-nr. 95172: 13, valve VIII dorsal view (× 17); 14, *do.* lateral view (× 17); 15, part of valve VI (× 17); 16, elevation of valve V; 17, dorsal girdle-spines l. 620 μ, the small spicules 50–80 μ long; 18, spicules of the ventral side l. 125 μ.

Fig. 19–24. *Lepidochitona liozonis* (Dall & Simpson). – Ensenada Honda, Culebra, Puerto-Rico, U.S.F.C., Smithsonian Inst. Holotype, reg. nr. 161920: 19, whole animal (× 13½); 20, dorsal yellowish brown girdle elements 35 μ long; 21, white dorsal spicule l. 50 μ; 22, marginal spicule l. 50 μ; 23, *do.* l. 10 μ; 24, ventral spicules l. 42 μ.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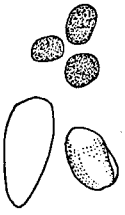
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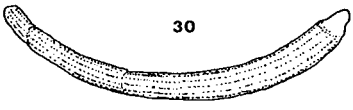

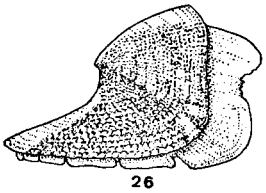
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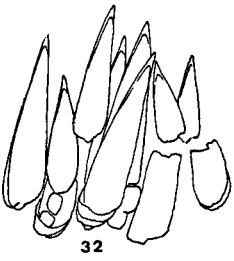
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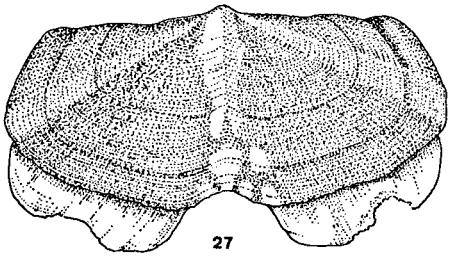
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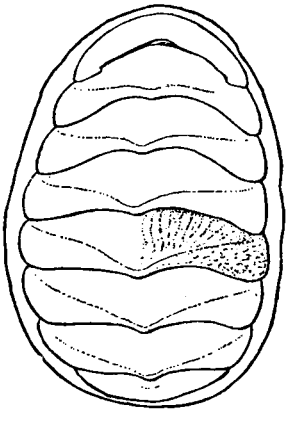
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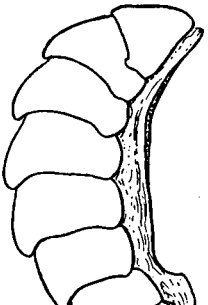
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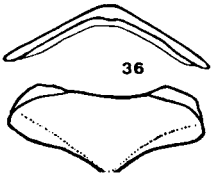
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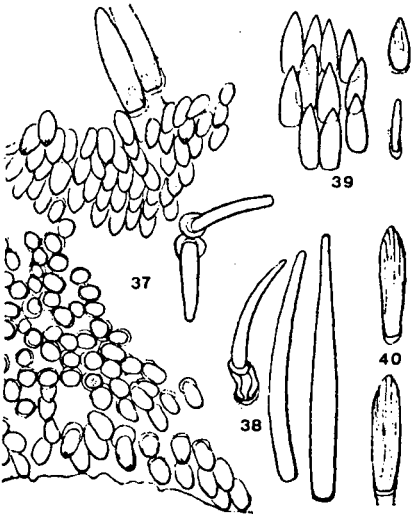
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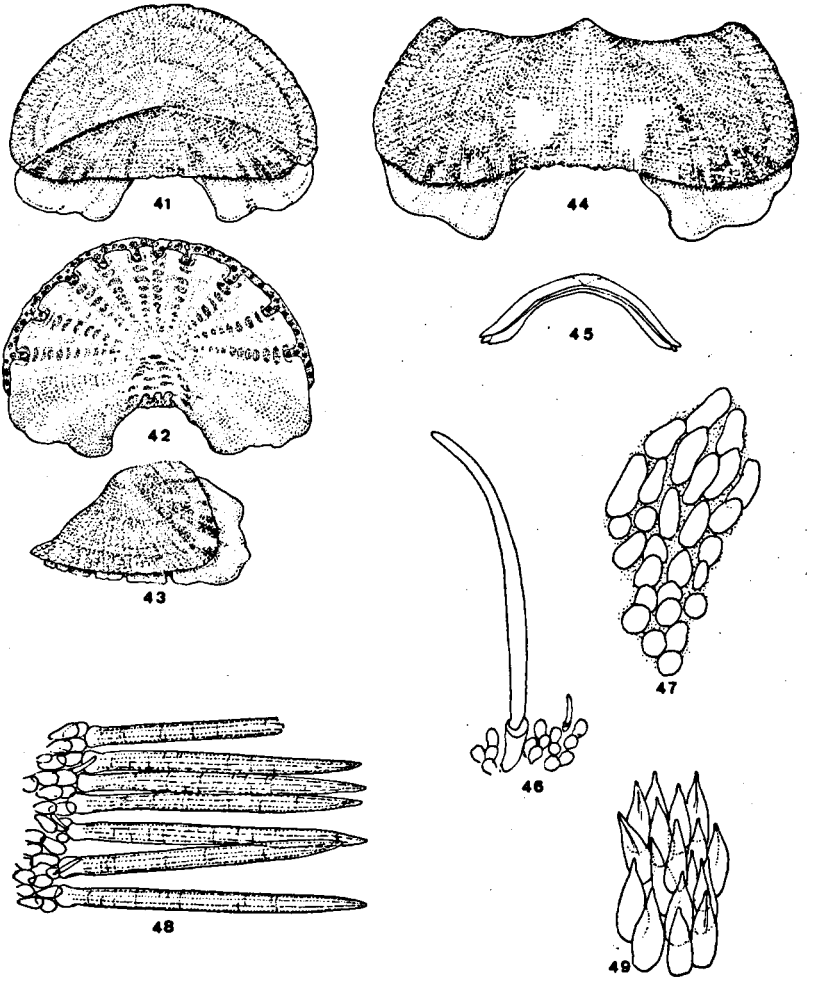


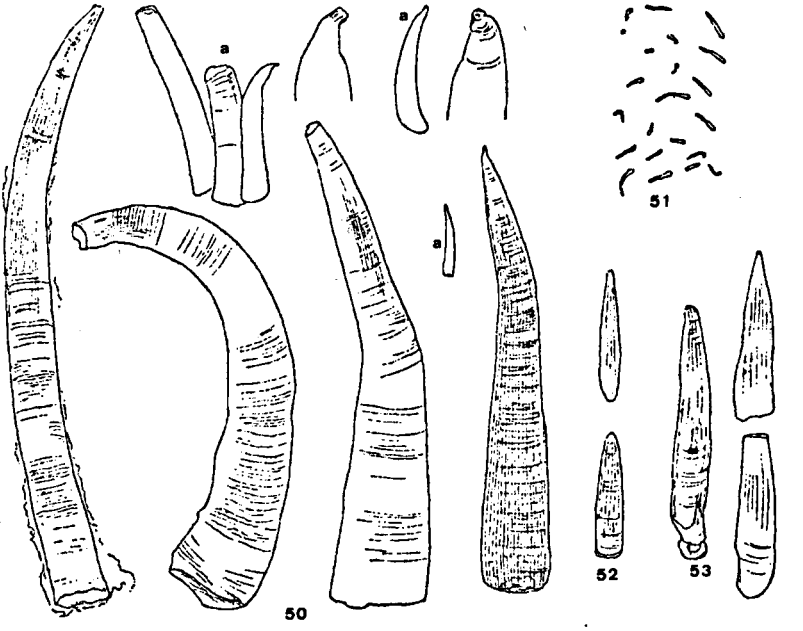
Fig. 25–40. *Lepidochitona liozonis* (Dall & Simpson). – 25–33, Bonefish Key, Fla., U.S.A., A. Koto leg., labelled "*Lepidochitona tropica* Pilsbry" (KtB 2848): 25. head valve (× 11¼); 26, tail-valve, lateral view (× 11¼); 27, valve IV (× 11¼); 28, calcareous corpuscules from the dorsal side of the girdle, 6–8 μ long; 29, solitary dorsal spicules 150 μ and 65 μ long resp.; 30, sutural spicules 235 μ and 160 μ long resp.; 31, marginal spicules 42 μ long; 32, ventral spicules 55–60 μ long; 33, elevation of valve IV. – 34–40, Cabo la Vela, Colombia, 12–15 fms., "Mercator." Holotype of *Trachydermon parvulus* Leloup = *L. liozonis* (D. & S.) (after LELOUP, 1941a): 34, whole animal, dorsal and lateral view (× 27½); 35, valve I; 36, intermediate valve, dorsal side and elevation; 37, part of the dorsal side of the girdle (× 225); 38, dorsal spicules; 39, ventral scales; 40, marginal spicules.

Fig. 41–49. *Lepidochitona rosea* sp. nov. – Trinidad: Monos, Avalon Bay, 10.I.1955 (H. 1382). Holotype, in RMNH Leiden: 41. tail valve (× 22½); 42, ventral side of tail valve (× 22½); 43, lateral view of tail valve (× 22½); 44, valve VII (× 22½); 45, elevation of median valve; 46. solitary dorsal spicule 184 μ long, minute spicule 16 μ long; 47, sutural scales, the largest 24 μ long; 48, marginal spicules l. 130 μ; 49, ventral spicules-scales 30 μ long.

Fig. 50–54. *Ceratozona rugosa* (Sowerby). – Girdle elements (after LELOUP, 1942): 50, dorsal spines (× 155); 50a, *do.* (× 26); 51, small dorsal spicules (× 155); 52, 53, ventral spicules; marginal spicules (× 155). – 54, part of radula row (after THIELE, 1909).
Fig. 55–57. *Cryptoconchus floridanus* (Dall). – Bonaire, Lac, Boca, 1.X.1948 (H 1086a): 55, juvenile specimen (× 13½); 56, girdle elements, ventral side. – Bonefish Key, Fla., A. Koto leg. (KtB 2853): 57, girdle elements, ventral side.

Fig. 58–64. *Acanthochitona hemphilli* (Pilsbry). – Curaçao: Fuik Baai, Duitse Bad, 17.IV.1949 (H 1038a): 58, marginal spicule (orange-yellow); 58a, top enlarged; 59, marginal spicule (vitreous); 60, large yellow and small white spiculae of sutural tuft; 61, yellow spicule of dorsal side; 62, white spicule dorsal side; 63, yellowish spicule-scale ventral side; 64, white spicule ventral side.
Fig. 65–71. *Acanthochitona rhodea* (Pilsbry). – 10–12 mi. W. of Cabo la Vela, Colombia, 28–29 fms., 12.I.1939, "Mercator", Inst. Roy. Sci. Nat. Belg. (after LELOUP, 1941a): 65–67, valves (× 6.8); 65, valve I; 66, valve IV; 67, valve VIII, dorsal and lateral view; 68–71, girdle elements (× 220; 69a and 71b × 37); 68, position of dorsal spicules, a, small ones, b, large ones; 69, spicules of the ventral side; 70, large spines of the sutural tufts, a, minute spicules among the spines, b, basal spicules; 71, mauve or white marginal spicules, a and b = yellow ones.

Fig. 72–73. *Acanthochitona bonairensis* sp. nov. – Bonaire: N. of Punt Vierkant, 9.XI.1948 (H 1059A). Holotype, in RMNH Leiden: 72, spicules from the ventral side of the girdle 100 μ long; 73, spicules from the dorsal side of the girdle, the large ones 380 μ long, the small ones 85 μ.
Fig. 74–75. *Acanthochitona spiculosa* (Reeve). – Bonefish Key, Fla., U.S.A., A. Koto leg. (KtB 3852): 74, valve VIII dorsal view; 75, valve V dorsal view.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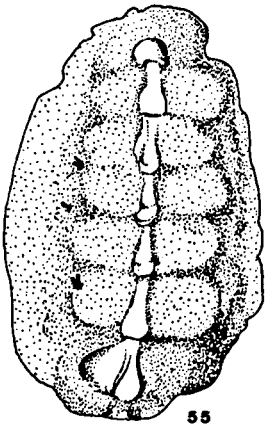
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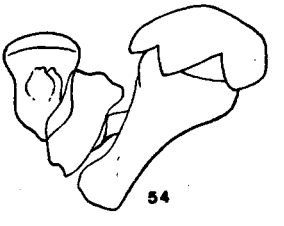
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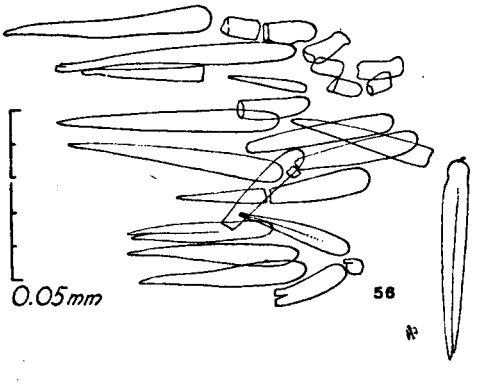
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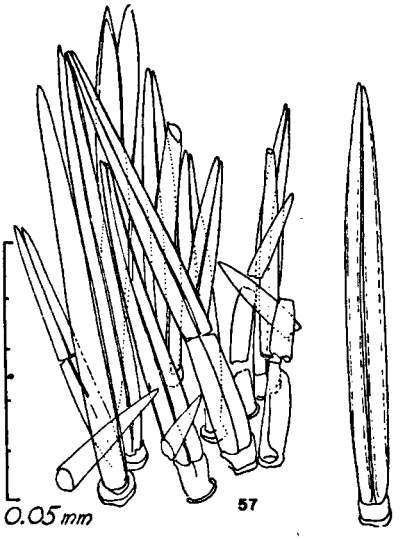
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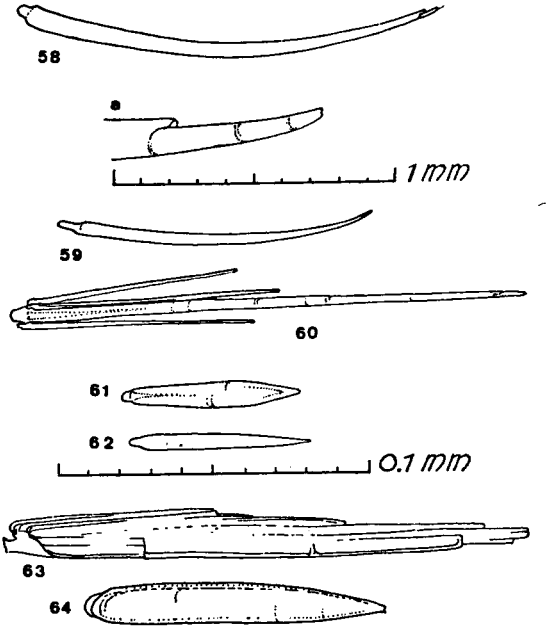
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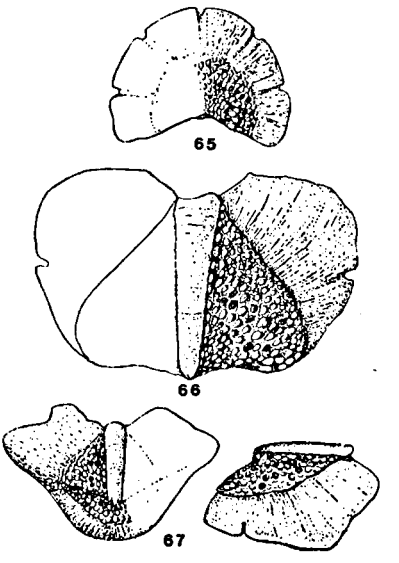
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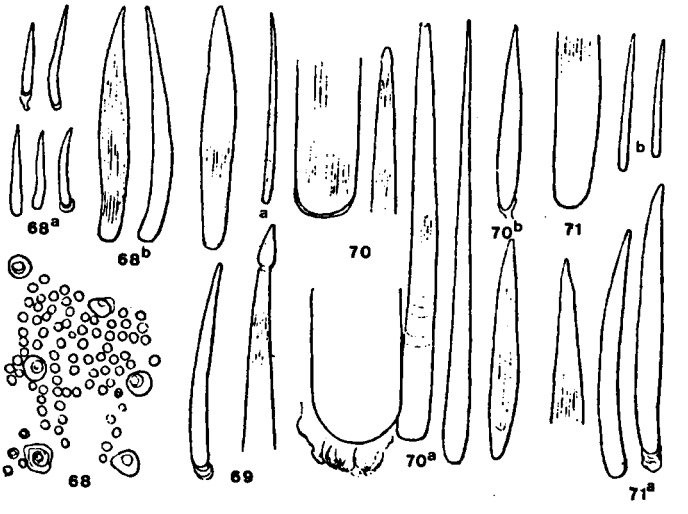
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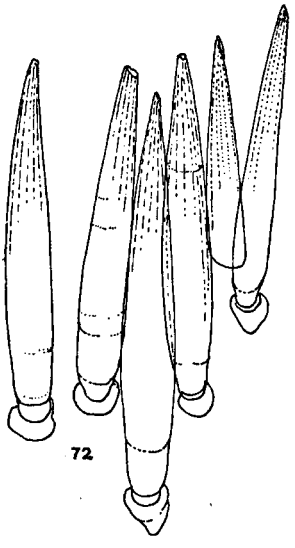

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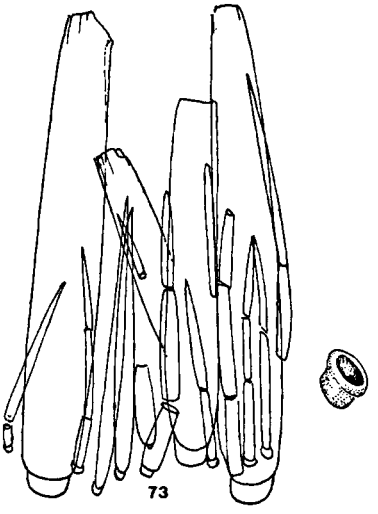

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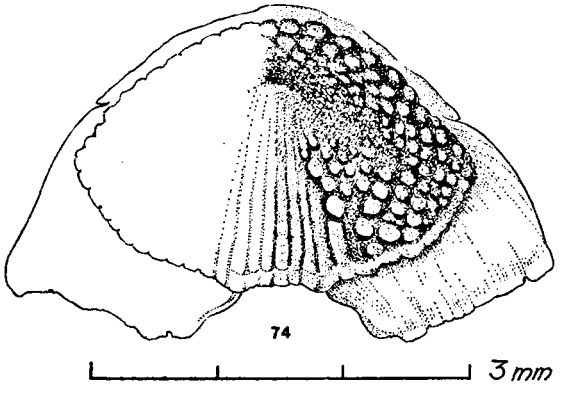

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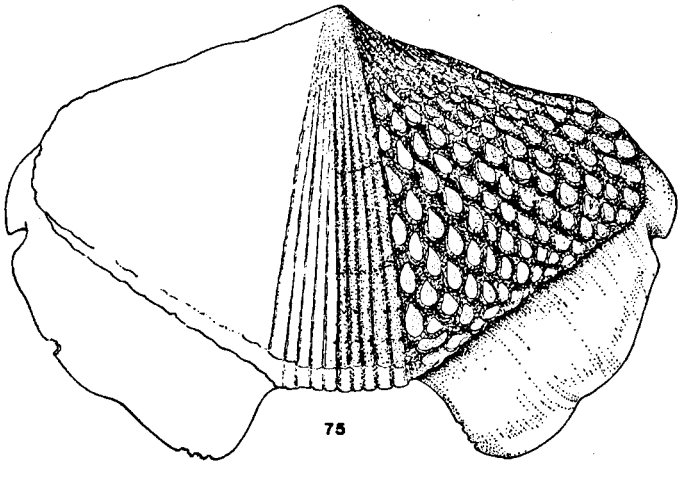

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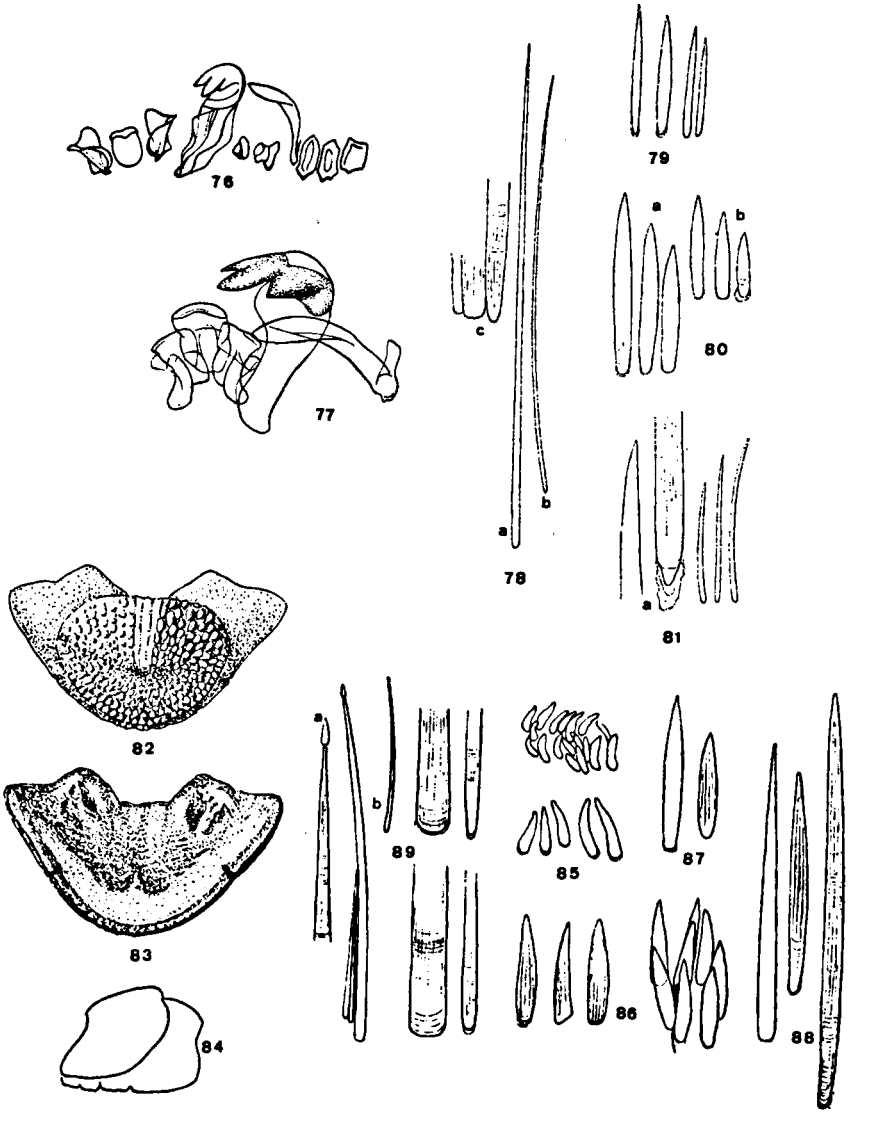


Fig. 76–81. *Acanthochitona spiculosa* (Reeve). – 76, radula row (after DALL, 1879); 77, part of radula-row (after THIELE, 1893). – 78–81, girdle elements, specimen from Guadeloupe (after LELOUP, 1941): 78, spines of sutural tufts, a = large one (× 21), b = small one (× 130), c = base of a and b (more enlarged); 79, spicules of the dorsal side (× 130); 80, spicules of the ventral side (× 130), a = close to the outer margin, b = in the middle and towards the inner margin; 81, marginal spicules (× 21, a = base and top × 130).

Fig. 82–89. *Acanthochitona pygmaea* (Pilsbry). – 8 mi. W. of Cabo la Vela, Colombia, 12–15 fms., 12.I.1939, "Mercator," Inst. Roy. Sci. Nat. Belg.; 89, Florida (after LELOUP, 1941a): 82, valve VIII, dorsal view (× 12½); 83, *do.* ventral view; 84, *do.* lateral view; 85, spicules of the dorsal side of the girdle (× 82½); 86, spicules-scales in the middle of the ventral side (× 215); 87, *do.* near the margin of the ventral side (× 215); 88, marginal spines (× 215); 89, large and small spines of the sutural tufts (× 215, a = × 82, b = × 36).

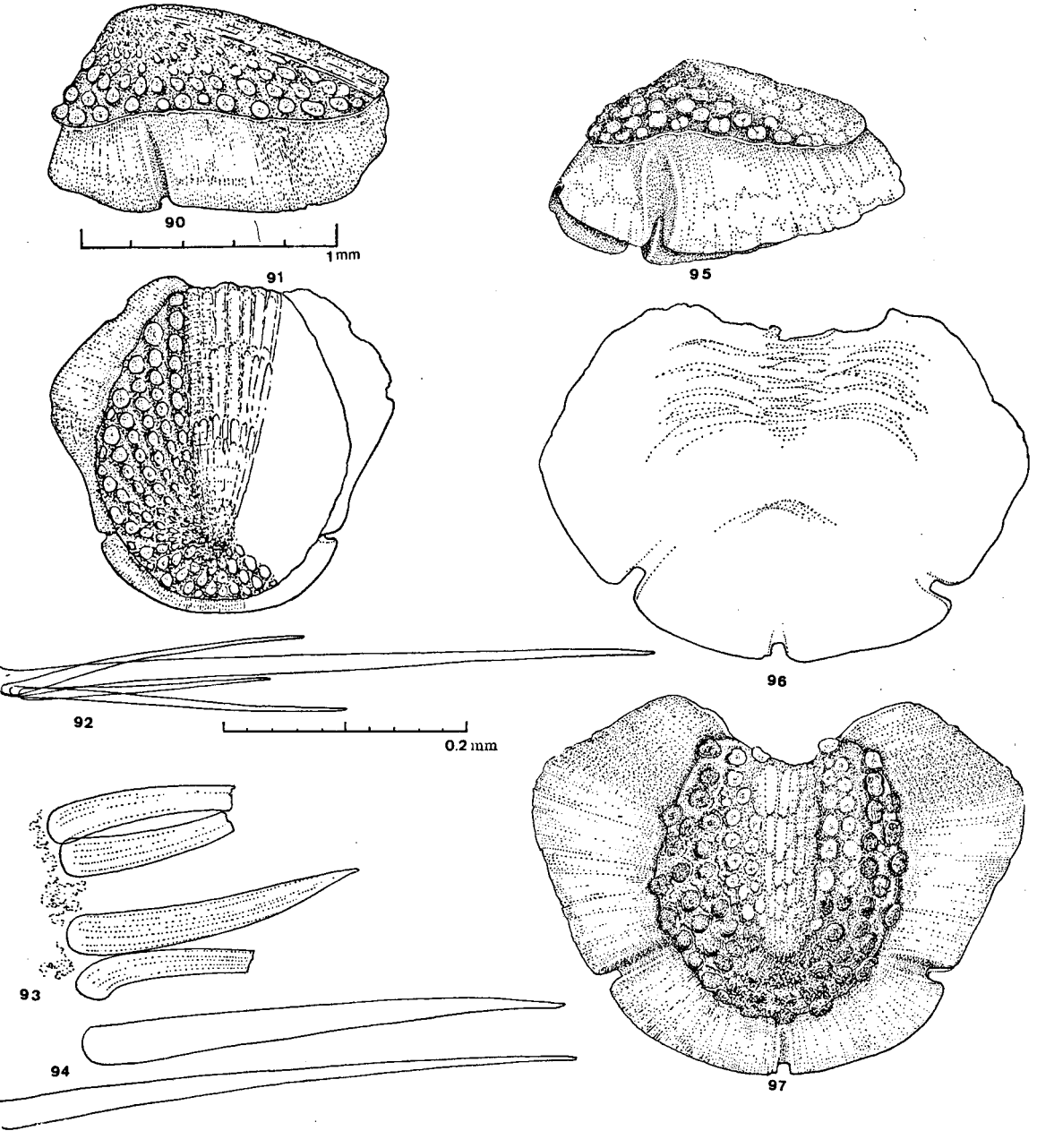


Fig. 90–94. *Acanthochitona elongata* sp. nov. – Bonefish Key, Florida, U.S.A., A. Koto leg., Paratype (KtB 2849): 90, valve VIII lateral view; 91, *do.* dorsal view; 92, spicules of sutural tufts, large and small ones; 93, spicules of dorsal side of the girdle; 94, spicules of the ventral side.

Fig. 95–97. *Acanthochitona interfissa* sp. nov. – Trinidad: Monos, Avalon Bay, 10.I. 1955 (H 1382), Paratype, now in RMNH Leiden (× 52); 95, tail valve lateral view; 96, *do.* ventral view; 97, *do.* dorsal view.

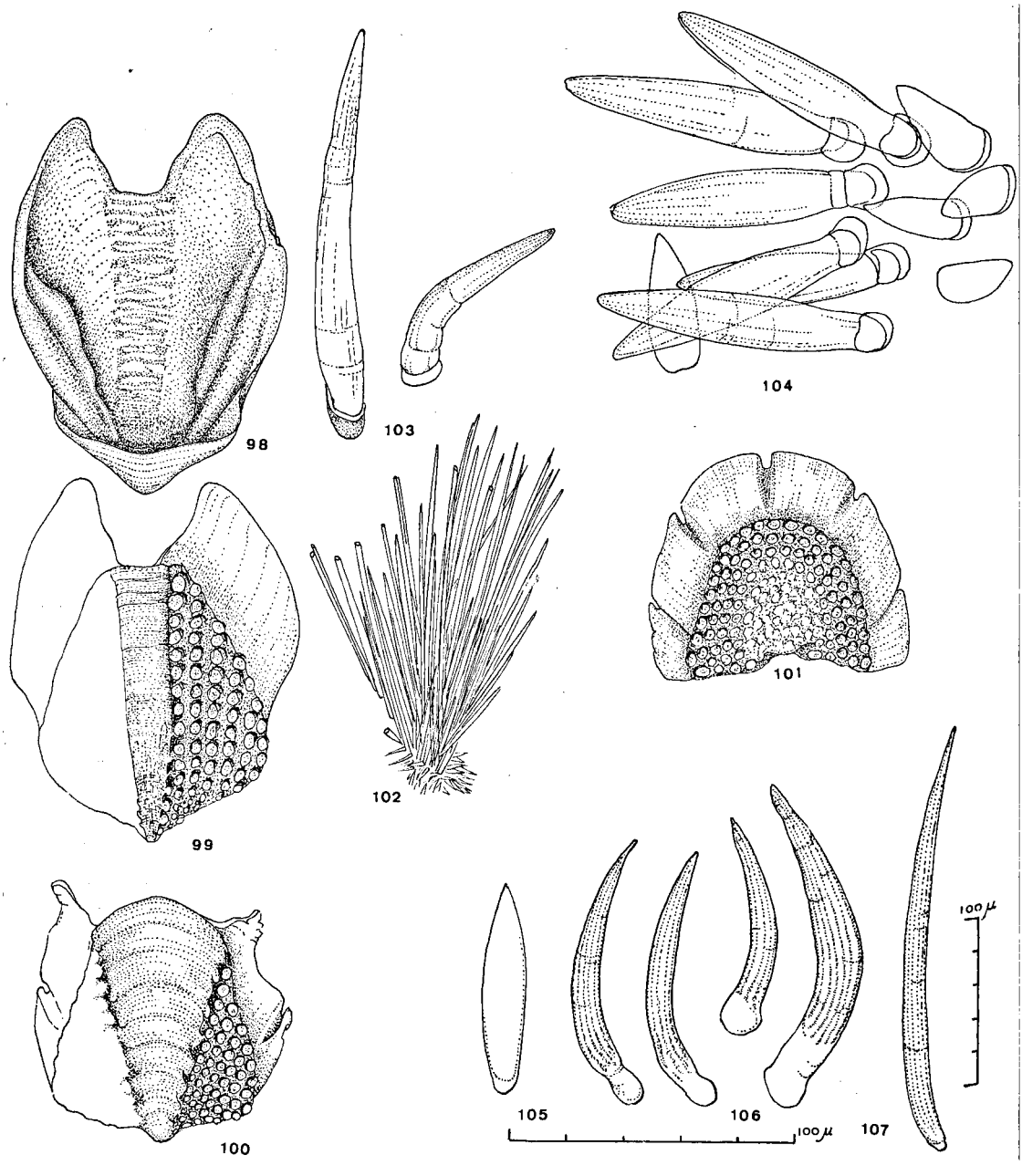


Fig. 98–107. *Acanthochitona interfissa* sp. nov. – 98–104, Trinidad: Monos, Avalon Bay, 10.I.1955 (H 1382), Paratype: 98, valve IV ventral view (× 36); 99, *do.* dorsal view; 100, valve II dorsal view (× 36); 101, valve I dorsal view (× 36); 102, sutural tuft, longest spines 730 μ; 103, marginal spicules l. 190 μ; 104, ventral spicules l. 48 μ. – 105–107, Aruba: Malmok, Arasji, 14.VIII.1955 (H 1301), Paratype: 105, ventral spicule; 106, dorsal spicules; 107, marginal spicule.

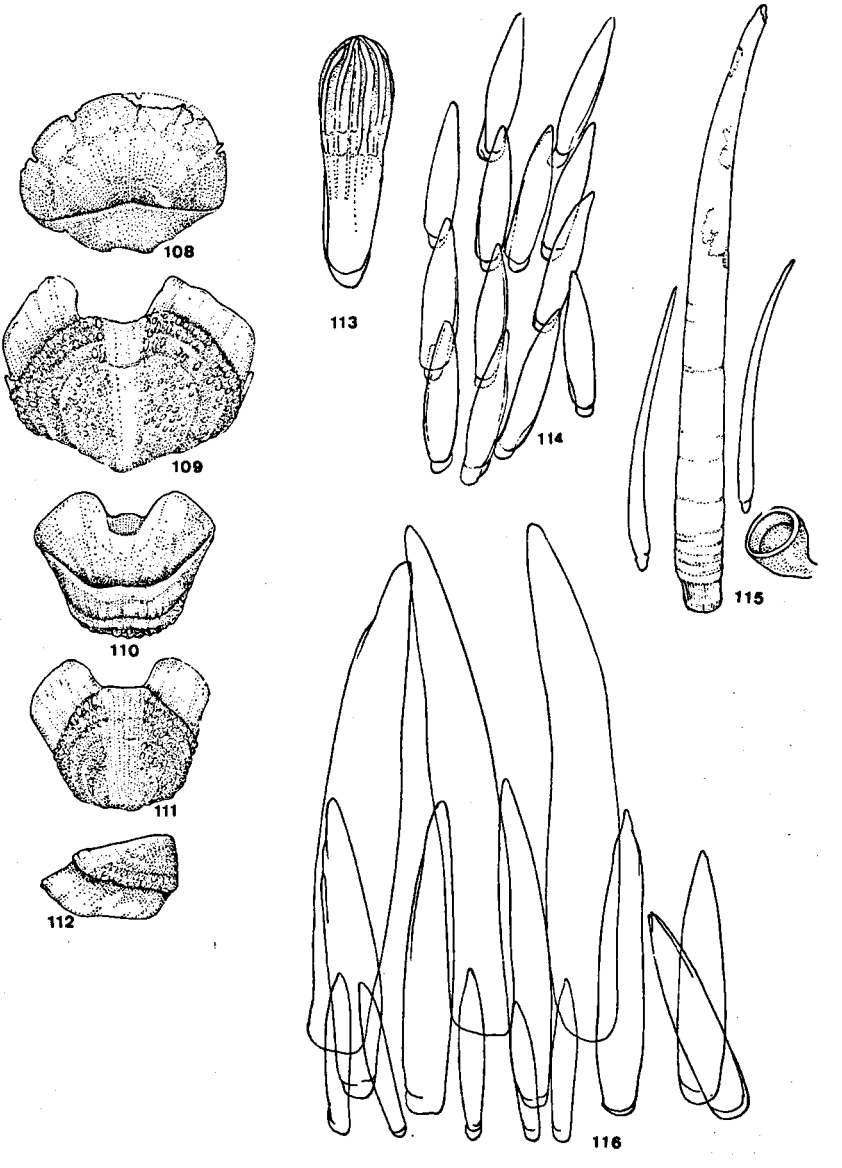


Fig. 108–116. *Choneplax lata* (Guilding). – St. John: Bay S. of Cruz Bay, 19.VI.1955 (H 1408): 108–112, separate valves (× 22½); 108, valve I ventral view; 109, valve IV dorsal view; 110, valve VIII ventral view; 111, valve VIII dorsal view; 112, valve VIII lateral view; 113–116, girdle elements: 113, dorsal spicule-scale l. 110–120 μ; 114, ventral spiculae l. 80 μ; 115, spicules of sutural tufts l. 530 μ; 116, three types of marginal spicules, the small ones l. 110 μ, the medium ones l. 190 μ, the large ones l. 365 μ.

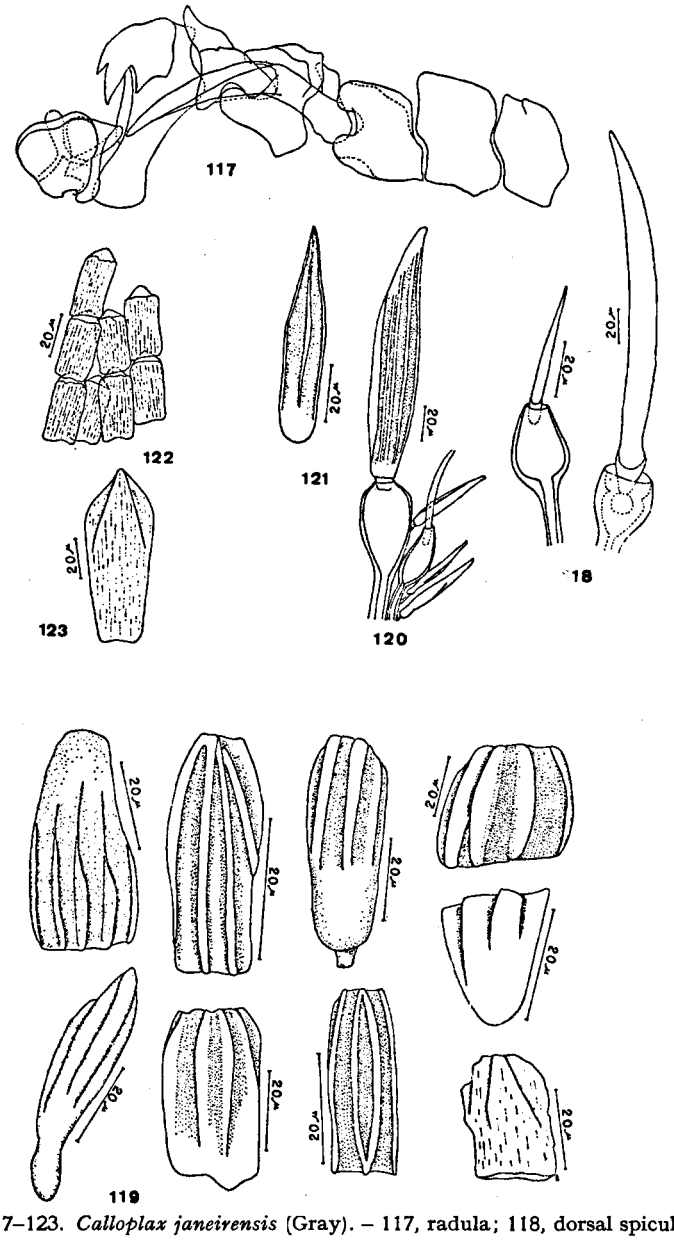


Fig. 117–123. *Calloplax janeirensis* (Gray). – 117, radula; 118, dorsal spicules; 119, various types of dorsal scales; 120, marginal spicules; 121, solitary marginal spicules, 122, ventral scales; 123, ventral scale close to the outer margin (after RIGHI, 1967).

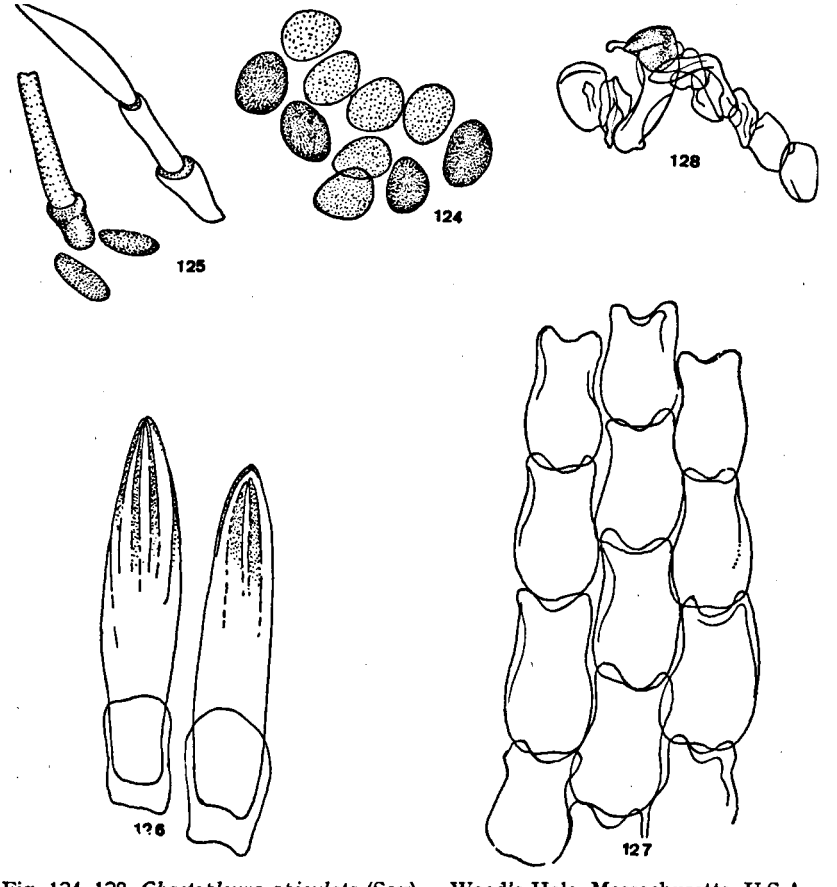


Fig. 124–128. *Chaetopleura apiculata* (Say). – Wood's Hole, Massachusetts, U.S.A., VIII.1924, H. Boschma leg. (KtB 3695): 124, girdle scales 28 μ long, from dorsal side, chestnut and yellowish brown; 125, dorsal spicules l. 120 μ scattered among the scales; 126, marginal spicules l. 150 μ; 127, ventral scales 50 μ long. – 128, radula row (after THIELE, 1893).

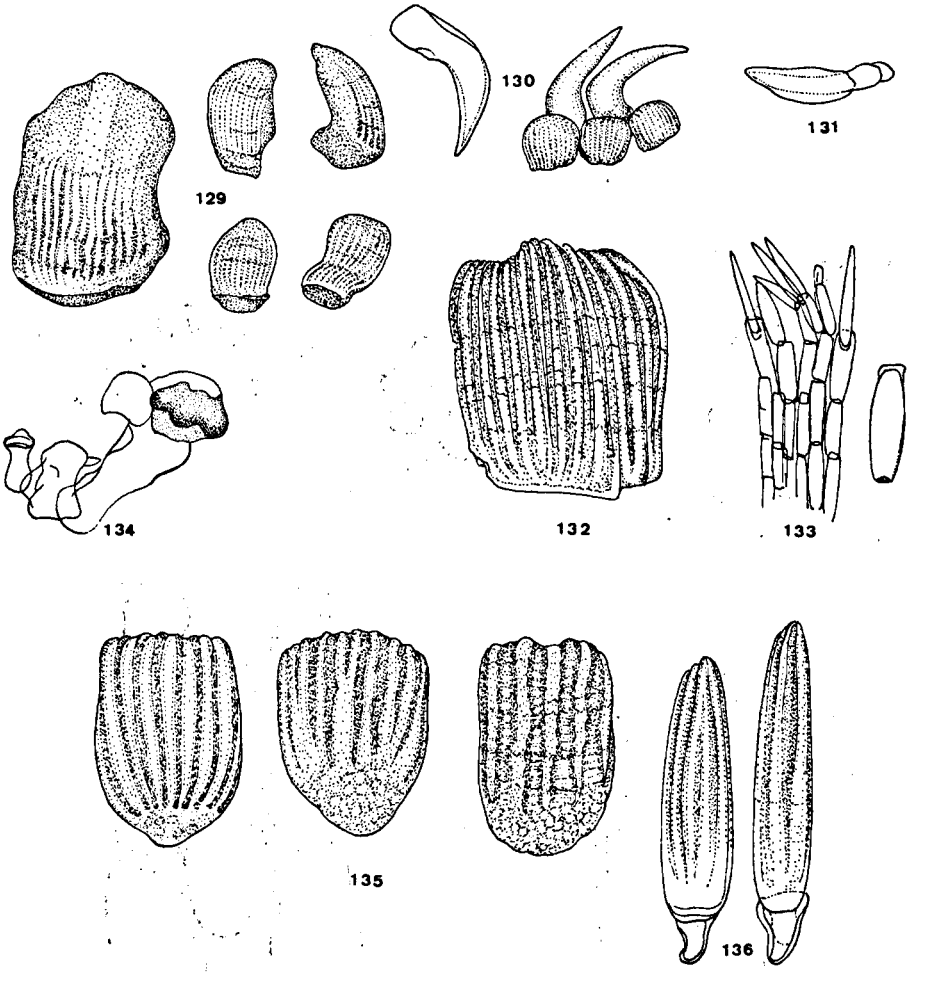
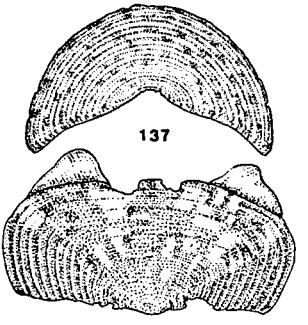


Fig. 129–134. *Ischnochiton purpurascens* (C. B. Adams). – 129–131, Tobago: Buccoo Reef, 16.I.1955 (H. 1387): 129, dorsal girdle scales l. 120–130 μ; 130, marginal spicules l. 116 μ; 131, spicule-scale. – 132–133, St. John, Turner Bay, 18.VI.1955 (H 1407): 132, dorsal scale; 133, ventral scales l. 100 μ. – 134, radula row (after THIELE, 1893).

Fig. 135–136. *Ischnochiton floridanus* Pilsbry. – Florida: Boca Grande (KtB 3729): 135, dorsal girdle-scales l. 130 μ; 136, marginal spicules l. 115 μ.

Fig. 137–150. *Ischnochiton boogii* Haddon. – 137–143, Bermuda, Haycock leg., Smithsonian Inst., reg. nr. 223354, Holotype of *Ischnochiton bermudensis* Dall & Bartsch: 137, valve I dorsal view; 138, valve VII dorsal view; 139, valve VIII dorsal view; 140, *do.* lateral view (all × 15); 141, dorsal girdle scales l. 25–60 μ; 142, marginal spicules l. 65 μ; 143, ventral scales 45 × 18 and 45 × 30 μ. – 144–146, Los Testigos, – 40 m., "Yacht Chazalie," 20.I.1896, BMNH (after LELOUP, 1938) (× 6): 144, valve I ventral view; 145, valve V ventral view and dorsal elevation; 146, valve VIII ventral and lateral view. – 147, Bermuda, 21.XII.1911, Maj. A. Peile, R.A., leg., BMNH: lateral view of median valve (after LELOUP, 1938) (× 6). – 148–150, girdle elements (× 195) (after LELOUP, 1938): 148, dorsal scales; 149, marginal spicules-scales and small spicules; 150, large marginal spicules.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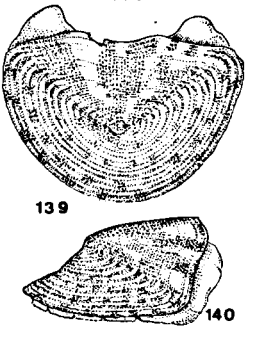
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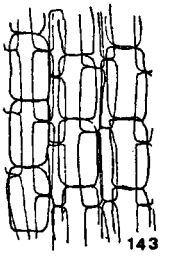
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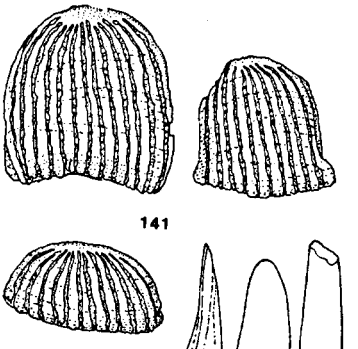
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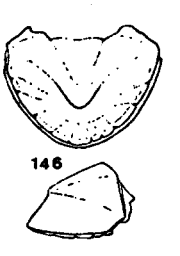
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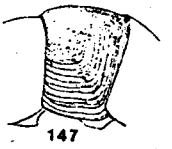
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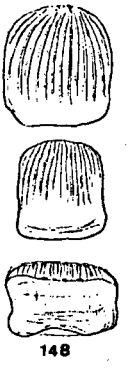
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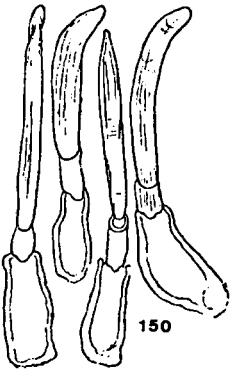
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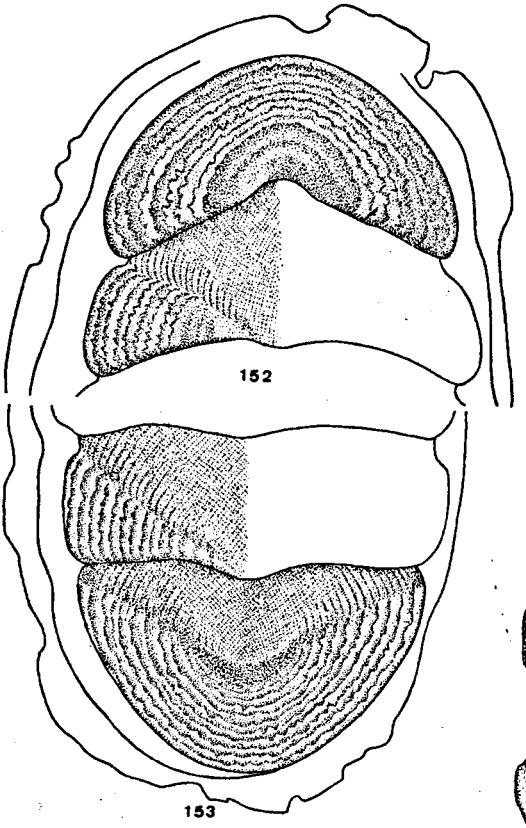
Fig. 151–161. *Ischnochiton striolatus* Gray. – 151–155, Rio de Janeiro, Rev. W. Hennah leg., VIII.1827, BMNH, Lectotype: 151, whole animal (× 3½); 152, valves I, II (× 16⅓); 153, valves VII, VIII (× 16⅓); 154, part of the girdle (× 28); 155, girdle scales (× 140). – 156, St. Thomas, Mus. Cuming, BMNH; labelled "*Ischnochiton caribbaeorum*" (Carpenter MS) Smith: valve VI (× 17). – 157, Fernando Noronha, labelled "*Ischnochiton caribbaeorum* (Carpenter MS) Smith. SMITH's type-set, BMNH: valves IV, V (curled) (× 16⅓); 158, West-Indies, labelled "*Ischnochiton ?jamaicensis* var. *viridior*" by CARPENTER, BMNH: valve VI (× 16⅓). – 159–160, Jamaica, Holotype of *Ischnochiton jamaicensis* (Carpenter MS) Pilsbry, Mus. Cuming, Brit. Mus. London: 159, whole animal (× 5½); 160, valves IV, V (× 16⅓). – 161, Curaçao, Spaansche Water, Van der Horst leg. (KtB 1566): valve VI (× 16⅓). – (All figures H. Heyn del.).

Fig. 162–166. *Ischnochiton striolatus* Gray. – 162–165, Dominica: Prince Rupert Bay, near Portsmouth, 15.VII.1967 (H 1546): 162, dorsal girdle scales from the base; 163, *do.* dorsal view (230 μ broad); 164, spicule-scale just above the margin 15 μ long; 165, ventral scales and marginal spicules 85 μ long. – 166, part of radula row (after THIELE, 1893).

Fig. 167–174. *Ischnochiton erythronotus* (C. B. Adams). – 167–168, Guadeloupe, Mus. Cuming, Brit. Mus. (N.H.), Holotype of *Ischnochiton funiculatus* Carpenter: 167, valves VII, VIII (× 12⅔); 168, girdle scales, dorsal side (× 99). – 169–173, St. Eustatius: Gallows Bay, 2 m deep, 15.VII.1949 (H 1116B): 169, dorsal girdle scale; 170, *do.* from the base 160 × 85 μ; 171, ventral scales 65 × 16 μ; 172, *do.* towards the outer margin; 173, marginal spicule, 100 μ. – 174. part of radula-row (after THIELE, 1893). – (Fig. 167–168 H. Heyn del.).

Fig. 175–178. *Ischnochiton papillosus* (C. B. Adams). – Pigeon Key, Florida; L. B. Holthuis leg., in RMNH Leiden: 175, dorsal girdle-scales 72 × 46 μ; 176, ventral scales 60 × 15 μ; 177, ventral and marginal elements l. 50 μ; 178, marginal spicule l. 70 μ.

Fig. 179–185. *Ischnochiton pseudovirgatus* sp. nov. – 179–180, Curaçao: Boca Lagoen, 13.XI.1948 (H 1020B), Holotype: 179, part of valves III and IV (× 30); 180, dorsal scale 67 × 38 μ. – 181–185, Aruba: Malmok, Arasji, 14.VIII.1955 (H 1301), Paratype: 181, dorsal scale; 182, group of dorsal scales, 183, ventral scales 22 × 15 μ; 184, ventral scales and infra-marginal spicules l. 50 μ; 185, supra-marginal spicule, large one l. 70 μ.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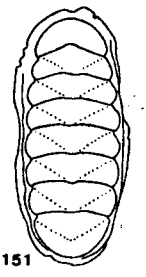
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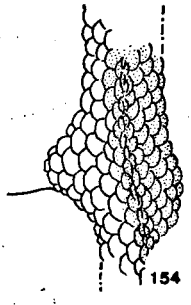
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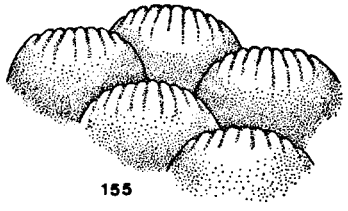
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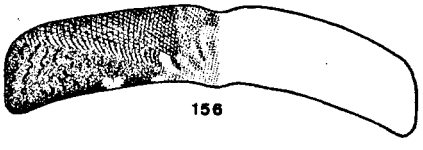
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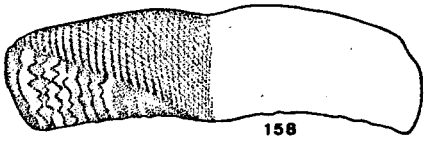
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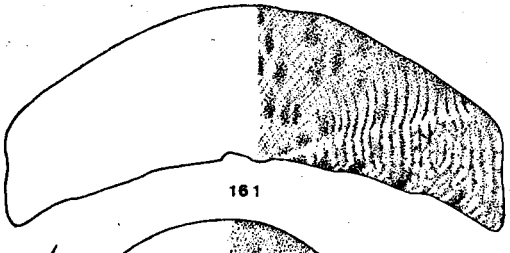
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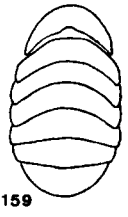
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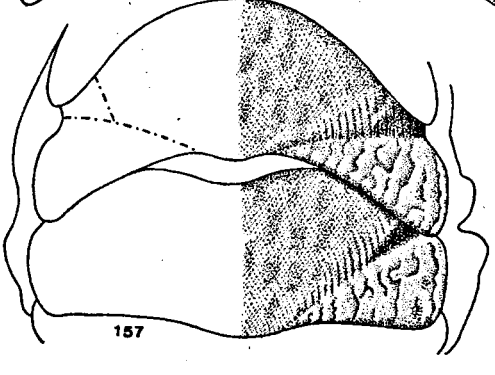
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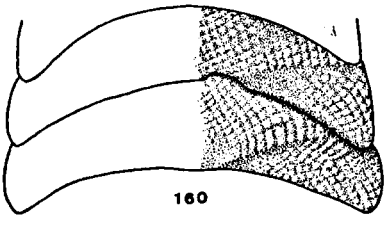
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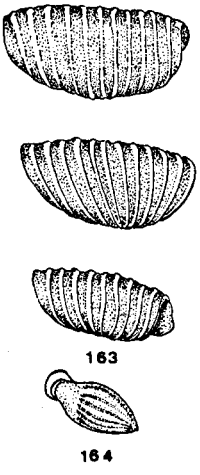
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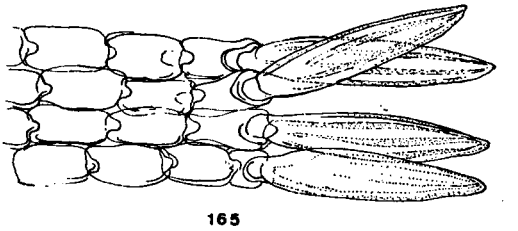
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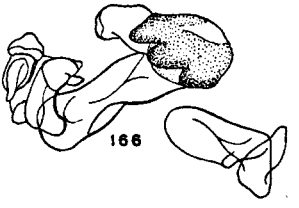
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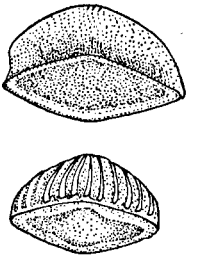
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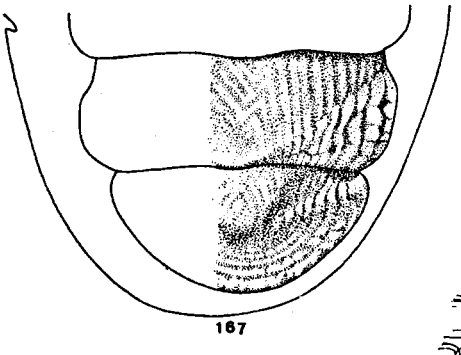
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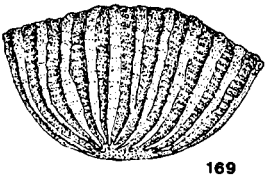
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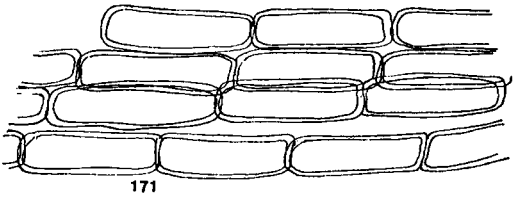
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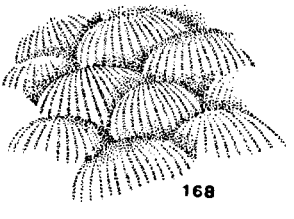
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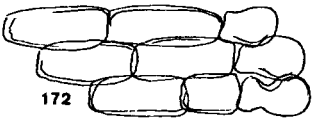
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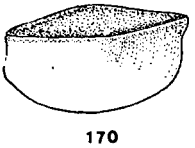
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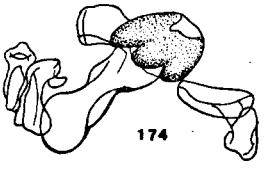
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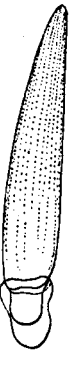
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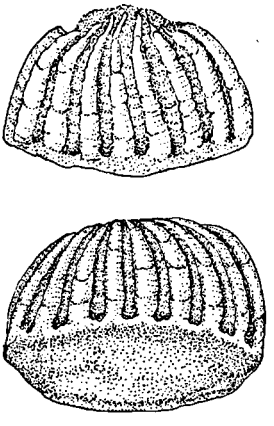

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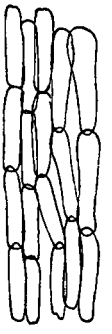

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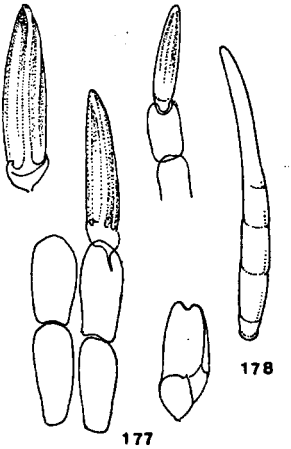

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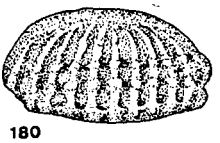

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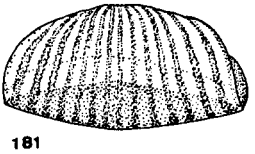

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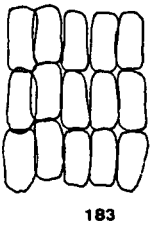

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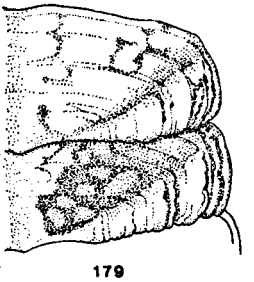

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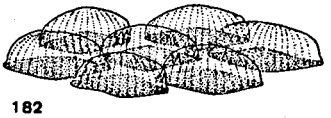

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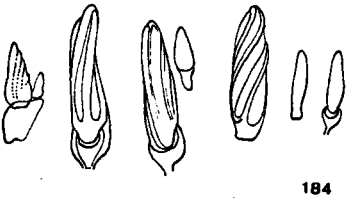

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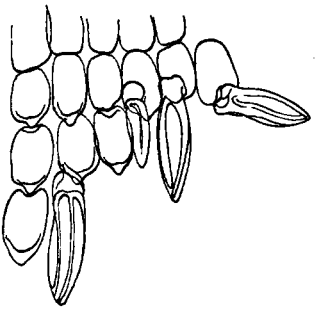

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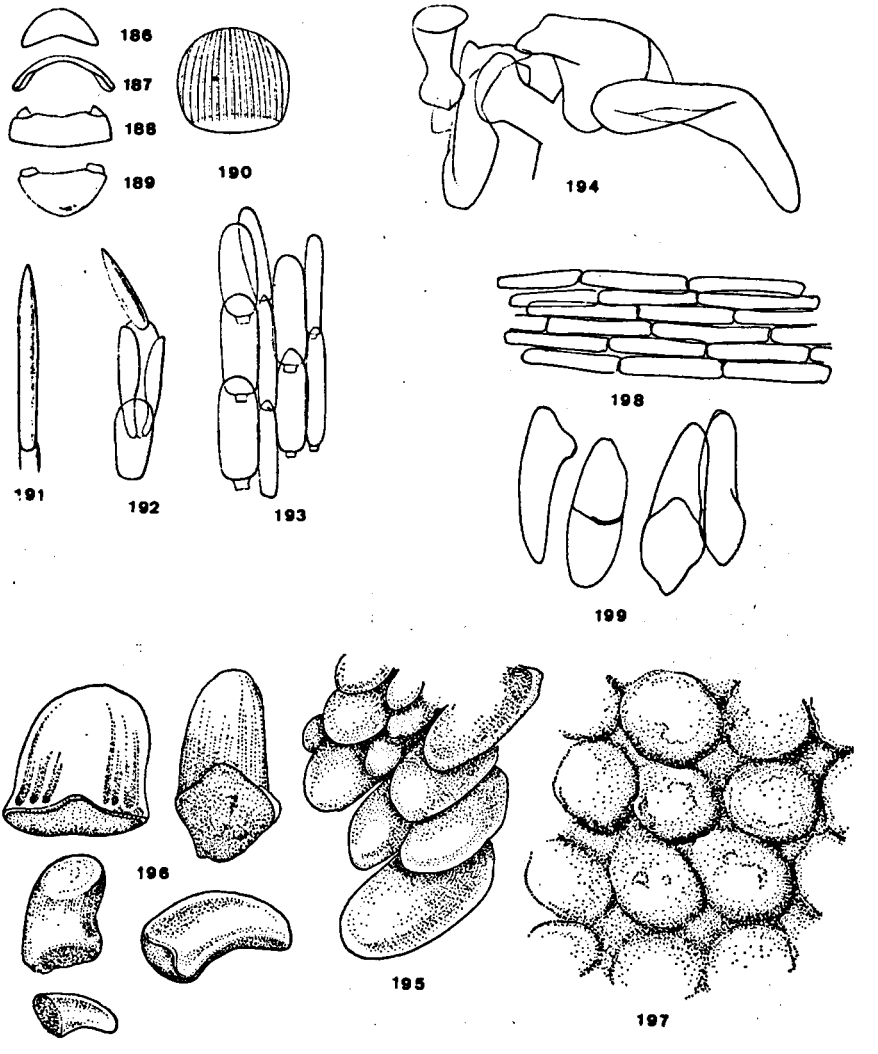


Fig. 186–194. *Ischnochiton hartmeyeri* Thiele. – Tortugas, Bird Key Reef, Holotype (after THIELE, 1910a): 186, valve I dorsal view; 187, valve V dorsal elevation; 188, valve V dorsal view; 189, valve VIII dorsal view; 190, dorsal girdle-scale; 191, supra-marginal spicule; 192, *do.*; 193, ventral scales; 194, part of a radula-row. (Fig. 190–193 × 330).

Fig. 195–199. *Ischnochiton exaratus* (G. O. Sars). – Bergen, Norway, T. Soot-Ryen leg. (KtB 3125): 195, group of dorsal corpuscules; 196, isolated dorsal girdle-elements, 220 μ long; 197, *do.* in situ, dorsal view, diam. 120 μ; 198, ventral scales; 199, marginal elements I. 160 μ.

Fig. 200–206. *Ischnochiton pectinatus* (Sowerby). – St. Eustatius: Gallows Bay, 2 m deep, 15.VII.1949 (H 1116B): 200, large dorsal girdle-scales 520 and 315 μ long resp.; 201, small dorsal scales 130 μ wide; 202, ventral scales 75 × 16 μ; 203, *do.* two layers of ventral scales, the roundish ones 30 × 22 μ; 204, marginal spicules 110 μ long; 205, supra-marginal spicule-scale 90 μ long. – 206, part of radula-row (after THIELE, 1893).

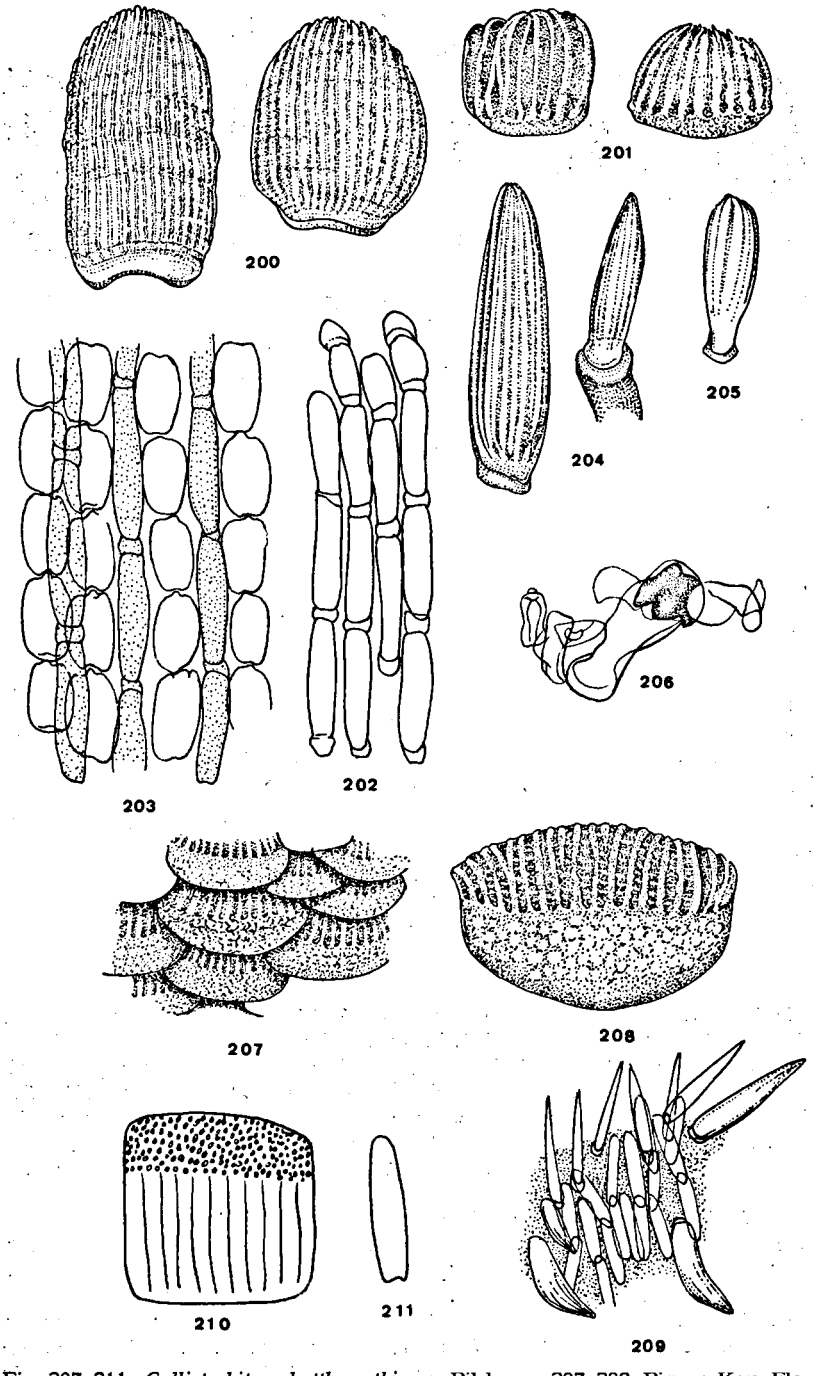
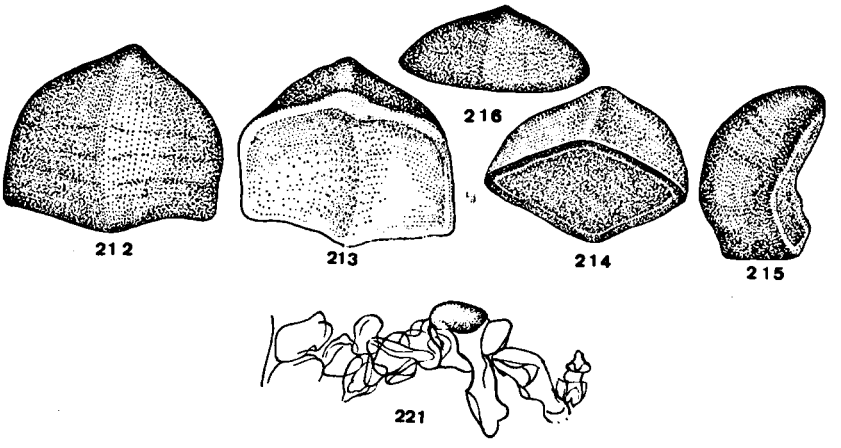


Fig. 207–211. *Callistochiton shuttleworthianus* Pilsbry. – 207–209, Pigeon Key, Fla., U.S.A., L. B. Holthuis leg., RMNH Leiden: 207, group of dorsal girdle-scales; 208, isolated dorsal scales 250 μ wide; 209, ventral and marginal spicules-scales, 100 μ long. – 210–211, doubtful specimen from Floreana, Galápagos Ids. (after BERGENHAYN, 1937): 210, dorsal girdle scale; 211, ventral scale.



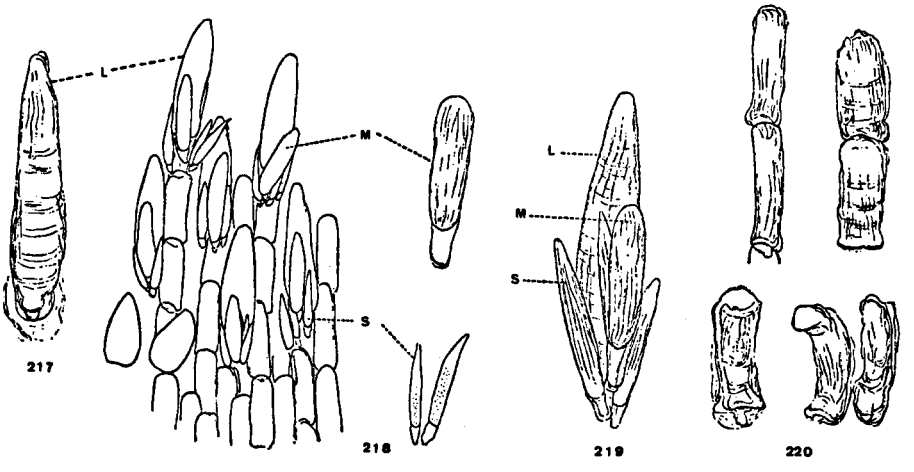
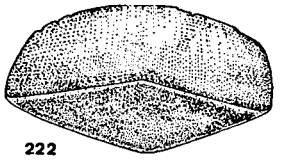


Fig. 212–221. *Chiton tuberculatus* Linnaeus. – 212–216, Saba, Fort Bay (H 1120): dorsal girdle-scales (× 40): 212–215, from the middle of the girdle; 212, dorsal view; 213, ventral view; 214, basal view; 215, lateral view; 216, short scale close to the outer margin. – 217–219, marginal elements (× 210) (after LELOUP, 1937): 217, isolated large marginal spicule; 218, part of outer margin with 3 types of spicules, small, medium and large ones; 219, isolated bunch of marginal spicules; 220, ventral scales (× 210) (after LELOUP, 1937). – 221, radula-row (after THIELE, 1893).

Fig. 222–227. *Chiton squamosus* Linnaeus. – Curaçao: Knip Baai (H 1017). 222–224, dorsal girdle scale (× 37): 222, basal view; 223, lateral view; 224, dorsal view; 225, part of the girdle-margin with three types of spicules, large, medium and small ones (× 190); 226, ventral scales (× 300). – 227, part of radula-row (after THIELE, 1893). Fig. 228–234. *Chiton marmoratus* Gmelin. – 228–233, girdle-elements (after LELOUP, 1937): 228–230, dorsal scales (× 34); 218, dorsal view; 229, basal view; 230, seen from behind; 231–232, marginal elements (× 210); 231, part of the outer margin, dorsal view, with three types of spicules: L = large, M = medium, S = small ones, SH = sheath of the large spicules; 232, large spicule and ventral scales, ventral view; 233, ventral scales (× 210). – 234, part of radula-row (after THIELE, 1893).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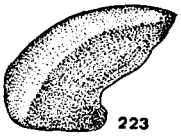
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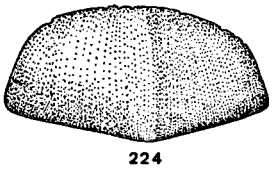
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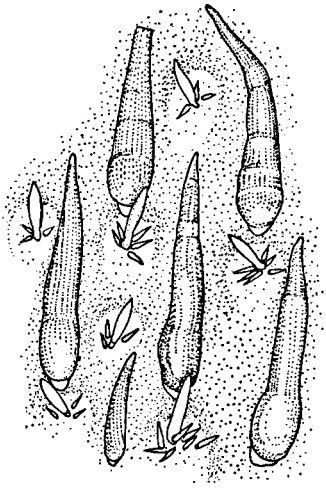
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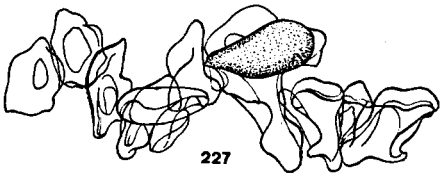
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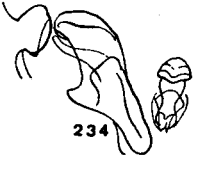
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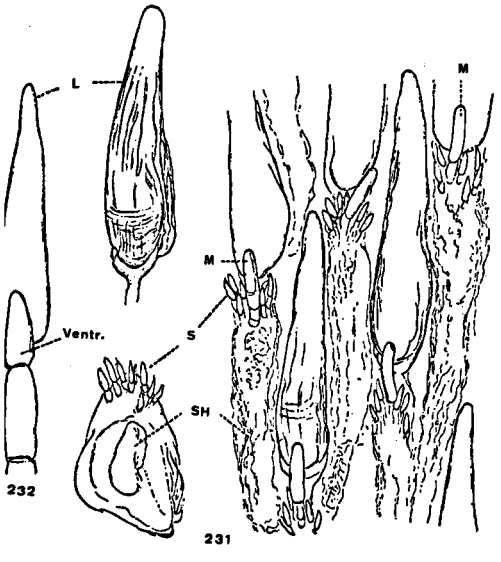

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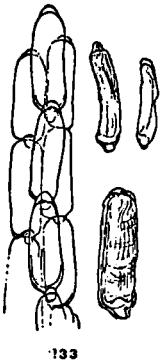
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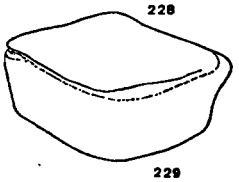
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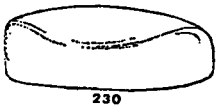
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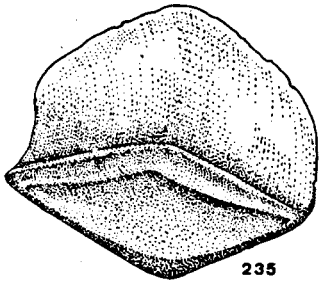

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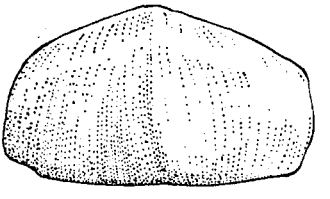

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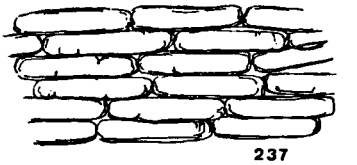

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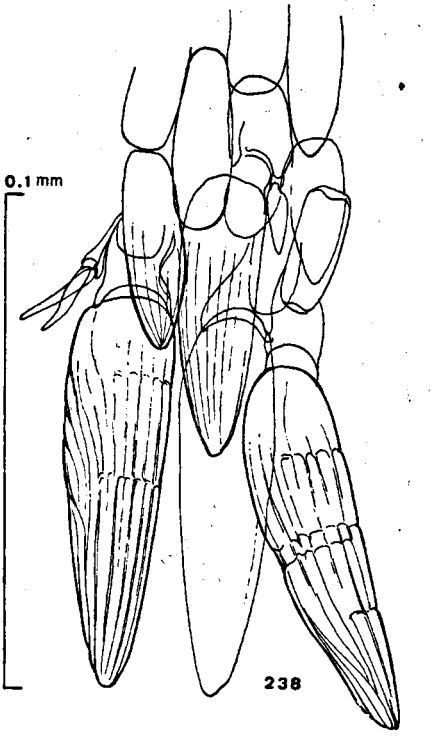

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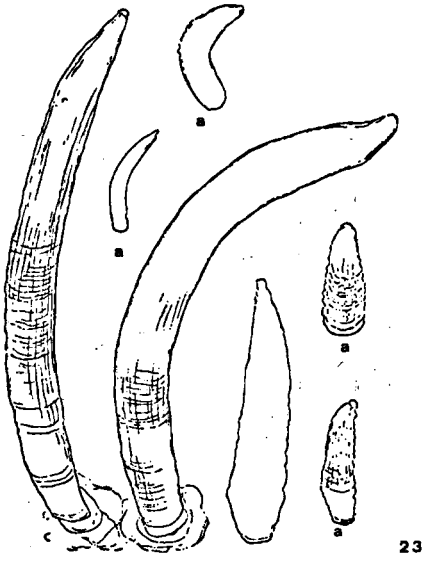

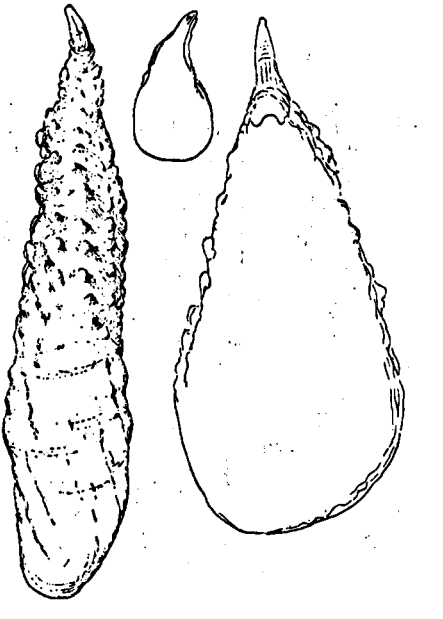

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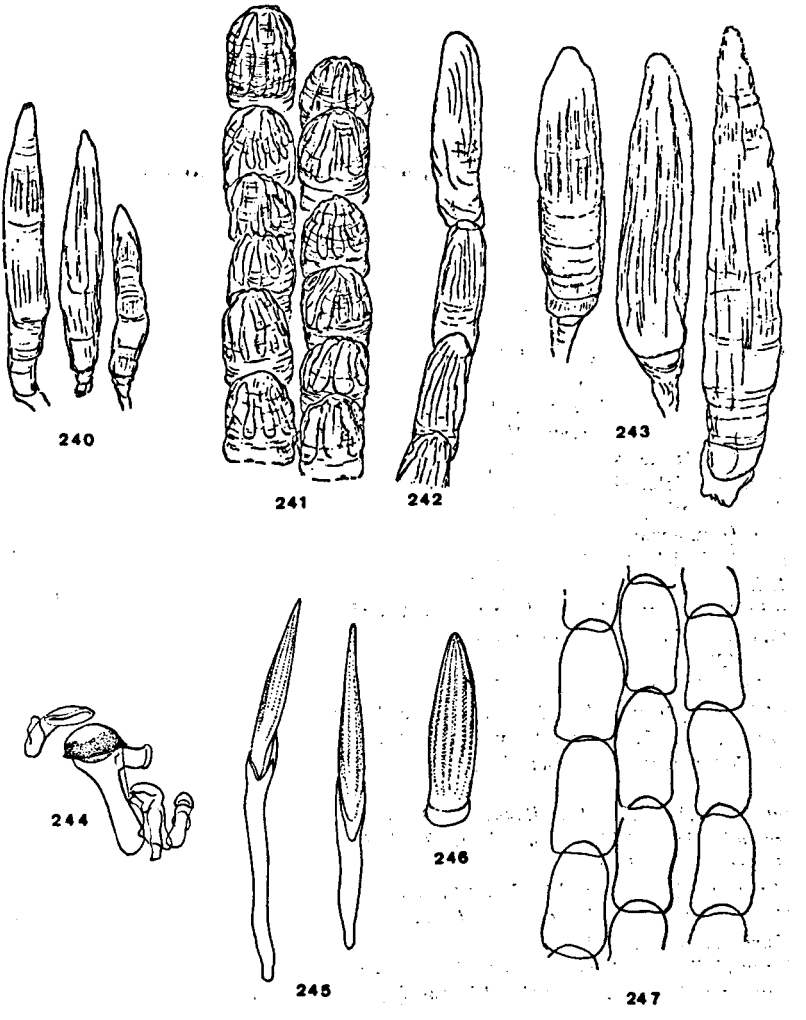

Fig. 235–238. *Chiton viridis* Spengler. – St. Barts: Public, near Gustavia, 4.VI.1949 (H 1121): 235, dorsal girdle scale, ventral view, 720 μ long; 236, *do.*, dorsal view; 237, ventral scales 85 × 18 μ; 238, part of the outer margin, ventral view.

Fig. 239. *Acanthopleura granulata* (Gmelin). - Dorsal spines (× 195, a × 32) (after LELOUP, 1937).

Fig. 240–244. *Acanthopleura granulata* (Gmelin). – 240–243, girdle-elements (× 195) (after LELOUP, 1937): 240, striated dorsal spicules; 241, ventral scales; 242, *do.* towards the outer margin; 243, marginal spicules. – 244, part of radula-row (after THIELE, 1893).

Fig. 245–247. *Tonicia schrammi* Shuttleworth. – Curaçao: Boca Playa Canoa, K. M. de Jong leg.; girdle-elements (× 375): 245, dorsal spicules; 246, marginal spicule; 247, ventral scales.

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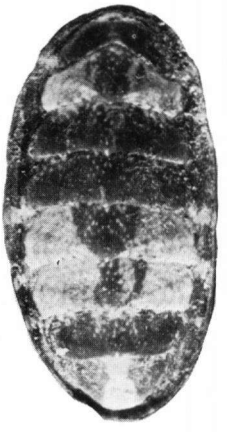
Bold type refers to genera and species described.



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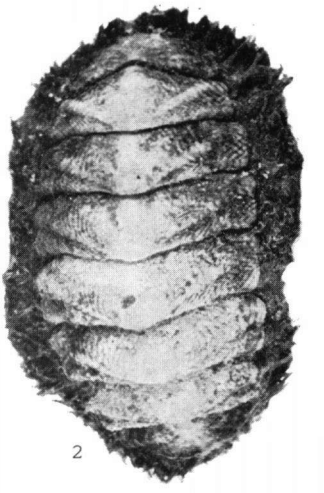

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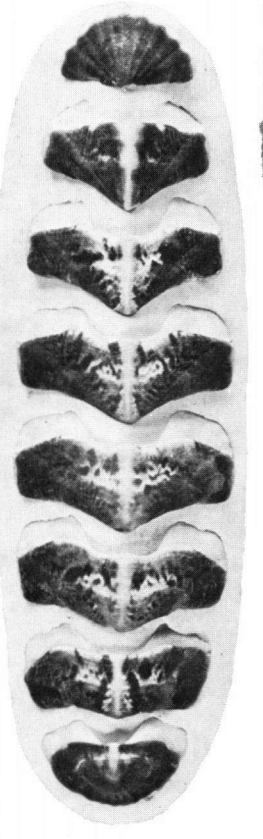

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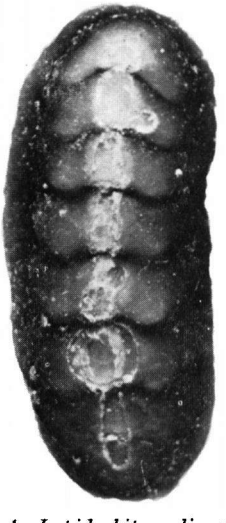

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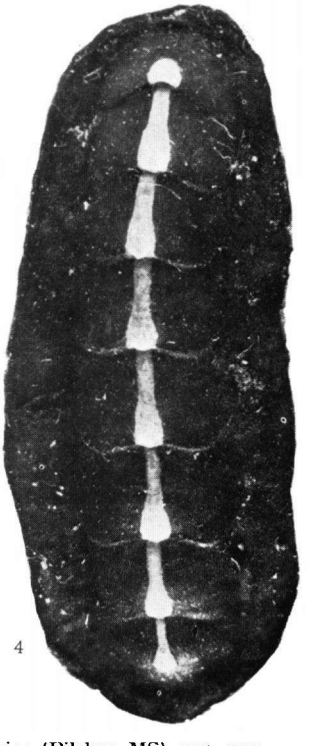
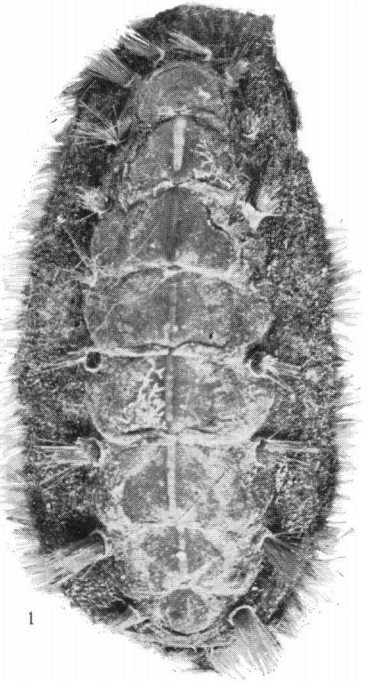
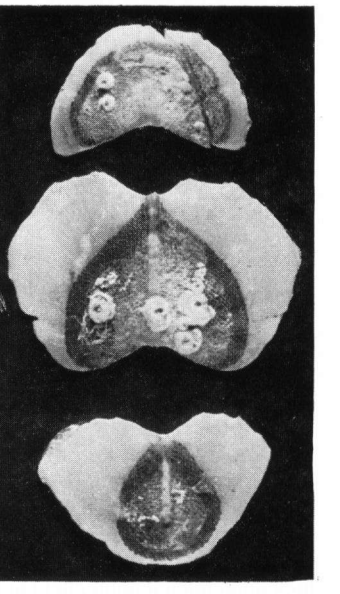


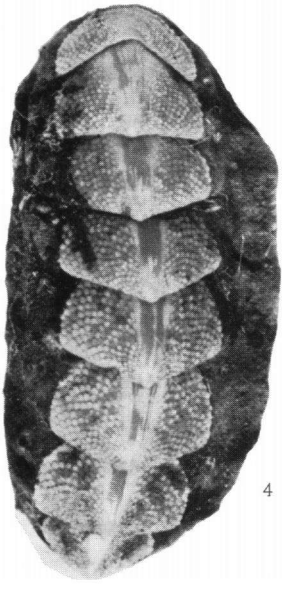
4

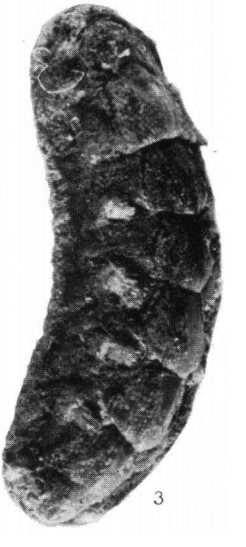
1 *Lepidochitona liozonis* (Dall & Simpson) var. *tropica* (Pilsbry MS) var. nov. - FLORIDA: Bonefish Key. A. Koto leg. (KtB 2848) Paratype, × 4.
2–3. *Ceratozona rugosa* (Sowerby). – 2. Specimen from FLORIDA: Boca Raton. A. Koto leg. (KtB 2845) × 2.5; 3. Specimen from ARUBA: Boca Andicuri (H. 1312). Disarticulated, × 2.25).
4–5. *Cryptoconchus floridanus* Dall – 4. Specimen from FLORIDA: Bonefish Key. A. Koto leg. (KtB 2853) × 5.5; 5. Specimen from ARUBA: near Pos Chiquita. Mrs. J. H. Beerman leg. (KtB 4474), × 7.5.

PLATE II

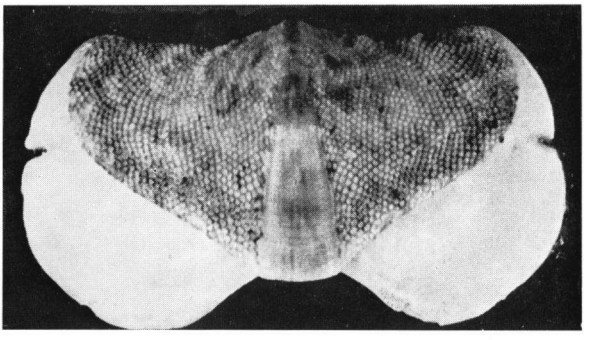








1–2. *Acanthochitona hemphilli* (Pilsbry). – 1. Specimen from CURAÇAO: Spaanse Water, under Porites. K. M. de Jong leg., × 2.8; 2. Specimen from CURAÇAO: Fuik Baai, Duitse Bad, valves I, VII, VIII (H. 1038a), × 4.
3. *Acanthochitona elongata* sp. nov. – FLORIDA: Bonefish Key. Holotype. A. Koto leg. (KtB 2849, now in RMNH, Leiden), × 7.5.
4. *Choneplax lata* (Guilding). – CURAÇAO: Spaanse Water. K. M. de Jong leg., × 7.5.



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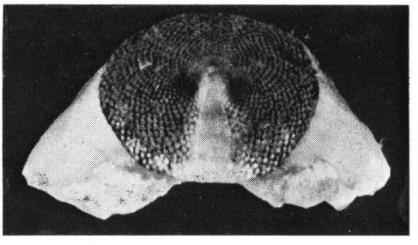

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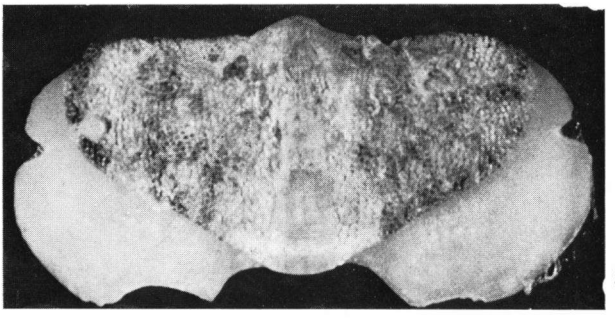

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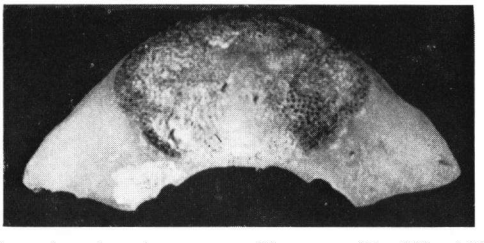
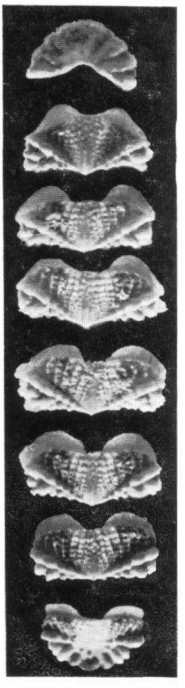


4

1–2. *Acanthochitona bonairensis* sp. nov. – BONAIRE: N. of Punt Vierkant. Holotype, × 6 (H. 1059A): 1. Valve VI; 2. Valve VIII.
3–4. *Acanthochitona communis* (Risso) – FRANCE: Bretagne, Roscoff, in front of Biol. Sta., ×6 (KtB 3483) : 3. Valve VI; 4. Valve VIII.

PLATE IV



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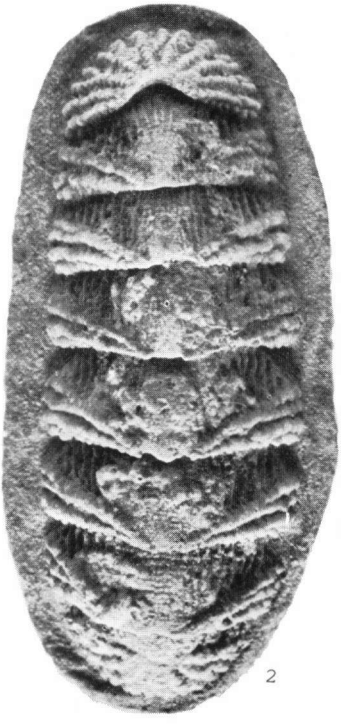

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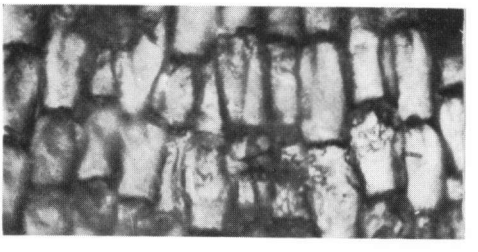

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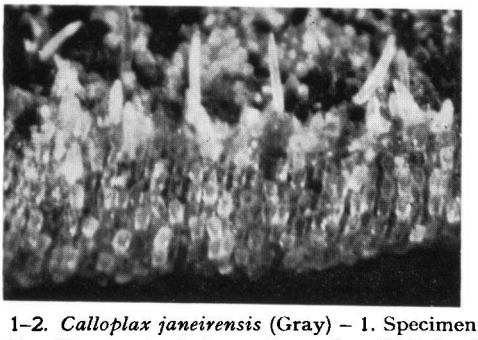

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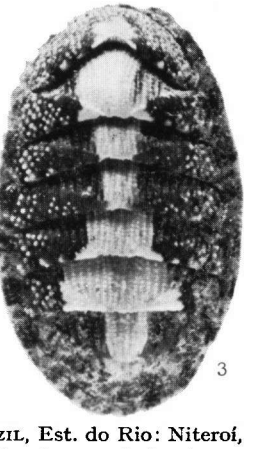
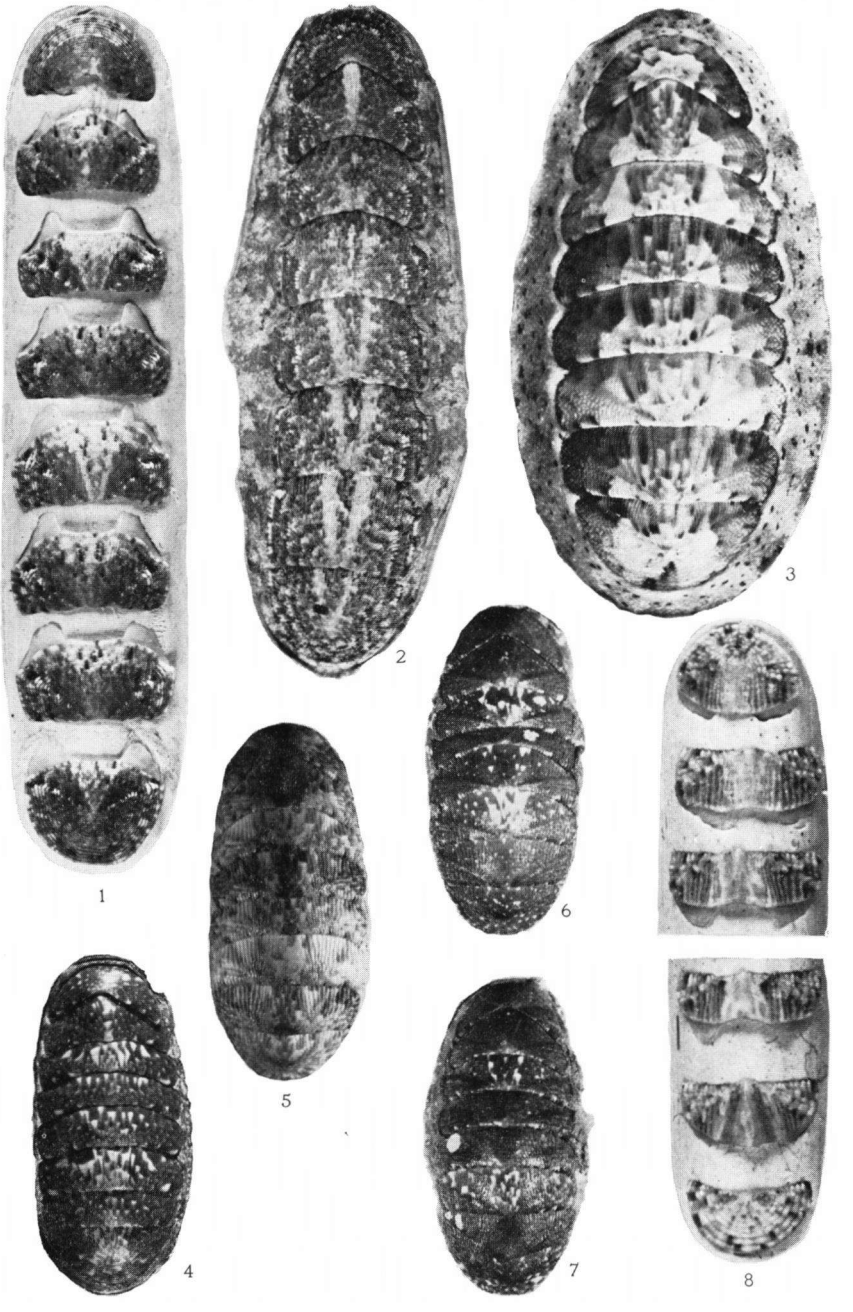
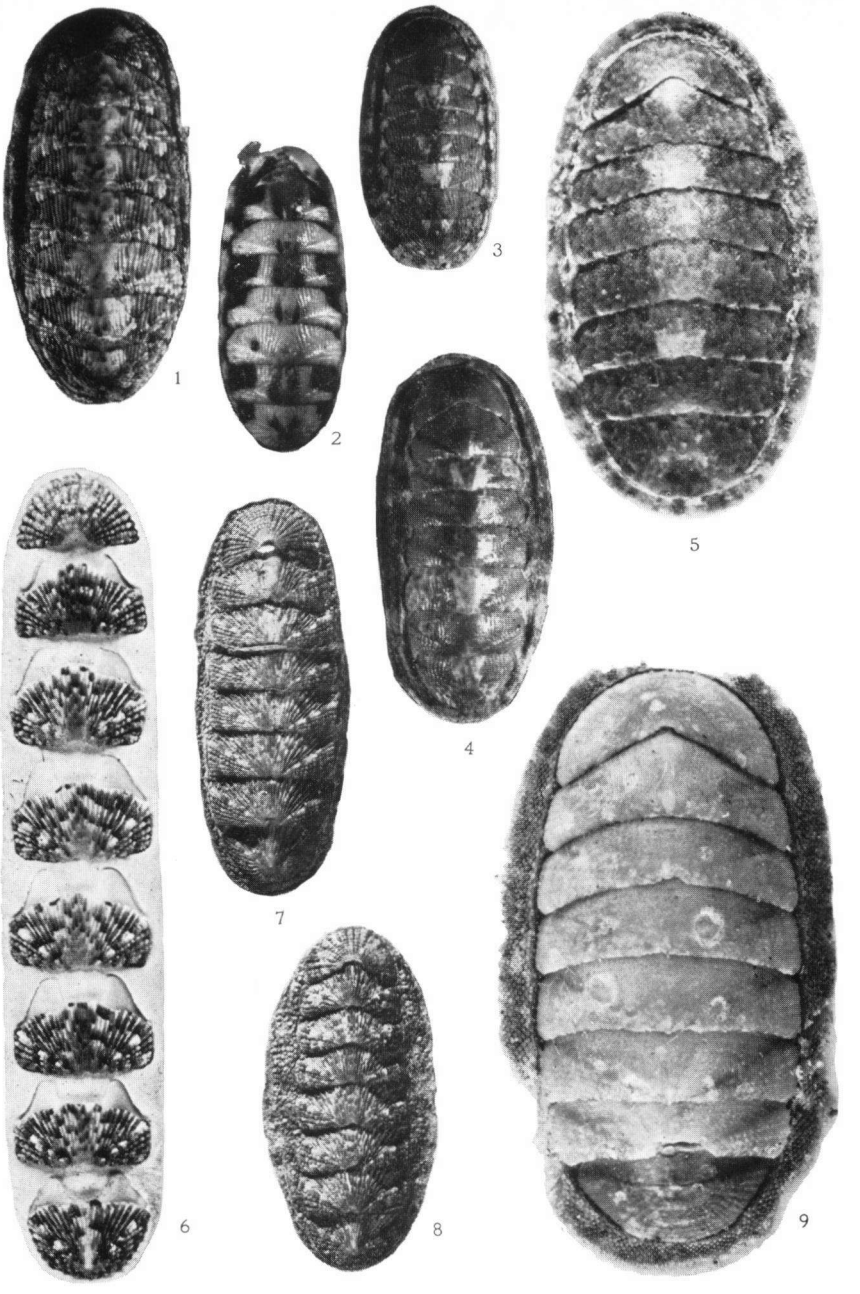


3

1–2. *Calloplax janeirensis* (Gray) – 1. Specimen from Brazil, Est. do Rio: Niteroí, Boa Viagem. A. de Souza Lopes leg. (KtB 3163), disarticulated, × 4; 2. Specimen from Dry Tortugas: Garden Key. A. Koto leg. (KtB 2846), × 5.5.
3–6. *Chaetopleura apiculata* (Say) – 3. Specimen from Florida: ½ mi. off E. end of Sanibel Island (KtB 3728), × 5.6; 4. Specimen from Rhode Island: 6 mi S of Tiverton, 2–3 fms., R. W. Foster leg. (KtB 3725), disarticulated × 2.6; 5. *Do.*, part of ventral side of the girdle, highly enlarged; 6. *Do.*, part of slightly curled girdle margin showing some dorsal and marginal spiculae and ventral scales, enlarged.



1. *Ischnochiton purpurascens* (C. B. Adams) – GRENADA: White Bay, Point Salines (H. 1389), disarticulated, × 2.25.
2. *Ischnochiton floridanus* Pilsbry – FLORIDA: Bonefish Key. A. Koto leg. (KtB 2850), × 2.5.
3. *Ischnochiton striolatus* Gray – CURAÇAO: S.-coast. K. M. de Jong leg., × 4.
4. "*Chiton* (*Ischnochiton*) *lutulatus*" Shuttleworth – PUERTO RICO. Blauner leg., ZMB. Holotype, × 3.5 (= *Ischnochiton striolatus* Gray).
5. *Ischnochiton erythronotus* (C. B. Adams) – ST. THOMAS. Blauner leg. Shuttleworth Coll., ZMB, × 3.5.
6–7. "*Chiton* (*Ischnochiton*) *lateritius* Shuttl." – ST. THOMAS. Blauner leg., Shuttleworth Coll., ZMB, × 3.5 [= *Ischnochiton erythronotus* (C. B. Adams)]; 6. Lectotype; 7. Syntype.
8. *Ischnochiton erythronotus* (C. B. Adams) – FLORIDA: Bonefish Key. B. R. Bales leg. (KtB 3724). Disarticulated, × 5.



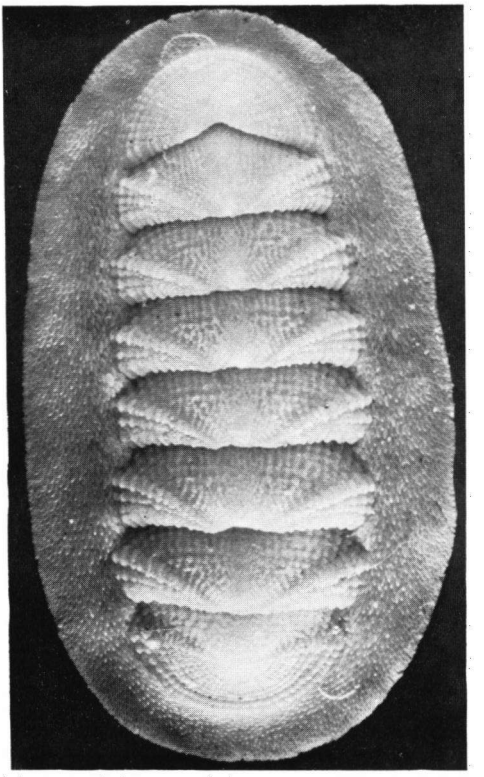
1–4. *Ischnochiton erythronotus* (C. B. Adams) – GUADELOUPE. Bernardi leg. Shuttleworth Coll., ZMB, × 3.5.

5. *Ischnochiton papillosus* (C. B. Adams) – FLORIDA: Bonefish Key. A. Koto leg. (KtB 2851), × 7.

6. *Ischnochiton pectinatus* (Sowerby) – ST. EUSTATIUS: Gallows Bay (H. 1116B), disarticulated, × 2.85.

7–8. "*Gymnoplax spiciferus*" Rochebrune – GUADELOUPE: "Ile Cochino" (= Ilet à Cochons?). Mus. Nat. Hist. Nat., Paris, × 2: 7. Lectotype; 8. Syntype [= *Ischnochiton pectinatus* (Sowerby)].

9. *Ischnochiton exaratus* (G. O. Sars) – NORWAY: Bergen. T. Soot-Ryen leg. (KtB 3125), × 6.25.



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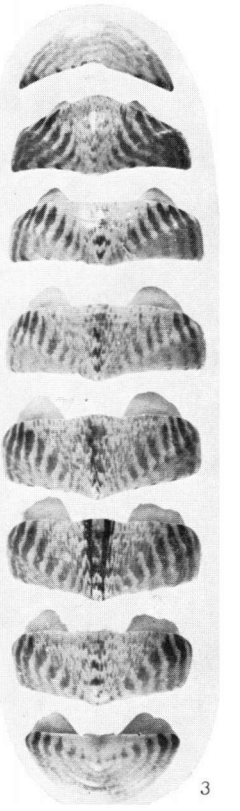

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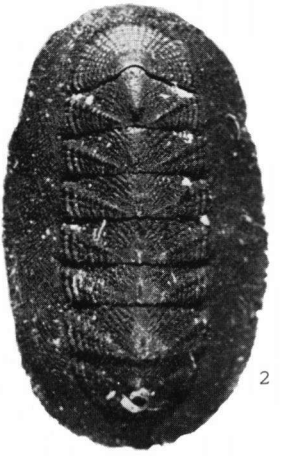

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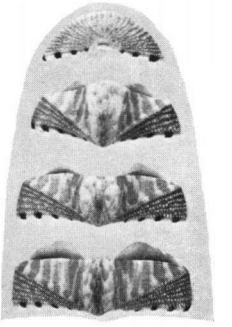
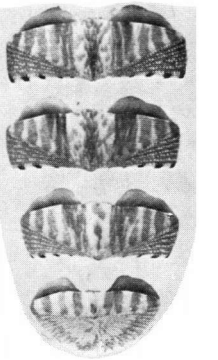
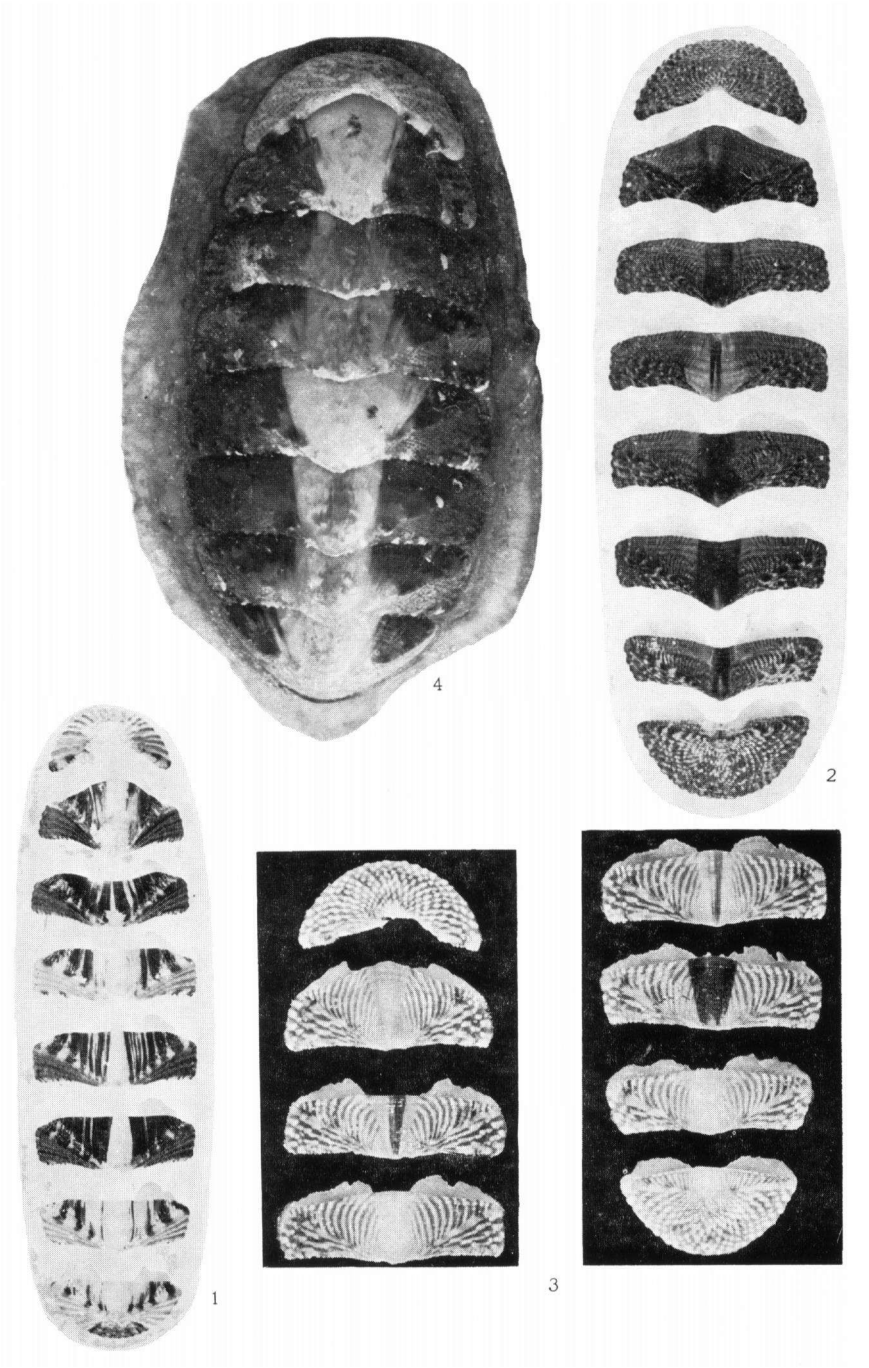




4

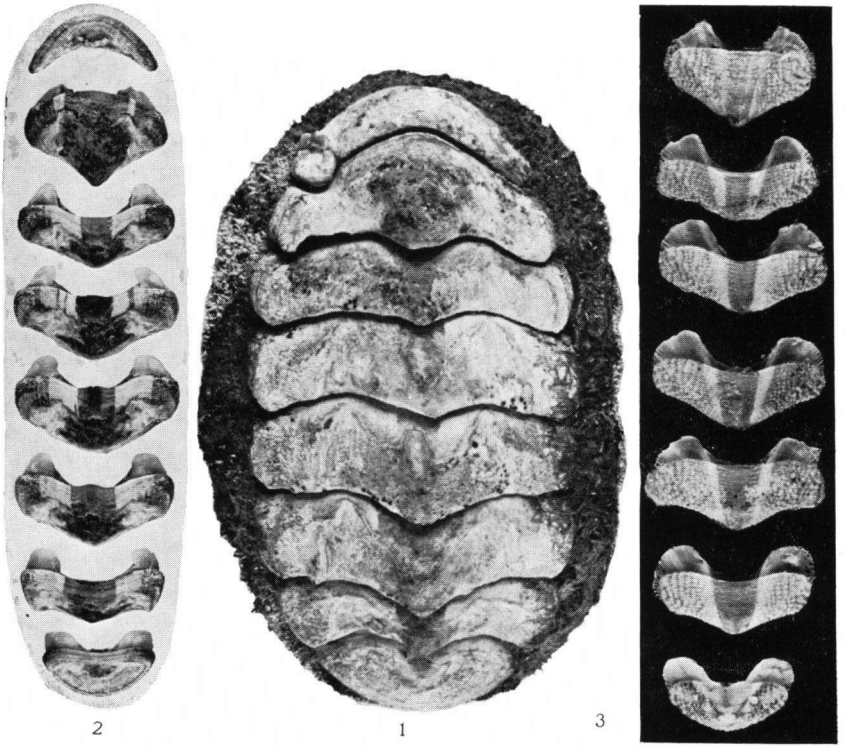
1. *Callistochiton shuttleworthianus* Pilsbry – CURAÇAO: Boca Playa Canoa. K. M. de Jong leg., × 6.25.
2. *"Chiton (Ischnochiton) reticulatus"* Shuttleworth *non* Reeve (= *Callistochiton shuttleworthianus* Pilsbry) – PUERTO RICO. Blauner leg., Shuttleworth Coll., ZMB, × 4.3.
3. *Chiton marmoratus* Gmelin. – BONAIRE: Boca Washikemba (H. 1375). Disarticulated, × 1.4.
4. *Chiton squamosus* Linnaeus – CURAÇAO: Boca Lagoen (H. 1020B). Disarticulated, × 1.25.

PLATE VIII



1. *Chiton viridis* Spengler – BAHAMAS: North Bimini, Entrance Point, W-shore (H. 1020B). Disarticulated, × 1.25.
2–3. *Chiton tuberculatus* Linnaeus – 2. Specimen from SABA: W of Fort Bay (H. 1120). Disarticulated, × 1.4; 3. Specimen from CUBA: Matanzas, Playa Bellamar (KtB 3085). Disarticulated, × 1.3.
4. *Tonicia schrammi* (Shuttleworth) – CURAÇAO · San Juan or Vaersenbaai. K. M. de Jong leg., × 2.7.

PLATE IX



1–3. *Acanthopleura granulata* (Gmelin) – 1. Specimen from FLORIDA: East Sister Keys. A. Koto leg. (KtB 1760), × 1.5; 2. Eroded specimen from the FLORIDA Keys (KtB 2430). Disarticulated, × 1.25; 3. Non-eroded juvenile specimen from KLEIN BONAIRE: SE-shore (H. 1372). Disarticulated, pl. I absent, × 2.5.