

ZOOLOGISCHE VERHANDELINGEN

UITGEGEVEN DOOR HET RIJKSMUSEUM VAN
NATUURLIJKE HISTORIE TE LEIDEN

(MINISTERIE VAN CULTUUR, RECREATIE EN MAATSCHAPPELIJK WERK)

No. 185

THE GENUS *LEPIDOCHITONA* GRAY, 1821 (MOLLUSCA:
POLYPLACOPHORA) IN THE NORTHEASTERN ATLANTIC
OCEAN, THE MEDITERRANEAN SEA AND THE BLACK SEA

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With 128 text-figures and 3 maps

SUMMARY

Nine species of *Lepidochitona* from the NE Atlantic and adjacent seas are described, two of which are new to science: *L. monterosatoi* from the Mediterranean Sea, and *L. iberica* from Ria de Arosa, NW Spain.

The taxa *Middendorffia* Dall, 1882, and *Mopaliella* Thiele, 1909, are rejected and synonymized with *Lepidochitona* Gray, 1821.

Ischnochiton stroemfelti Bergenhayn, 1931, is recognized as an intermediate form between *Ischnochiton* Gray, 1847, and *Lepidochitona* Gray, 1821, classed with the latter genus by the authors on account of several arguments.

INTRODUCTION

The genus *Lepidochitona* Gray, 1821, as it is now understood, with the subgenera *Lepidochitona* s.s., *Spongioradsia* Pilsbry, 1894, and *Dendrochiton* Berry, 1911, comprises thirty (perhaps thirty-one) recognized species, inhabiting both sides of the Atlantic Ocean, the eastern Pacific Ocean from Alaska to Perú, and the western Pacific from the Aleutians to the Japanese Sea. In the NE Atlantic nine species are found, in the SE Atlantic one (S. Africa), and in the W Atlantic two. The remaining eighteen (nineteen?) species are found in the Pacific, viz. eight (nine?) species of *Lepidochitona* s.s., and six species of the subgenus *Dendrochiton*, are found along the west coast of the American continent, and the four known species of the subgenus *Spongioradsia* from the Aleutians south to the Bonin Islands.

This paper deals with the species inhabiting the NE Atlantic, the Mediterranean Sea and the Black Sea. These are, in chronological order:

Chiton cinereus Linnaeus, 1767, the type of the genus;

Chiton corrugatus Reeve, 1848, the type of *Middendorffia* Dall, 1882;

Chiton (Acanthopleura) piceolus Shuttleworth, 1853;

Chiton furtivus Di Monterosato, 1872;

Nuttallina (Middendorffia) simrothi Thiele, 1902;

Trachydermon canariensis Thiele, 1909;

Ischnochiton stroemfelti Bergenhayn, 1931;

Lepidochitona monterosatoi nov. sp.;

Lepidochitona iberica nov. sp.

The subdivision of the genus *Lepidochitona* Gray, 1821, is rather complicated, and in many respects a matter of appreciation. Dall (1882: 287) created a genus *Middendorffia* (ex Carpenter MS) for *Chiton polii* Philippi, 1836 (non Deshayes, 1833) = *Chiton corrugatus* Reeve, 1848, a common Mediterranean species. Pilsbry (1893: 88) ranked *Chiton (Acanthopleura) piceolus* Shuttleworth, 1853, into the genus *Nuttallina* Dall, 1879, subgenus *Middendorffia* Dall, 1882, and Thiele (1902: 287) included a new species, *Nuttallina (Middendorffia) simrothi*, into the same subgenus.

Thiele (1909: 16) also erected a new genus, *Mopaliella*, for those *Lepidochitona* species with additional groups of long spines on the perinotum; he designated as type *Chiton bipunctatus* Sowerby, 1832 (non G. Fischer, 1808) = *Tonicella (Mopaliella) stigmata* Dall, 1910, and ranked it somewhere between *Cyanoplax* Pilsbry, 1892, and *Nuttallina* Dall, 1879.

A morphological study of the shell plates, the perinotum elements, and the radulae of the European and North-African species revealed that maintenance of the taxa *Middendorffia* and *Mopaliella* is hardly or not possible. The type of the genus *Middendorffia*, *L. corrugata* (Reeve), only differs from the other *Lepidochitona* species in the somewhat stronger developed articulamentum, in the slightly reduced and thickened insertion teeth, the rather coarse granulation of the tegmentum, though still much finer than in *L. canariensis* (Thiele), a true *Lepidochitona*, and the radially ribbed anterior valve and lateral areas of the intermediate valves, a characteristic that is also found, though less conspicuous, in the head valve of *L. monterosatoi* sp. nov.

Dall (1882: 287) in his diagnosis of the taxon *Middendorffia* states: "Lorica et zona extus ut in *Acanthopleura*" and further: "...girdle: granular bristles." These definitions, however, can hardly be taken serious, as *L. corrugata* is in no way to be compared with *Acanthopleura*, and its girdle is that of an ordinary *Lepidochitona*, clothed with small calcareous corpuscles

and groups of small spiculae only, without any elements that could justify the term "bristles". Dall's diagnosis must have misled Pilsbry, otherwise that author would never have ranked *Middendorffia* under the genus *Nuttallina*.

L. piceola (Shuttleworth, 1853), and *L. simrothi* (Thiele, 1902), both allocated to *Middendorffia*, also have much reduced insertion teeth, especially in the tail valve, but otherwise they differ widely from *L. corrugata*: the pleurae and apophyses of the intermediate valves of both species are strongly thrown forward, resulting in a deep, rounded, bay-like sinus, and neither of them shows any traces of radiating ribs on the head valve and on the lateral areas of the intermediate valves.

In *L. piceola* the girdle is thickly beset with short, ribbed spines, so Shuttleworth's supposition that he had to do with an *Acanthopleura* is not surprising, especially as the black jugal bands on the valves — as in *A. granulata* (Gmelin, 1791) — strengthen the superficial resemblance with that species. The girdle of *L. simrothi* on the contrary is not only clothed with the typical calcareous corpuscles as in *L. cinerea* (L.), but also with many groups of long, generally curved spines, which is the only feature characterizing the genus *Mopaliella* Thiele, 1909. However, *L. monterosatoi* sp. nov. shows some resemblance to *Middendorffia* (weak radial ribs on the head valve) as well as to *Mopaliella* (groups of long spines on the perinotum), though otherwise it is in no way to be compared with *L. simrothi* or *L. corrugata*. Moreover, *L. iberica* sp. nov. also shows much reduced insertion teeth in the tail valve, though in other respects it is a true *Lepidochitona*, closely related to *L. canariensis* (Thiele, 1909).

For these reasons it may be clear that neither the taxon *Middendorffia*, nor *Mopaliella*, can be retained, both taxa being based on false interpretations of the value of certain morphological characteristics, which means that they have to be synonymized with *Lepidochitona* s.s.

That *Lepidochitona* Gray, 1821 is quite near to *Ischnochiton* Gray, is shown by *Ischnochiton stroemfelti* Bergenhayn, 1931, a species showing many features which justify its classification in *Lepidochitona*. It has the tegmentum decidedly porous, and the granular, quincuncial sculpture also resembles that of *L. cinerea*. It also has the insertion teeth rather short, a little roughened on the outside, but the clothing of the girdle is more like that of an *Ischnochiton*. The dorsal scales are somewhat curved, ribbed, though hardly or not imbricating. Among them small spiculae are found, which is rarely the case in *Ischnochiton* species. The ventral scales are rectangular, like in *Ischnochiton*, not pointed, as they are in *Lepidochitona*. Thoroughly estimating these arguments we are inclined to believe that

I. stroemfelti should be classed with *Lepidochitona* rather than with *Ischnochiton*.

The genus *Lepidochitona* was created by Gray in a long forgotten publication (1821: 234), in which the name occurs under Polyplacophora: "a, Plates placed on the back of the mantle. 1 Gymnoplax or gymnoplacidae. Acanthochitona. Chiton fascicularis, Lepidochitona. Chiton marginatus," without precizing the new generic names. As the word chiton (= coat of mail) is masculine, it is hard to understand why Gray used it in the accusative, but there is no reason for emendation.

Gray himself obviously forgot both names, as they do not reappear in his later papers, where he uses (1847: 69-70) the name *Acanthochites* "Leach" in Risso, 1826 for *Acanthochitona* (type also *Chiton fascicularis* L.), mentioning *Acanthochiton* Herrmannsen, 1846, as a synonym. *Chiton marginatus* "Montagu" (= *marginatus* Pennant, 1777 = *cinereus* Linnaeus, 1767) now appears (1847a: 127) as the type of Gray's second section of *Ischnochiton*, marked **, characterized by the words: "Scales of mantle minute, granule-like."

This section was given the rank of a subgenus of *Ischnochiton*, named *Trachydermon*, by Carpenter (1864: 649), who listed nine species from the west coast of North America, of which the first mentioned, *retiporosus*, should be regarded as the type. *I. (T.) retiporosus* Carpenter is now recognized as a species of *Lepidozonia* Pilsbry, 1892. Of the other species only *hartwegii* Carpenter, 1855 (syn.: *nuttallii* Carpenter, 1855), and *dentiens* Gould, 1846 (syn.: *pseudodentiens* Carpenter, 1864) are now assigned to *Lepidochitona* s.s., the rest of them belonging to *Ischnochiton* Gray, 1847, *Tripoplax* Berry, 1919, and *Dendrochiton* Berry, 1911, a subgenus of *Lepidochitona*. This makes *Trachydermon* a name which cannot be used in any sense.

Sars (1878: 115) created a new genus *Craspedochilus* with *C. marginatus* Pennant, 1777, as the type species. Consequently this nominal taxon belongs in the synonymy of *Lepidochitona* Gray.

Pilsbry (1892: 44) introduced *Cyanoplax* (type: *Chiton hartwegii* Carpenter, 1855) as a subgenus of *Tonicella* Carpenter, 1873. *Chiton hartwegii*, however, is in all respects a true *Lepidochitona*, which makes *Cyanoplax* another synonym of *Lepidochitona*.

Finally Thiele (1893) erected the new genera *Adriella* (type: *Chiton variegatus* Philippi, 1836) and *Mopaliopsis* (type: *Chiton cingillatus* = *Lepidochitona hartwegii*, non *Chiton cingillatus* Reeve, 1847), principally based on characteristics of the radulae. As *Chiton variegatus* is a mere synonym of *C. cinereus* L., and *Mopaliopsis* falls into the synonymy of *Cyano-*

plax, *Adriella* as well as *Mopaliopsis* must be looked upon as synonyms of *Lepidochitona* s.s.

The genus *Lepidochitona* s.l. is probably represented as early as the Middle Eocene, perhaps even the Lower Eocene, in the Paris Basin. Although the descriptions and figures of the species cited from these layers are not always adequate, several of them can be referred to the present genus. However this may be, there is no doubt that the genus is represented in the Middle Oligocene of the Mainz Basin (Janssen, 1978), and afterwards in the Miocene of the Basins of Piedmont (Sacco, 1896), Bohemia (Reuss, 1860) and Vienna (Šulc, 1936), and also in Central Poland (Baluk, 1971), Transsylvania (Šulc, 1936), Hungary (Csepregy-Meznerics, 1950), and the Aquitanian Basin (Cossman & Peyrot, 1917). From then on many traces of the genus *Lepidochitona* have been found in Pliocene and Pleistocene layers all over Europe, except for the northern part.

In North America the earliest occurrence of a species possibly referable to the genus *Lepidochitona* can be traced in the Oligocene of Vancouver Island (Berry, 1922). The species, *Oligochiton lioplax* Berry, 1922, is a probable ancestor of the species belonging to the subgenus *Spongioradsia* Pilsbry, 1894. In Miocene and Pliocene layers no lepidochitonoid species have been found so far, and it is only in the Pleistocene of the Lower San Pedro Series that several of the recent *Lepidochitona* species make their first appearance.

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We are greatly indebted to the many persons who have contributed, in one way or another, to the realization of the present paper: Dr. E. Gittenberger of the Rijksmuseum van Natuurlijke Historie, Leiden, and Dr. Ph. Bouchet of the Laboratoire de Malacologie, Muséum National d'Histoire Naturelle, Paris, for the loan of specimens from the museum collections, and for enabling us to make use of the museum facilities, Dr. Roy Oleröd of the Naturhistoriska Riksmuseet, Stockholm, Dr. H. E. Coomans of the Instituut voor Taxonomische Zoölogie, Universiteit van Amsterdam, Dr. W. Vader of the Tromsø Museum, Amanuensis Jon-Arne Sneli of the Biologisk Stasjon, Trondheim, and Dr. R. Kilius of the Zoologisches Museum der Humboldt Universität, Berlin, for the loan of specimens, and for providing valuable information and literature, and last but not least to all those gentlemen who generously provided us with specimens collected by them, such as the late Dr. C. O. van Regteren Altena (Heemstede), Dr. G. C. Cadée (Leiden), Ir. A. Verduin (Leiden), C. Altimira (Barcelona), Ch. Geerts (Brussel), A. Verhecken (Antwerpen), F. Nolf (Oostende), Dr. P. Gillis (Serskamp, Belgium), J. Van de Vijver (Sint-Niklaas), I. Tümtürk, and C. Cavli (Istanbul).

DESCRIPTIVE PART

In the descriptions of chitons the "angle of divergence" is often mentioned in degrees. This, however, is an arbitrary and inefficient manner to denounce

the dorsal elevation of these animals, as in many species the back of the shell is not carinated, the sides are often convex, sometimes the shell is regularly arched. Therefore we chose a more adequate method by which the height of elevation is expressed in the quotient of height : width of the tegmentum of valve IV, as shown in fig. 1.



Fig. 1. Valve IV of a chiton, anterior view. H = height of tegmentum. W = width of tegmentum. Dorsal elevation = H/W .

In the references to the specimens the following abbreviations are used: BMNH = British Museum (Natural History), London; ITZA = Instituut voor Taxonomische Zoölogie der Universiteit van Amsterdam (formerly: Zoölogisch Museum, Amsterdam); K = Private collection of P. Kaas; KBIN = Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussel; MNHN = Muséum National d'Histoire Naturelle, Paris; NHRM = Naturhistoriska Riksmuseet, Stockholm; RMNH = Rijksmuseum van Natuurlijke Historie, Leiden; VB = Private collection of R. A. Van Belle; ZMB = Zoologisches Museum, Bern; ZMHU = Zoologisches Museum der Humboldt Universität, Berlin.

All species are illustrated by original figures prepared by the senior author (PK), chiefly from material in the Rijksmuseum van Natuurlijke Historie, Leiden and in the private collections of the authors. The classification is that proposed by the junior author (RAVB) in *Inf. Soc. belg. Malac.*, 1975-1978.

Class POLYPLACOPHORA De Blainville, 1816

Order NEOLORICATA Bergenhayn, 1955

Suborder CHITONINA Thiele, 1910

Family Ischnochitonidae Dall, 1889

Subfamily Lepidochitoninae Iredale, 1914

Lepidochitona Gray, 1821

Lepidochitona Gray, 1821: 234. Type: *Chiton marginatus* Pennant, 1777 = *Lepidochitona cinerea* (Linnaeus, 1767).

Trachydermon Carpenter, 1864: 649 (ex parte). Type: *Trachydermon retiporosus* Carpenter, 1864.

Lepidochiton Thiele, 1929: 8. Type: *Chiton marginatus* Pennant, 1777.

Trachochiton Risbec, 1946: 190. Type: *Trachochiton cinereus* (? Linnaeus, 1767).

Animals small to medium-sized, oval to elongate-oval, tegmentum varying from almost smooth to uniformly granulose, lateral areas of intermediate

valves not prominent. Terminal valves many-slit, intermediate valves generally with one slit in the insertion plate (sometimes more than one) on either side; insertion teeth somewhat obtuse and sometimes rugose on the outside. Eaves generally spongy, apophyses separated. Girdle dorsally clothed with not imbricating calcareous corpuscles of different forms and sizes, with or without longer spines, sometimes with branching corneous appendices bearing calcareous spicules. Ventral girdle scales distally obtusely pointed. Gills mero-branchial to holobranchial, preanal. Major lateral tooth of the radula tricuspidate.

Subgenus **Lepidochitona** s.s.

- Lepidochitona* Gray, 1821: 234. Type: *Chiton marginatus* Pennant, 1777.
Craspedochilus Sars, 1878: 114. Type: *Chiton marginatus* Pennant, 1777.
Dawsonia Carpenter in Dall, 1882: 287, non Hart, 1868, nec Nicholson, 1873, nec Fritsch, 1879. Type: *Chiton polii* Philippi, 1836, non Deshayes, 1833.
Middendorffia (Carpenter MS) Dall, 1882: 284. Type: *Chiton polii* Philippi, 1836, non Deshayes, 1833.
Beania (Carpenter MS) Dall, 1882: 287, non Johnston, 1840. Type: *Chiton pseudorissoi* (Carpenter MS) Dall, 1882 (nom. nud.).
Beanella Dall, 1882: 284. Type: *Chiton pseudorissoi* (Carpenter MS) Dall, 1882 (nom. nud.).
Cyanoplax Pilsbry, 1892: 40. Type: *Chiton hartwegii* Carpenter, 1855.
Adriella Thiele, 1893: 391. Type: *Chiton variegatus* Philippi, 1836, non Röding, 1798, nec De Blainville, 1825, nec Leach, 1852.
Mopaliopsis Thiele, 1893: 393. Type: *Chiton cingillatus* Reeve, 1847.
Mopaliella Thiele, 1909: 16. Type: *Chiton bipunctatus* Sowerby, 1832.
Lophochiton Berry, 1925: 26, non Ashby, 1923. Type: *Basiliochiton lobium* Berry, 1925.
Ploiochiton Berry, 1926: 105. Type: *Basiliochiton lobium* Berry, 1925.

Insertion plates with a single slit on either side of the intermediate valves. Girdle without branching corneous appendices.

Lepidochitona (L.) cinerea (Linnaeus, 1767)

(figs. 2-17, 128¹; map 1)

- Chiton cinereus* Linnaeus, 1767: 1107 ("In O. Norvegico"). Type: The Linnean Society of London.
Trachydermon cinereus; Leloup, 1934: 15 (bibliography and synonymy).

To Leloup's elaborate list should be added:

- Chiton cinereus*; Hanley, 1855: 17; Sowerby, 1859: pl. 10 fig. 13; Dodge, 1952: 23.
Trachydermon cinereus; Leloup & Volz, 1938: 20, figs. 26-28, 29a-b, 30a-b.
Lepidochiton cinereus; Van Benthem Jutting, 1936: 79, figs. 30-33; Muus, 1959: 43, fig. 25.
Lepidochitona cinereus; Matthews, 1953: 241-8; Malatesta, 1962: 155, figs. 11-12; McKay & Smith, 1979: 2.
Lepidochitona cinerea; Laghi, 1977: 105.
Chiton marginatus; Brown, 1823: 402; Brown, 1827: pl. 35 fig. 3; Fleming, 1828: 289;

- Sowerby, 1841: 3; Lovén, 1846: 160; Jeffreys, 1869: 199; Locard, 1892: 233, fig. 210; Nobre, 1940: 503.
- Lepidochiton marginatus*; Jakovleva, 1952: 72, text figs. 29 (1-4), pl. 3 figs. 5a-b.
- ? *Chiton fuscatus* Brown, 1827: pl. 35 fig. 17.
- Chiton quinquevalvis* Brown, 1823: 402 (five-valved); 1827: pl. 35 fig. 22 (emend.: *quinquevalvis*).
- Chiton variegatus*; Aradas & Benoit, 1870: 115.
- Non: *Chiton cinereus*; Fleming, 1828: 289; ? Brown, 1823: 402; Brown, 1827: pl. 35 fig. 18; Sowerby, 1841: 4 [all = *Leptochiton asellus* (Gmelin, 1791)].

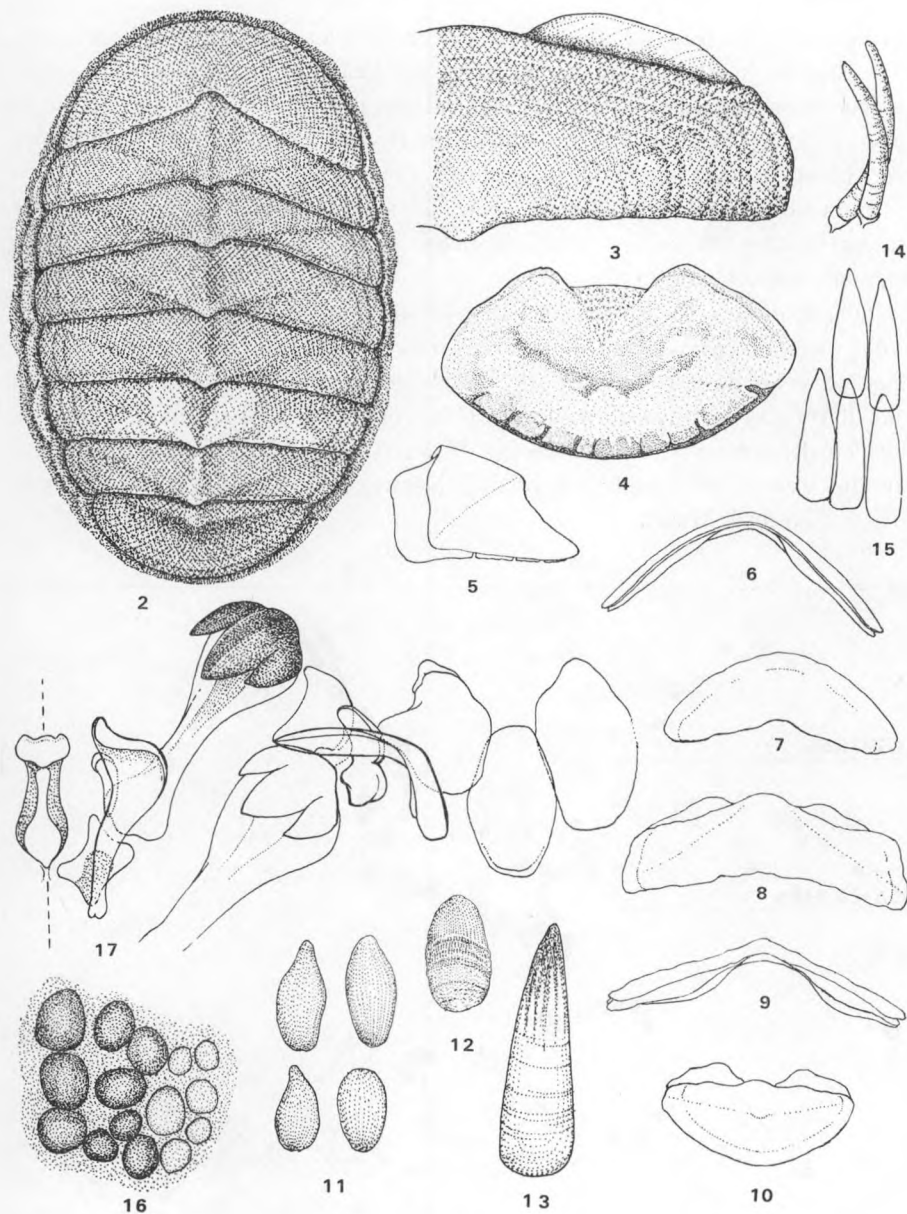
Material examined. — In the different collections studied this very common species is represented by many specimens collected from 69°40'N 19°E (Tromsøya: Lands, 18 specimens, low tide, 11.v.1877, J. Sparre Schneider leg. in Tromsø Mus.) southward along the Atlantic coast of Europe and in the Mediterranean Sea (see map 1). Largest specimen 25 × 16 mm from Audresselles, Pas-de-Calais, France, 12.vii.1951; Univ. of Amsterdam leg., K 3572 (figs. 7-10).

Description. — Animal generally 12 to 16 mm long, exceptionally up to 25 mm, oval, dorsal elevation 0.38, subcarinated, side slopes a little convex (fig. 2). Colour of tegmentum diverse: cinereous, olivaceous or fulvous, frequently blotched with other colours in all possible patterns.

Tegmentum evenly sculptured all over with fine diamond-shaped granules (fig. 128¹), arranged in a somewhat irregular quincunx pattern, eventually forming more or less longitudinal rows towards the side margins, a few concentric growth lines often discernible in full-grown specimens. Head valve semicircular in front, the posterior margin forming an obtuse entrant angle with a rounded notch in the middle (fig. 7). Intermediate valves broadly rectangular (figs. 3, 6, 8), the posterior margin almost straight, produced to a small apex at the top, not beaked, lateral areas but slightly raised, not distinctly separated from the central area. Tail valve oval (figs. 4, 10), much smaller than the head valve, mucro not prominent, slightly anterior, posterior slope a little concave (fig. 5).

The articulamentum is whitish or, depending on the colour of the tegmentum, tinged with blue or brown. Eaves spongy, insertion plates short, slit formula 8-10/1/10-12, slit rays clearly visible, teeth slightly roughened on the outside, rugose on the posterior valve. Sutural laminae broadly rounded, jugal sinus straight to slightly convex, about one fifth of the total width.

Usually the girdle has alternating bars of a lighter and a darker colour. It is dorsally clothed with small, closely set, not imbricating calcareous corpuscles, which are oblong, very obtusely pointed, ± 90 μm long, 40-50 μm in diameter, those near the sutures almost twice as long (figs. 11, 12, 16). They are imbedded in the girdle-tissue, the roundish heads sticking out.



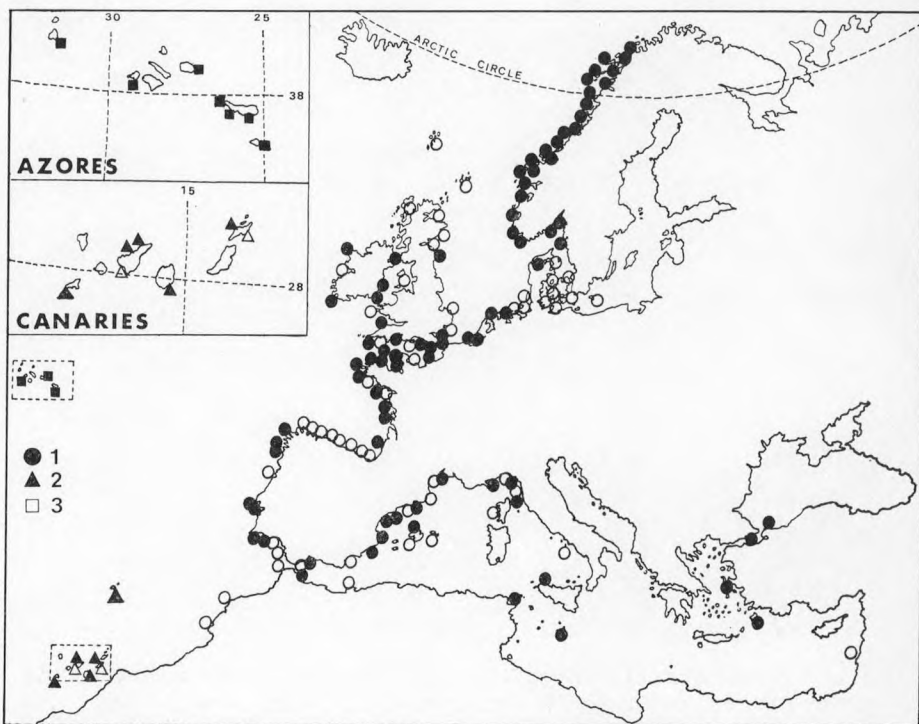
Figs. 2-17. *Lepidochitona (L.) cinerea* (L., 1767). 2, Whole specimen, dorsal view, $\times 5.6$; 3, part of valve IV, dorsal view, $\times 8.4$; 4, valve VIII, ventral view, $\times 8.4$; 5, ditto, lateral view, $\times 8.4$; 6, valve IV, anterior view, $\times 4.2$; 7, camera lucida sketch of valve I, dorsal view, $\times 2.8$; 8, ditto, valve II, $\times 2.8$; 9, ditto, anterior view, $\times 2.8$; 10, ditto, valve VIII, dorsal view, $\times 2.8$; 11, isolated calcareous corpuscles from dorsal side of girdle, near sutures, $\times 87.5$; 12, ditto, from centre of girdle, $\times 175$; 13, marginal spicule, $104 \times 28 \mu\text{m}$; 14, dorsal spicules, $1.76 \mu\text{m}$; 15, ventral scales, $48 \times 12 \mu\text{m}$; 16, part of girdle, dorsal view, $\times 175$; 17, half row of radula, $\times 160$.

Figs. 2-6, Nieuweschild, Isle of Texel, Noord-Holland, The Netherlands, 10.VI.1949, K 1898. Figs. 7-10, Audresselles, Pas-de-Calais, France, 12.VII.1951, K 3572. Figs. 11-17, Veere, Zeeland, The Netherlands, K 1898a.

Irregularly scattered among these occur slender, slightly bent spicules, sheathed in small chitinous cups, $\pm 76 \mu\text{m}$ long (fig. 14). There is a conspicuous marginal fringe of stout, conical spicules, striated near the tip, up to $104 \mu\text{m}$ long (fig. 13). Ventral side of the girdle covered with radiating rows of oblong, distally pointed scales, about $50 \mu\text{m}$ long, $12 \mu\text{m}$ wide (fig. 15).

Central tooth of the radula elongate, dilated anteriorly, cusp of the major lateral tooth with three pointed denticles, the median one somewhat larger than the others (fig. 17).

Distribution. — With the exception of Iceland, *L. cinerea* is found along all European coasts from Tromsø, Norway, down into the Mediterranean Sea. Also in the SW part of the Baltic Sea, in the Black Sea, and on the northern and northwestern coast of Morocco. Its bathymetrical range is principally intertidal and sublittoral. It was dredged between 50 and 70 m in the Vesterålen islands (Nordland, Norway) by T. Soot-Ryen, in June 1936 (Tromsø Mus.).



Map 1. 1, *Lepidochitona* (*L.*) *cinerea* (*L.*); 2, *L. (L.) canariensis* (Thiele); 3, *L. (L.) simrothi* (Thiele). Black symbols indicate specimens studied by the present authors; open symbols are records in the literature.

The distribution in time was treated very well by Malatesta (1962: 156-157, fig. 12), who concludes: "The data concerning its chronological distribution, as may be seen, are rather scarce. As far as may be inferred from them, it seems as if *L. cinereus* originated somewhere between France and northern Italy in the late Miocene or the younger Pliocene and that it got a wide distribution both in the Mediterranean and N. Atlantic only during the Pleistocene."

Discussion. — The older authors, such as Fabricius (1780: 423), Brown (1827), and Fleming (1828), mistook *Leptochiton asellus* (Gmelin, 1791) for Linnaeus' *cinereus*, using the younger name *marginatus* Pennant (1777: 71, pl. 36 fig. 2) instead of it. Only Lowe (1825: 99) and Forbes & Hanley (1849: 402, not pl. 58 fig. 1; 1853) used the correct name. A few years later Hanley (1855: 17), from the type material in the collection of Linnaeus, settled the true status of *C. cinereus* L., concluding that it was the species called *marginatus* by Pennant and subsequent authors. Nevertheless Jeffreys, Sars, and most other European writers persevered in the erroneous interchange of names. One of the difficulties might have been, that Poli (1791: 4, pl. 3 figs. 1-20) attached the name *Chiton cinereus* to the Mediterranean species now known as *L. corrugata* (Reeve, 1848).

At last, on the authority of Pilsbry (1892: 68), the name *L. cinereus* got general recognition as the correct name for the species up till then called *marginatus* Pennant.

Philippi (1836: 107) described *Chiton variegatus* from Sicily, which for a long time was regarded either as a distinct species (Thiele, 1893: 391, pl. 32 fig. 7) or as a variety of *cinereus* L. (Pilsbry, 1892: 69). Thiele even made it the type of a new genus *Adriella* on account of supposed differences in the radula and in the characteristics of the shell plates and girdle-elements when compared to *cinereus* L.

Pilsbry "preferred to retain the Mediterranean form distinct, at least as a geographic variety, for it differs from *Tr. cinereus* of the north in being constantly smaller, having fewer slits in the end valves, and having the sutural plates of a decidedly different shape."

In spite of Thiele's efforts (1902: 283, pl. 21 fig. 58) to demonstrate these differences, we have not been able to confirm them. The study of the radulae, valves and girdles of disarticulated Mediterranean specimens does not reveal any differences at all, when compared to Atlantic specimens. The form of the sutural plates, the number of slits (generally 8/1/11), the perinotum elements and the radulae are exactly alike. There is only a difference in size. Northern specimens usually grow larger than those from the Atlantic coast of southern France, the Iberian Peninsula, and the Medi-

terranean, but this may be due to modifying influences of the environment, as there are temperature and salinity. In our opinion Thiele's figures are deceiving, and *Chiton variegatus* Philippi has to be added to the many synonyms of *Lepidochitona cinerea* (L.).

The great variation in colour imposed Dautzenberg & Durouchoux (1906: 59) to name the varieties "ex colore" *adumbrata*, *albocarinata*, *miniata*, *nigrescens*, *rubrocarinata*, and *straminea*, which, of course, are of no importance.

Lepidochitona (L.) canariensis (Thiele, 1909)

(figs. 18-31, 128²; map 1)

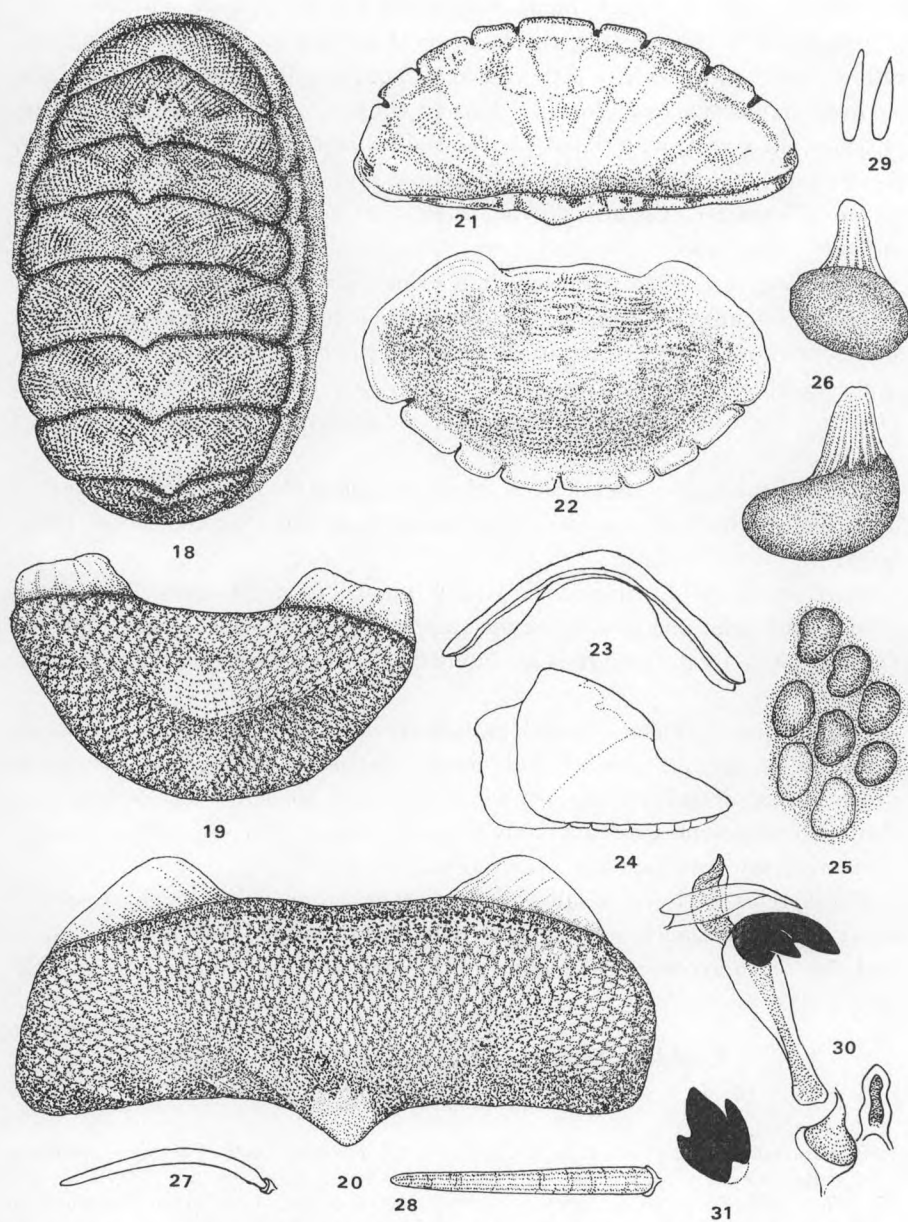
Trachydermon canariensis Thiele, 1909: 15, pl. 2 figs. 14-25; Bergenhayn, 1931: 14, pl. 2 figs. 57-58; Leloup, 1968: 10, fig. 5. Type: ZMHU 101918.

Material examined. — Canary Islands: Tenerife, Puerto de la Cruz, littoral, 9.iii.1947, Dr. C. O. van Regteren Altena leg., RMNH/1; Tejina, x.1975, ex coll. C. Altimira, VB 2777d/1; Tenerife, intertidal, viii.1967, Ch. Geerts leg., VB 2777c/3; Gran Canaria, San Augustin, under rocks, low tide, v.1971, F. Nolf leg., VB 2777b/2; Lanzarote, La Caleta, intertidal, x.1974, Dr. P. Gillis leg., VB 2777a/2, K 4850/1; Hierro, SW coast, off Faro de Orchilla, 5-25 m, bottom with some sand, 8.ix.1977, Cancap II: Tydeman Canary Islands Expedition 1977, sta. D8, RMNH/1; Madeira, near Canical, 32°44'N 16°44'W, 0-22 m, 2.iii.1976, "Onversaagd" Madeira-Morocco Exp. 1976, sta. 14, RMNH/1.

Description. — Animal generally 5 to 8 mm long, maximum 8.5 × 5 mm, oval to elongate oval, dorsal elevation 0.39, subcarinated, side slopes slightly convex (fig. 18). Colour of tegmentum variable: fulvous, roseate, olivaceous, or cinereous, frequently dotted or blotched with lighter and darker colours.

Tegmentum evenly sculptured with diamond-shaped granules (fig. 128²), much coarser than in *L. cinerea*, arranged in quincunx, tending to form converging longitudinal rows on the pleurae of the intermediate valves. Head valve (fig. 21) about one third of a circle; intermediate valves (figs. 20, 23) broadly rectangular, definitely beaked, the anterior margin slightly excavated between the apophyses; lateral areas hardly raised, though clearly indicated by a diagonal fold which is most obvious near the apical area. Tail valve (figs. 19, 22, 24) hardly smaller than the head valve, about one third of a circle, anterior margin concave between the apophyses, mucro prominent, subcentral, the post-mucronal slope concave.

Articulamentum white to greyish or roseate, depending on the colour of the tegmentum, porous in the middle directly behind the jugal sinus. Insert-



Figs. 18-31. *Lepidochitona (L.) canariensis* (Thiele, 1909). 18, Whole specimen, $\times 8.4$; 19, valve VIII, dorsal view, $\times 17.5$; 20, valve IV, dorsal view, $\times 17.5$; 21, valve I, ventral view, $\times 17.5$; 22, valve VIII, ventral view, $\times 17.5$; 23, valve IV, anterior view, $\times 8.4$; 24, valve VIII, lateral view, $\times 17.5$; 25, calcareous corpuscles from the dorsal side of the girdle, diameter $30 \mu\text{m}$; 26, isolated corpuscles, $\times 17.5$; 27, dorsal girdle spicule, $160 \times 12 \mu\text{m}$; 28, marginal spine, $220 \times 16 \mu\text{m}$; 29, ventral girdle spicules, $68 \times 10 \mu\text{m}$; 30, part of a radula row, $\times 17.5$; 31, cusp of major lateral radula tooth, $\times 175$.

Fig. 18, San Augustin, Gran Canaria, Canary Is., Spain, V.1971, F. Nolf, leg., VB 2777b.
Figs. 19-31, La Caleta, Lanzarote, Canary Is., Spain, X.1974, Dr. P. Gillis leg., VB 2777a.

ion plates short, the teeth blunt, roughened on the outside, slit formula: 7-10/1/8-10, the slit rays not visible. Sutural laminae more or less triangular, rather small; sinus wide, a little concave, about one third of the total width.

Girdle rather narrow, dorsally densely clothed with oval calcareous corpuscles, on a narrow, striated base embedded in the girdle tissue (fig. 25), the roundish or oval heads, brown, yellow and white, sticking out, about 30 μm in diameter (fig. 26). Among them, scattered at random, small groups of 2-4 white, smooth, slightly bent, bluntly pointed spicules are found, 160 μm long, 12 μm in diameter, stalked in short chitinous cups (fig. 27). There is a fringe of long, slender, straight, longitudinally weakly grooved spines, 220 μm long, 16 μm in diameter (fig. 28). Ventrally the girdle is clothed with close set radiating rows of tiny, narrow, distally pointed scales (fig. 29), the infra-marginal scales larger and relatively wider, bluntly pointed or truncated.

Cusp of the major lateral tooth of the radula with three sharply pointed denticles of which the median one is decidedly larger than the others (figs. 30, 31).

Distribution. — *L. canariensis* is only known from Madeira, the Canary islands and from one locality in the Cap Verde Archipelago: Saõ Vicente (fide Leloup, 1968: 10). It is an intertidal species. Geological distribution: Recent.

Discussion. — Thiele as well as Leloup described the dorsal perinotum elements as oblong, pointed and distally decidedly striate. In our girdle preparations, magnified 400 \times , we were unable to detect any striation on them. All corpuscles are invariably bluntly rounded at the top, often abruptly narrowing towards the base, as described above.

The species is closely related to *L. cinerea*, from which it may easily be separated by its much smaller size, its strongly beaked intermediate valves and the much coarser granulation of the tegmentum (compare figs. 128¹ and 128²).

Lepidochitona (L.) corrugata (Reeve, 1848)

(figs. 32-44, 128⁶; map 2)

Chiton cinereus; Poli, 1791: 4, pl. 3 figs. 1-20 (+ *Lophyrus melphictensis* = anatomy of same); Costa, 1829: 1; 1844: 40; Kaas, 1957: 83.

Nuttallina (Middendorffia) cinerea; Pilsbry, 1893, con var. *pseudorissoi* Carpenter in Pilsbry, 1893: 283-285, pl. 54 figs. 28-33; Thiele, 1902: 287, figs. 66a-c.

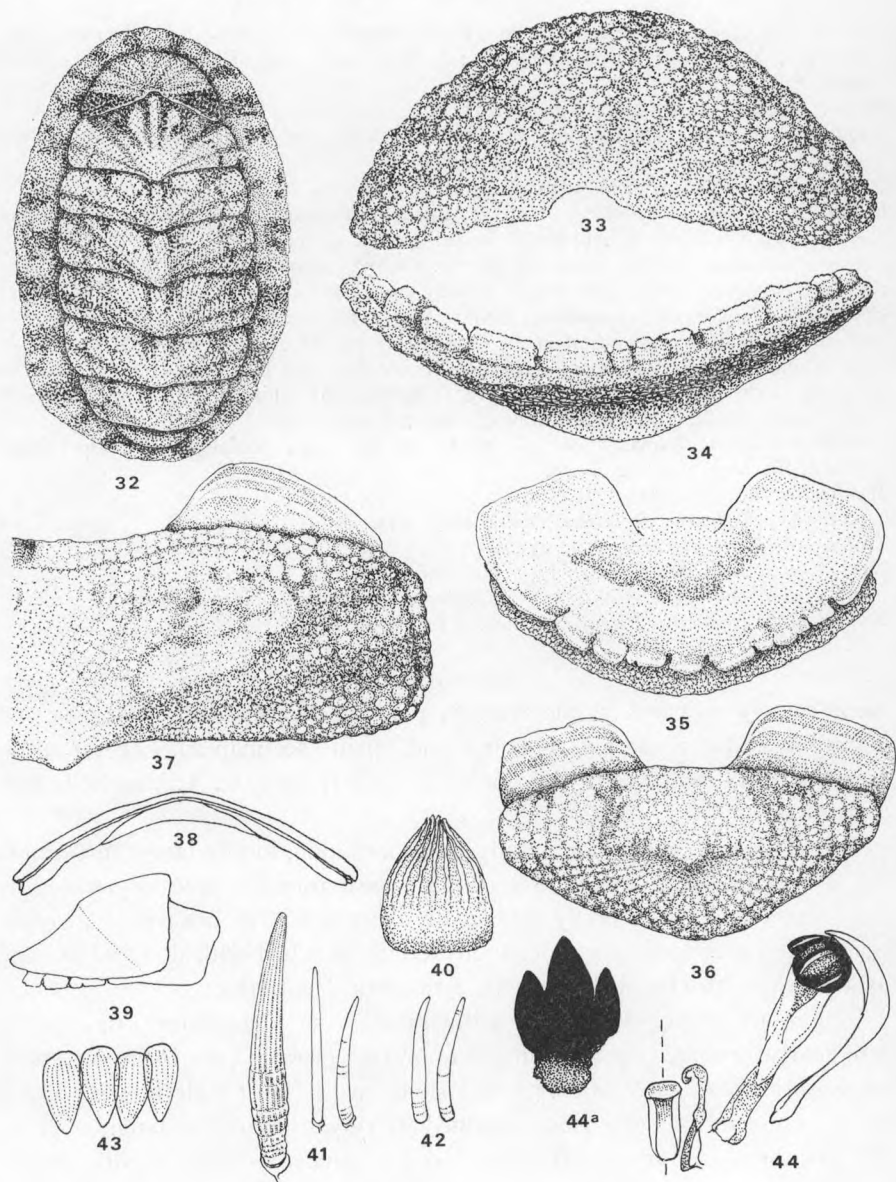
Chiton polii Philippi, 1836: 106; O. G. Costa, 1841: 7; Philippi, 1844: 83; Forbes, 1844: 135; Réquien, 1848: 37; Jeffreys, 1856: 26; Capellini, 1859: 321; Petit de la Saussaye, 1860: 244; Brusina, 1866: 82; Weinkauff, 1868: 409; Petit de la Saussaye, 1869: 87; Appellius, 1869: 47; Issel, 1870: 1; Aradas & Benoit, 1870: 114; Di Monterosato, 1872: 29; Jeffreys, 1873: 113; Di Monterosato, 1875: 21; Tiberi, 1878: 146, 157; Di Monterosato, 1878a: 77; 1879: 13; Dall, 1882: 287; Dautzenberg, 1883: 15; Dollfus, 1883:

- 3; Marion, 1883: 23; Fischer, 1885: 874; Granger, 1885: 170; Locard, 1886: 348; Garnault, 1888: 108; Carus, 1889: 181; Pallary, 1917: 143; Plate, 1901: 509; Kaas, 1957: 83.
- Chiton (Lepidopleura) polii*; Tiberi, 1877: 140.
- Middendorffia polii*; Thiele, 1893: 391; 1909: 4; Vayssière, 1913: 39; Coen & Vatova, 1933: 5; Sulc, 1936: 11; Lacourt, 1977: 228.
- ? *Chiton caprearum* Scacchi, 1836: 9.
- Chiton caprearum*; Dautzenberg, 1886: 2; Bucquoy, Dautzenberg & Dollfus, 1886: 492, pl. 61 figs. 7-9, pl. 62, fig. 1; Nobre, 1940: 501, pl. 14 fig. 18.
- Chiton (Nuttalina) (sic!) caprearum*, con var. *major*; Pallary, 1900: 366.
- Chiton (Nuttalina) (sic!) caprearum*; Pallary, 1902: 28; 1913: 148.
- Chiton (Middendorffia) caprearum*; Bellini, 1901: 112; 1929: 60.
- Middendorffia caprearum*; Leloup & Volz, 1938: 15, figs. 17-19, 20a-d, 21, 49, 53a-b, 54; Malatesta, 1962: 157, figs. 13-14; Riedl, 1963: pl. 119; Mars, 1965: 20; Ghisotti & Sabelli, 1970: 5; Sabelli & Spada, 1971: 6, fig. 16; Ghisotti, 1972: 51; Altimira, 1972: 34; Sabelli, 1974: 74; Altimira, 1975: 73; 1976: 589.
- Chiton corrugatus* Reeve, 1848: pl. 28 sp. & fig. 185; Iredale, 1914: 130. Type: B.M.N.H., Mus. Cuming no. 53.
- Middendorffia corrugata*; Thiele, 1929: 9; Kaas, 1974: 97.
- Chiton (Lepidopleura) decipiens* Tiberi, 1877: 141.
- Chiton crenulatus*, Locard, 1892: 233.
- Non: *Chiton cinereus* Linnaeus, 1767 = *Lepidochitona (L.) cinerea* (L.).
- Non: *Chiton polii* Deshayes, 1833 = *Chiton (Rhyssoptax) olivaceus* Spengler, 1797.
- Non: *Chiton crenulatus* Risso, 1826, *nomen inquirendum*.

Material examined. — This common species is represented by many specimens mostly collected in the western part of the Mediterranean Sea and along the southern coast of Portugal and Spain (see map 2). Largest specimen, 23 × 13 mm, Spain (Alicante): Altea, 8.iv.1975, R. A. Van Belle leg., VB 2581a.

Description. — Animal generally 12-18 mm long, locally larger, maximum 23 × 13 mm, oval, dorsal elevation 0.27, back rounded, side slopes slightly convex (fig. 32). Generally eroded or encrusted with calcareous growth; non-eroded specimens are roseate olivaceous, blotched with dirty white, and ashen brown patches in different, symmetrical patterns.

Tegument evenly sculptured with rather coarse granules (fig. 128⁶), irregularly arranged in quincunx, one or two growth lines in larger specimens only. Head valve (figs. 33, 34) about two fifth of a circle, with 8 or 9 weak, rounded, radiating ribs. Intermediate valves broadly rectangular (figs. 37, 38), the posterior margin a little concave, almost straight; slightly beaked in juveniles, the beaks generally disappearing by erosion when adult, lateral areas hardly raised, though indicated by a rounded diagonal rib, another subobsolete rib accompanies the posterior margin. Tail valve (figs. 35, 36, 39) small, very short, broadly triangular, much smaller than the head valve; mucro elevated, somewhat behind the centre, postmucronal slope almost straight.

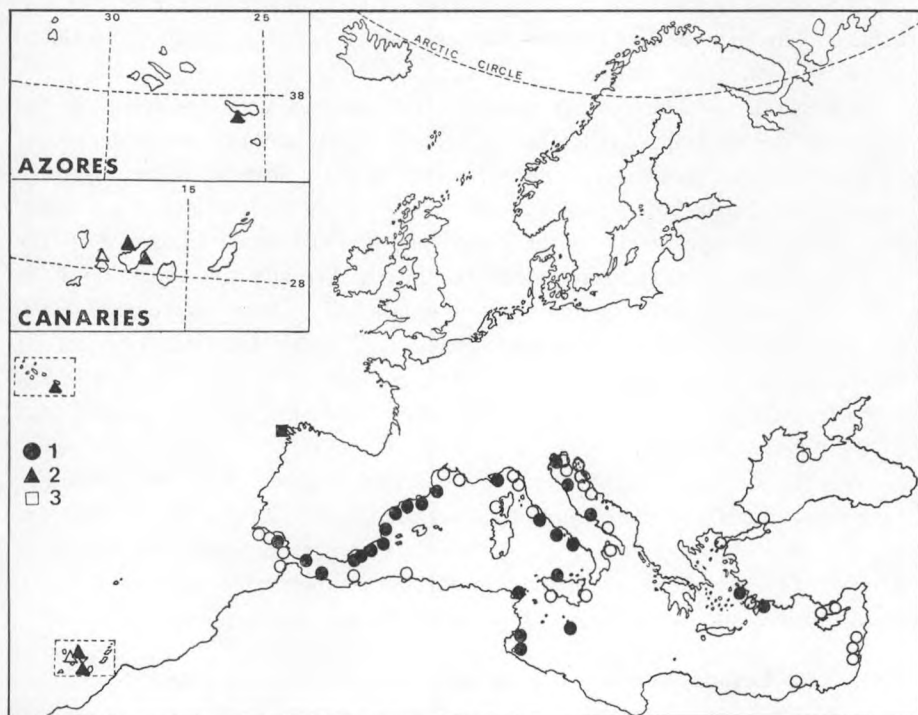


Figs. 32-44. *Lepidochitona (L.) corrugata* (Reeve, 1848). 32, Whole specimen, $\times 4.2$; 33, valve I, $\times 17.5$; 34, ditto, dorso-rostral view, $\times 17.5$; 35, valve VIII, ventral view, $\times 17.5$; 36, ditto, dorsal view, $\times 17.5$; 37, valve IV, dorsal view of right half, $\times 17.5$; 38, ditto, anterior view, $\times 8.4$; 39, valve VIII, lateral view, $\times 17.5$; 40, calcareous corpuscule from dorsal side of girdle, $92 \times 112 \mu\text{m}$; 41, marginal spine and spicules, resp. $400 \times 64 \mu\text{m}$, $240 \times 16 \mu\text{m}$, and $200 \times 20 \mu\text{m}$; 42, dorsal spicules, $200 \times 20 \mu\text{m}$; 43, ventral girdle scales, $52 \times 25 \mu\text{m}$; 44, part of a half radula row, $\times 175$; 44a, cusp of major lateral radula tooth.

Figs. 32-44, Benidorm, Alicante, Spain, V.1975, Van Belle, leg., K 4848.

Articulamentum dirty white to light bluish, changing to brownish near the centre of the valves. Eaves coarsely spongy, slit formula 8-9/1/10-11, the slits corresponding in position to the external ribs, except in the tail valve; slit rays short, teeth thickened at the edges, those of the tail valve very short, rugose, somewhat directed forward. Sutural laminae of the intermediate valves broadly triangular, sinus slightly concave or flat, two fifth of the total width of the valve; the tail valve has the apophyses broadly rectangular, the jugal sinus about one fifth of the width of the valve.

Girdle moderately wide, banded with alternative beige and dark brownish patches. On the dorsal side densely paved with erect, oblong, distally pointed and striated or ribbed, not imbricating calcareous corpuscles, measuring about $90 \times 110 \mu\text{m}$ (fig. 40). Among them, scattered at random, small, straight or slightly bent, white spicules are found, solitary or in small groups of 2 or 3, about $200 \mu\text{m}$ long, $20 \mu\text{m}$ in diameter (fig. 42). The marginal fringe is formed by stout, decidedly longitudinally ribbed spines, $\pm 400 \times 64 \mu\text{m}$, and smaller, non-striate spicules, $\pm 200 \times 20 \mu\text{m}$ (fig. 41). The



Map 2, 1, *Lepidochitona* (*L.*) *corrugata* (Reeve); 2, *L.* (*L.*) *piceola* (Shuttleworth); 3, *L.* (*L.*) *iberica* nov. sp. Black symbols indicate specimens studied by the present authors; open symbols are records in the literature.

ventral scales are rather short, conical, distally pointed, and slightly striated, $52 \times 25 \mu\text{m}$ (fig. 43), arranged in close set radiating rows.

The first lateral tooth of the radula has a fish hook-shaped cusp, the major lateral with a tridentate cusp, the denticles sharply pointed, the central one largest (figs. 44, 44a).

Distribution. — *L. corrugata* has been reported from most parts of the Mediterranean Sea, but records of the northeastern coast of Africa are scarce. It also lives in the Black Sea and on the southern coast of Portugal and Spain (see map 2). By preference it dwells in the *Littorina neritoides*-zone, hiding in crevices of rocks, exposed to the surf.

Its geological distribution was summarized by Malatesta (1962: 157): "...The genus *Middendorffia* is represented as early as in the Miocene in Piedmont and Bohemia basins. *Middendorffia lepida* (Reuss) from the Tortonian of Piedmont seems to have existed until the upper Pliocene. That species shows marked relationships with the living *M. caprearum*, which is the probable derivative of its. The later species appears in the old Pleistocene of Messina, it is found in a younger layer of Carrubbare near Reggio Calabria, and in Nizzeti near Catania in clays whose age is generally considered to be Sicilian."

Discussion. — The correct name of this species was discussed by the senior author (Kaas, 1957: 83, and 1974: 97). Many authors, however, prefer to use the older name *Middendorffia caprearum* (Scacchi, 1836: 9), presumably on the authority of Di Monterosato (1879: 15), who states to have seen authentic specimens in the collection of Petit de la Saussaye in the Muséum National d'Histoire Naturelle, Paris. Actually the collection Petit only contains one lot of 3 dry specimens labelled "*Chiton caprearum* Scacchi", from Martigues (Camargue, France). Though Dr. Ph. Bouchet of the Laboratoire de Malacologie, MNHN, advised us that the locality is not to be trusted, there is no evidence that the sample might have formed part of the original type lot.

Scacchi's original diagnosis reads: "Clypeis 8 tuberculatis virescentibus, fascia marginali squamoso-muricata, perbelle ciliata. Longus lin. 6, latus lin. $4\frac{1}{4}$." It was collected on rocks in the isle of Capri, from which the name was derived. The diagnosis is worthless and as no further references were given, we think it wiser to consider *caprearum* to be a nomen dubium.

Lepidochitona* (L.) *piceola (Shuttleworth, 1853)

(figs. 45-56, 128⁷; map 2)

Chiton (*Acanthopleura*) *piceolus* Shuttleworth, 1853: 206; Pilsbry, 1893: 229. Type: ZMB.

Chiton piceolus; H. & A. Adams, 1858: 475.

Nuttallina (Middendorffia) piceolus; Pilsbry, 1893a: 88.

Nuttallina piceola; Nierstrasz, 1906: 515.

Middendorffia piceola; Bergenhayn, 1931: 14, pl. 1 figs. 21-24, pl. 2 figs. 59-64; Malatesta, 1962: 158.

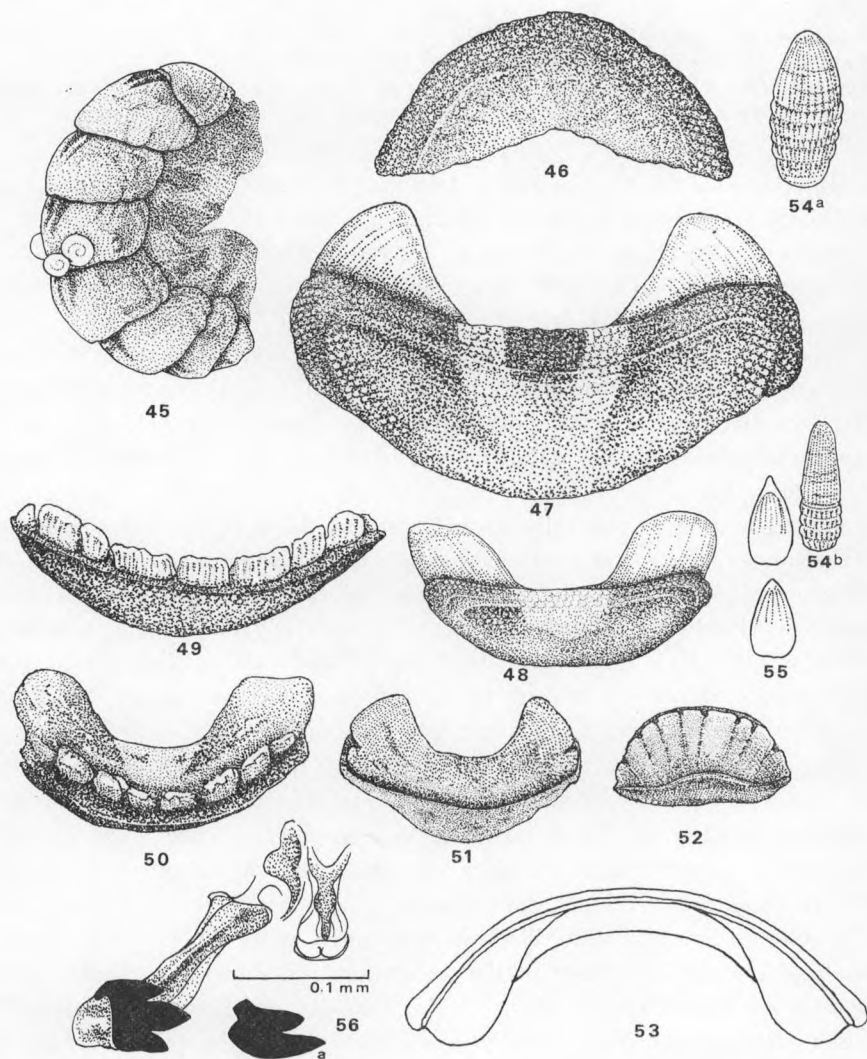
Material examined. — Canary Islands: Tenerife, Puerto de la Cruz, 9.iii.1947, C. O. van Regteren Altena leg., RMNH 3949/2; K 3315/1; Puerto Orotava, playa, 10.iii.1947, C. O. van Regteren Altena leg., RMNH 3949/1; Azores: São Miguel: Ponta Delgado, W side of harbour, 22.ix.1979, M. Lavaleye leg., RMNH/2.

Description. — Animal about 10 mm long, 6 mm wide, oval, the back regularly rounded, not carinated, dorsal elevation 0.31. Tegmentum greenish grey, the back marked by a black band, accompanied by yellowish white bands; sometimes the black dorsal band is divided by a narrow white jugal stripe (fig. 45).

The tegmentum is generally strongly eroded, the sculpture only preserved in the younger parts of the valves, especially along the anterior margins which are protected by the preceding valves. The sculpture consists of rather coarse, roundish, closely set tubercles (fig. 128⁷), regularly disposed in quincunx on the whole valves. Head valve about two fifth of a circle (figs. 46, 49, 52), intermediate valves not beaked, the apices generally worn away, the front margin regularly concave, the sides strongly projecting forwardly; lateral areas hardly discernible, not raised (figs. 47, 51, 53). Tail valve with the mucro a little behind the centre, subobsolete, postmucronal area not separated from the antemucronal area, posterior slope slightly concave (figs. 48, 50). One or two concentric growth lines are almost always present.

Articulamentum strongly developed, so that the valves are rather thick. The colour is greyish blue, black in the centre, with two yellowish brown bands where the light parts of the tegmentum are showing through. There is always a strong apical callus. Slit formula: 8/1/7, the teeth of insertion rather short, roughened, dorsally grooved, those of the tail valve poorly developed, somewhat directed forward, slitrays only present in the head valve, the apophyses narrow at the base, triangular in the intermediate valves, trapezoid in the tail valve; the jugal sinus narrow, deeply concave.

Girdle rather wide, 0.4 of the total width, dirty white banded with ochraceous or brown, closely clothed with erect, short, blunt spicules, which are finely longitudinally grooved, and ringed by lines of growth at the base, 48-56 μm long (fig. 54a, b). In the dried and disarticulated specimen we could study there were no marginal spicules to be found, though Bergenhayn (1931: 16) described them as being stout, ribbed, weakly ringed



Figs. 45-56. *Lepidochitona (L.) piceola* (Shuttleworth, 1853). 45, Whole specimen, $\times 4.2$; 46, valve I, dorsal view, $\times 17.5$; 47, valve IV, dorsal view, $\times 17.5$; 48, valve VIII, dorsal view, $\times 17.5$; 49, Valve I, dorso-rostral view, $\times 17.5$; 50, valve VIII, caudo-ventral view, $\times 17.5$; 51, valve IV, ventral view, $\times 8.4$; 52, valve I, ventral view, $\times 8.4$; 53, valve IV, anterior view, $\times 15.8$; 54 a-b, dorsal girdle spicules, l. 48-56 μm ; 55, ventral girde scales, 36 \times 16 μm ; 56, part of a radula row; 56a, cusp of major lateral radula tooth.

Fig. 45, Puerto Orotava, Tenerife, Canary Is., Spain, 10.III.1947, C. O. van Regteren Altena leg., RMNH 3949. Figs. 46-56, Puerto de la Cruz, Tenerife, Canary Is., Spain, 9.III.1947, C. O. van Regteren Altena leg., K 3315.

needles in chitinous cups, yellowish or transparent, 175 μm long (Bergenhayn's measurements of the dorsal and ventral girdle elements of a 7 mm long specimen are about 60% larger than we measured in a 10 mm long specimen). Ventral scales flat, slightly striated, about wedge-shaped, the sharply pointed top somewhat thickened (fig. 55).

The major lateral tooth of the radula has a tridentate cusp, the central denticle decidedly longest (fig. 56, 56a).

Distribution. — Canary islands: Tenerife (Shuttleworth, Van Regteren Altena); Gomera (May, *vide* Bergenhayn); Azores: São Miguel (first record). Intertidal.

Geological distribution: Recent.

Lepidochitona (L.) monterosatoi nov. sp.

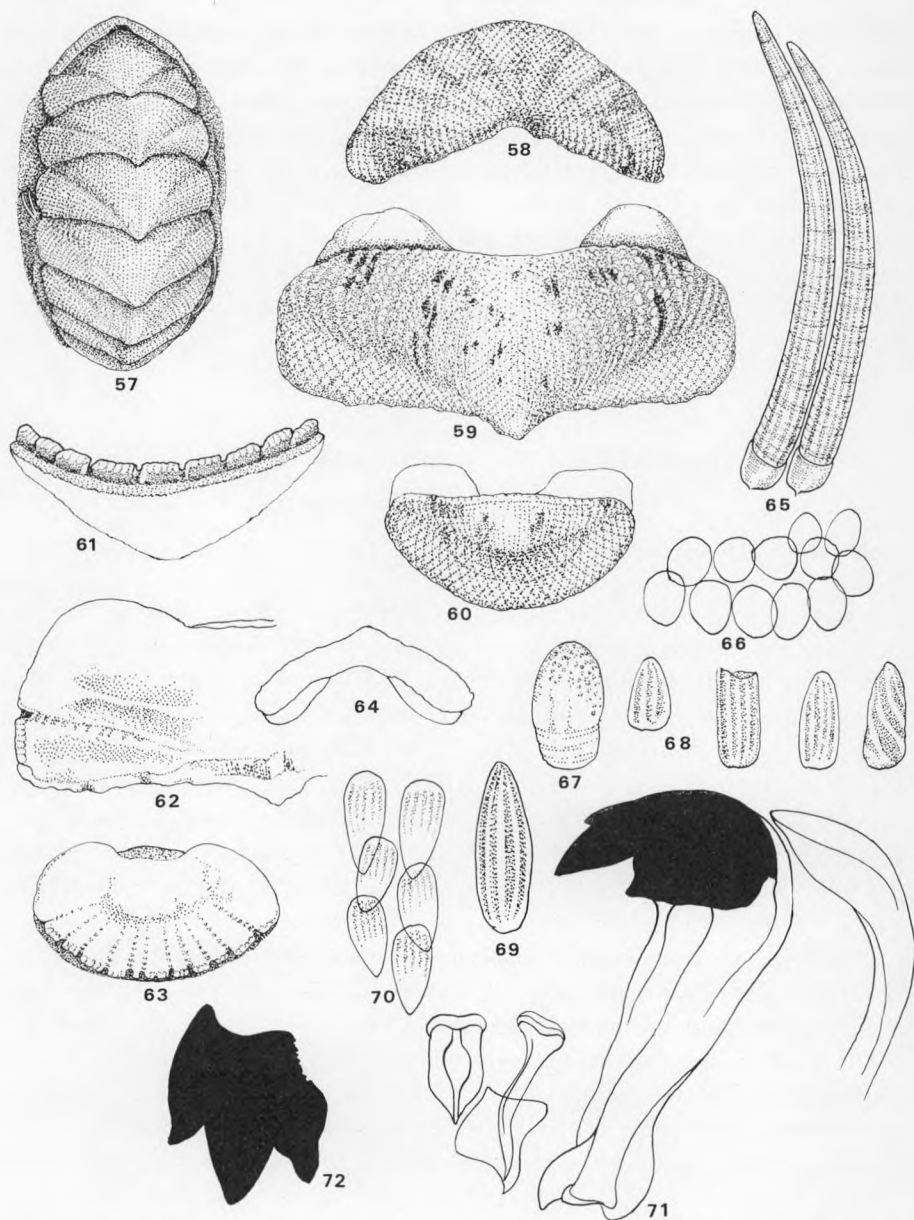
(figs. 57-72, 1288; map 3)

Lepidochitona (Mopaliella) sp. Van Belle, 1977: 31, figs. 7-9.

Material examined. — France: Alpes Maritimes: Cap d'Antibes, Port de l'Olivette, on a stone on sandy bottom, 0.5 m, iv.1978, R. A. Van Belle leg., RMNH 55386/1 (holotype) 7.8 \times 4.6 mm, dry; Var: off Toulon, Le Carnier, 17 m., iv.1972, J. Van de Vijver leg., VB 2587a/1 (paratype), dry, \pm 7.5 \times 4 mm, disarticulated; Italy: Tyrrhenian Sea, Tuscan Archipelago, 1-40 m, vii.1976, A. Verhecken leg., KBIN 26095/1 (paratype), dry, curled, 5.4 \times 3.2 mm (fig. 57); Turkey: southern Aegean coast, Torba, 3 m., x.1978, I. Tümtürk & C. Cavli leg., VB 2587b/1 (paratype), 12 \times 5.9 mm, dry; MNHN/1 (paratype), 7.1 \times 3.8 mm, dry; K 4849/1 (paratype), 4.9 \times 2.6 mm, dry.

Diagnosis. — Animal rather small, up to 12 mm long, elongate oval, dorsal elevation 0.41, subcarinated, the valves beaked, yellowish rose with eventual patches of light green and reddish brown (fig. 57). Evenly granulated all over, the granules tending to form more or less diverging series on the pleural areas. Lateral areas moderately elevated, head valve sometimes with about eight subobsolete radial ribs. Girdle narrow, clothed with not imbricating small calcareous corpuscles and bunches of several long, bent spines.

Description. — Tegmentum rather coarsely granulated (fig. 1288), the granules convex, roundish oval to somewhat diamond shaped, arranged in quincunx on the end valves, the lateral areas and the jugal parts of the intermediate valves, in curved, diverging, longitudinal series on the pleurae of the central areas. Head valve (figs. 58, 61) semicircular, the posterior



Figs. 57-72. *Lepidochitona (L.) monterosatoi* nov. sp. 57, Whole specimen, $\times 8.4$; 58, valve I, dorsal view, $\times 17.5$; 59, valve IV, dorsal view, $\times 17.5$; 60, valve VIII, dorsal view, $\times 17.5$; 61, valve I, dorso-rostral view, $\times 17.5$; 62, right half of valve IV, ventral view, $\times 17.5$; 63, valve VIII, ventral view, $\times 17.5$; 64, valve IV, anterior view, $\times 8.4$; 65, dorsal girdle spines, $350 \times 28 \mu\text{m}$; 66, calcareous corpuscles near outer margin of girdle, $12-18 \mu\text{m}$ diameter; 67, ditto, near suture, isolated, $48 \times 24 \mu\text{m}$; 68, marginal spicules, l. $24-36 \mu\text{m}$; 69, ditto, $60 \times 20 \mu\text{m}$; 70, ventral girdele scales, $40 \times 14 \mu\text{m}$; 71, part of radula row; 72, cusp of major lateral radula tooth.

Fig. 57, S. of Elba, Livorno, Italy, VII, 1976, A. Verhecken leg., paratype, KBIN 26095. Figs. 58-72, Le Carnier, Toulon, Var, France, Van de Vijver leg., paratype, VB 2587a.

margin forming an obtuse entrant angle, with a rounded notch at the top, in full grown specimens with about eight subobsolete radial ribs, corresponding to the slits of the articulamentum. Intermediate valves about rectangular, the front margin a little concave, the hinder margin decidedly beaked, especially in immature specimens, the lateral areas conspicuously raised (figs. 59, 62, 64). Tail valve small, about two fifth of a circle, the anterior margin slightly convex, the mucro subcentral, not prominent, posterior slope a little concave (figs. 60, 63).

Articulamentum glossy, white, the colours of the tegmentum showing through. Insertion plates short, teeth obtuse, more or less rugose on the outside. Slit formula of the only disarticulated specimen 8/1/7, the slits markedly inequidistant; slit rays, but for the head valve, distinct, the eaves spongy. Apophyses broadly triangular in the intermediate valves, trapezoid in the tail valve, sinus a little concave to flat, about one third of the width of the valve.

Girdle densely covered with small, oblong, erect calcareous corpuscles, somewhat pitted at the rounded top, 12-18 μ in diameter (fig. 66), those near the sutures larger and relatively longer, 48 \times 24 μm (fig. 67). Among them occur groups of 2-10 or more long, white, finely longitudinally grooved, almost always regularly curved, slender spines, up to 350 μm long, 28 μm in diameter, sheathed in chitinous cups which are as long as wide, rising from pores in the cuticula of the perinotum. They are not only found intersegmental, but also disposed at random on the middle of the girdle and even close to the outer margin (fig. 65). There is a short fringe of marginal spicules of different forms and sizes, always longitudinally striate to sulcate, the largest bluntly pointed, thickest in the middle, up to 60 μm long (figs. 68, 69). Ventral scales about twice as long as wide, the base bluntly rounded, distally gradually tapering to a point, always with five subobsolete striae. They are irregularly arranged in radiating rows (fig. 70).

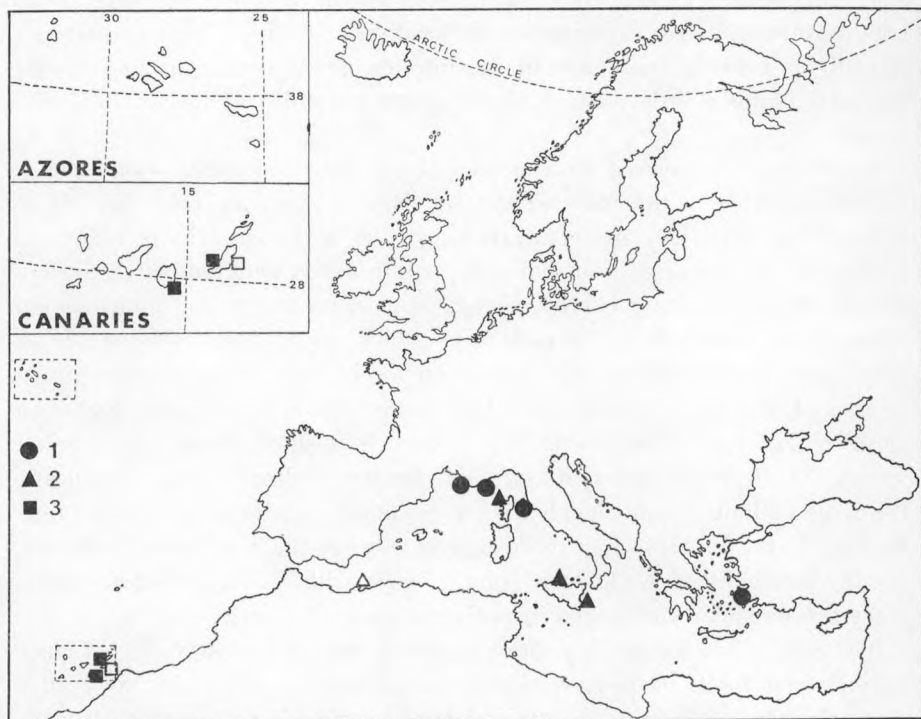
The radula has the rhachis short, squarish, with a narrow inflected cusp. First lateral tooth narrow, weakly S-shaped, distally widening to a cusp similar to that of the rhachis, major lateral tooth with a tridentate cusp, the denticles sharply pointed, the central one largest (figs. 71, 72).

Distribution. — *L. monterosatoi* seems to be a rather rare species, though it is hard to understand why it was not discovered earlier, as within the past few years several specimens were brought to light, as well on the southern coast of France (Toulon, Cap d'Antibes), as in the Tyrrhenian Sea (near Elba), and in the Aegean Sea (Torba, on the Turkish coast) (See map 3). It seems to be a sublittoral species. Geological range: Recent.

Discussion. — The first specimen (from the Tyrrhenian Sea) that came

to the hands of the junior author, was provisionally described and figured by him (Van Belle, 1977: 31, figs. 7-9) without naming it. Shortly afterwards several other specimens turned up. We take a pleasure in naming it after the marquis Di Monterosato who a century ago contributed so much to our knowledge of the Mediterranean molluscan fauna.

It is easily recognizable by its subcarinated shell, its raised lateral areas, the arrangement of the granules on the pleural parts of the intermediate valves, and the bunches of curved long spines on the perinotum. Its nearest relative is, perhaps, *L. simrothi* from the Azores, which, however, is much smaller, with a relatively wider girdle and not raised lateral areas.



Map 3. 1, *Lepidochitona (L.) monterosatoi* nov. sp.; 2, *L. (L.) furtiva* (Di Monterosato); 3, *L. (L.) stroemfelti* (Bergenhayn). Black symbols indicate specimens studied by the present authors; open symbols are records in the literature.

Lepidochitona (L.) simrothi (Thiele, 1902)

(figs. 73-87, 128⁹; map 1)

Nuttallina (Middendorffia) simrothi Thiele, 1902: 287, pl. 21 figs. 67a-d, 68a-d, 69;

Nierstrasz, 1906: 154. Type: ZMHU 39335.

Middendorffia simrothi; Bergenhayn, 1931: 16; Malatesta, 1962: 158.

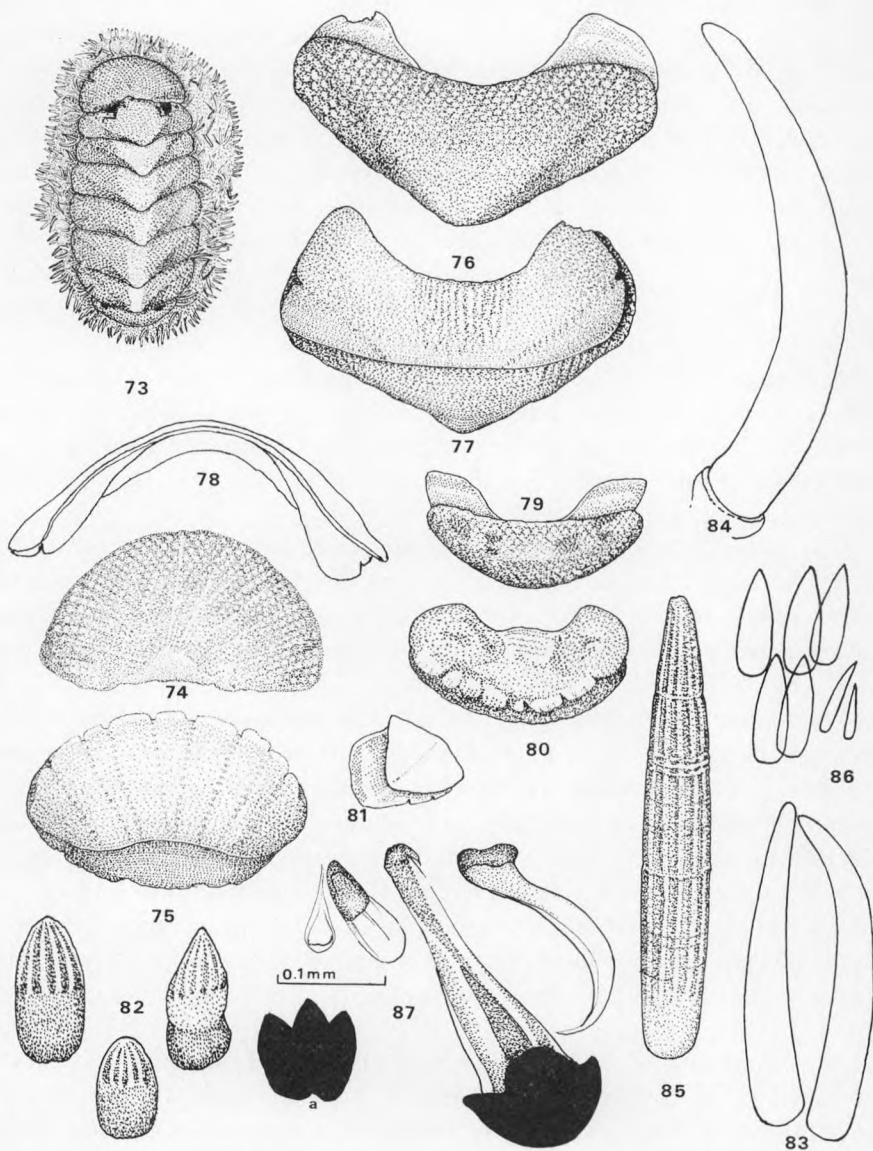
Material examined. — Azores: Faiál, Horta, small island near harbour, 2-3 m, on large barnacles, 11.x.1971, Exp. Jean Charcot Biaçãoes 1971, sta. L 9, MNHN/± 100, K 4885/10; Caldeira Inferno, 0.5 m, 11.x.1971, ditto, sta. L 11, MNHN/2; Terceira: W. Monte Brazil, 7 m, 8.x.1971, ditto, sta. L 8, MNHN/1; Silveira, Poça dos Frades, 12.x.1967, Frias Martins leg., VB 2882d/1; Flores: Lajas das Flores, 23.x.1979, M. Lavaley leg., RMNH/1; São Miguel: Morro de Capultan, 10 m, on large barnacles, 4.xi.1971, Exp. Jean Charcot Biaçãoes 1971, sta. P 41, MNHN/4; Capelas, low tide, 5.x.1971, ditto, sta. L 6, MNHN/1; Ilhen dos Mosteiros, 3-5 m, 2.xi.1971, ditto, sta. P 38, MNHN/1; Ponta Delgada, Calheta, intertidal, 12.vi.1971, 24.v.1972, 31.v.1972, Frias Martins leg. VB 2882a, b, c/many; Villa Franca, 12.vi.1967, Frias Martins leg., VB2882e/many valves; Mosteiros, on *Patella* sp. 4-5 m, 20.ix.1979, M. Lavaley leg., RMNH/1; W. of Praia de Popula, E. of Ponta Delgada, 24.ix.1979, M. Lavaley leg., RMNH/2; Santa Maria: San Lourenço, 16.ix.1979, M. Lavaley leg., RMNH/1.

Description. — Animal small, 5-8 mm long, the width about half the length, elongate oval, dorsal elevation 0.37, the back evenly rounded, side slopes convex (figs. 73, 78). Colour roseate, mostly blotched with patches of grass-green or sky-blue, sometimes with dark brown or white markings, rarely the darker colours predominating.

Tegmentum sculptured with round, convex-topped granules, evenly arranged in quincunx (fig. 128⁹). Head valve large, semicircular, the posterior margin almost straight, the slit rays shining through, giving the appearance of about 8 radial grooves (fig. 74). Intermediate valves decidedly beaked, the lateral areas hardly raised, though clearly marked by a subobsolete diagonal fold, especially near the apex, the sides strongly thrown forward, by which the valves are widely V-shaped (fig. 76). Tail valve very small, semilunar, posterior margin about one third of a circle, the front margin regularly concave, mucro a little behind the centre, posterior slope straight (figs. 79, 81).

Articulamentum whitish, the insertion plates short, somewhat crenulated at the edges, in the head valve with about 8 fairly equidistant slits, the slit rays distinct, porous (fig. 75); the intermediate valves with a strong callus, the central part porous, 1-1 slits, the slit rays distinct, apophyses broadly triangular, the jugal sinus about one third of the width of the valve, deeply concave (fig. 76). Tail valve with 7 slits, slit rays not discernible, the teeth much reduced, roughened, somewhat directed forward, the apophyses trapezoid (fig. 80). The eaves are porous in all valves.

Girdle densely clothed with small, erect, distally deeply sulcate and more



Figs. 73-87. *Lepidochitona (L.) simrothi* (Thiele, 1902). 73, Whole animal, $\times 8.4$; 74, valve I, dorsal view, $\times 17.5$; 75, ditto, ventral view, $\times 17.5$; 76, valve IV, dorsal view, $\times 17.5$; 77, ditto, ventral view, $\times 17.5$; 78, ditto, anterior view, $\times 17.5$; 79, valve VIII, dorsal view, $\times 17.5$; 80, ditto, ventral view, $\times 17.5$; 81, ditto, lateral view, $\times 17.5$; 82, calcareous corpuscles from dorsal side of girdle, $\pm 56 \times 25 \mu\text{m}$; 83, dorsal girdle spicules, $230 \times 28 \mu\text{m}$; 84, ditto, large spine, $320 \times 35 \mu\text{m}$; 85, marginal spine, $174 \times 27 \mu\text{m}$; 86, ventral girdle scales, $40 \times 12 \mu\text{m}$, small ones $24 \times 5 \mu\text{m}$; 87, part of radula row; 87a, cusp of major lateral radula tooth.

Figs. 73-87, Horta, Faiál, Azores, Portugal, 11.X.1971, Exp. Jean Charcot Biaçãoes 1971, sta. L9, MNHN.

or less pointed calcareous corpuscles, about twice as long as wide, $56 \times 25 \mu\text{m}$ (fig. 82). Among them, intersegmental and dispersed at random, groups of several long, smooth, curved needles occur, up to $320 \mu\text{m}$ long (figs. 83, 84). There is a marginal fringe of long, straight, longitudinally sulcate, bluntly pointed spines, $\pm 175 \mu\text{m}$ long (fig. 85). Ventral scales about three times as long as wide, smooth, round at the base, conical at the top, arranged in close radiating rows, $40 \times 12 \mu\text{m}$. Among them smaller, relatively narrower scales are found, $24 \times 5 \mu\text{m}$ (fig. 86).

Rhachidian tooth of the radula poorly developed, distally gradually widening, with a small cusp; major lateral tooth with a tridental cusp, the central denticle hardly larger than the others (fig. 87).

Distribution. — *L. simrothi* is only known from the Azores: Flores, Faiál, Gomera, Terceira, Santa Maria, and São Miguel, where it appears to be a rather common littoral and sublittoral species. Geological distribution: Recent.

Discussion. — Thiele ranked this species, together with *L. corrugata*, in the subgenus *Middendorffia*, though the only resemblance is to be found in the insertion plates. Thiele did not mention the bunches of long spines on the perinotum, the only characteristic on which he later founded the genus *Mopaliella*.

L. simrothi is more closely related to *L. monterosatoi* nov. sp., from which it is recognizable by its smaller size, the indistinct lateral areas, and its colour, mostly roseate, but practically always marked with small green or bluish dots.

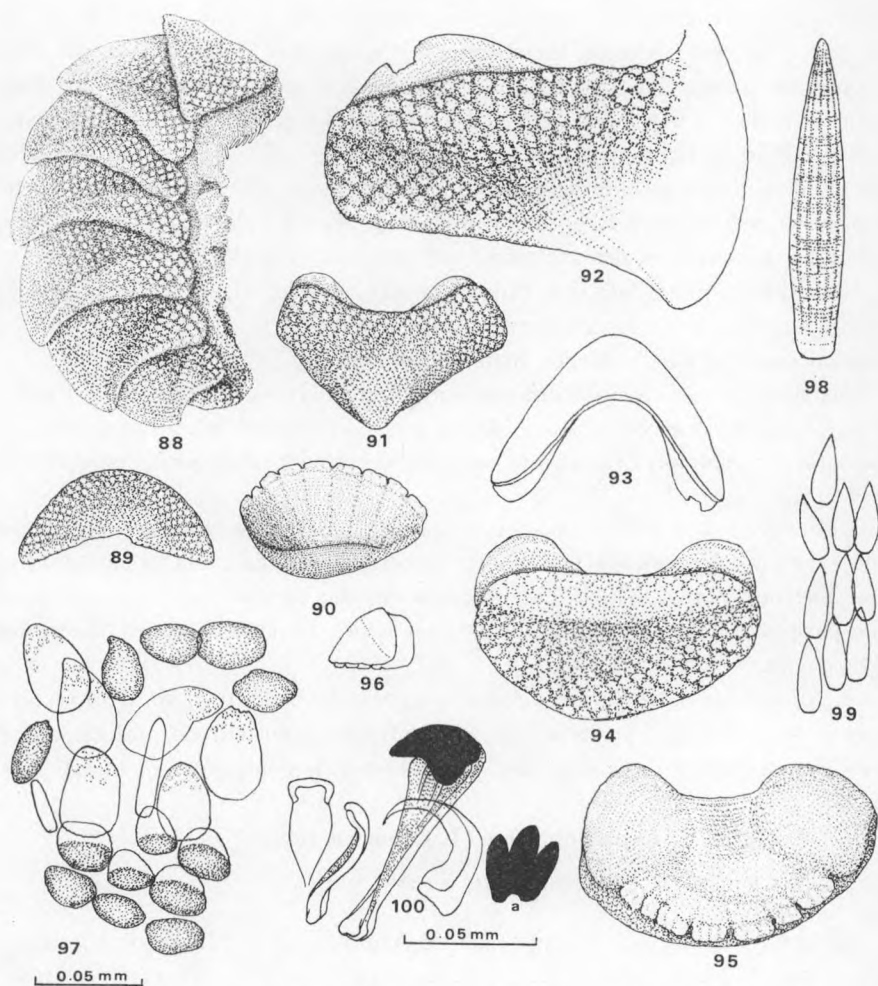
Lepidochitona (L.) iberica nov. sp.

(figs. 88-100, 128³; map 2)

Material examined. — Spain: Ria de Arosa, 1200 m NNW of El Grove, 15 m, maerl, 30.vii.1962, G. C. Cadée leg., sta. 1154, RMNH 55384/1 (holotype); RMNH 55385/2 (paratypes); MNHN/1 (paratype); K 4710/2 + 1 disarticulated (paratypes); VB 2765a/2 (paratypes).

Diagnosis. — Animal very small, oval, up to 3 mm long when stretched. Valves very highly arched, dorsal elevation 0.66, not carinated, strongly beaked, lateral areas raised. Tegmentum uniformly roseate, relatively coarsely granulated all over; the granules roundish, quincuncially arranged on the head valve, the post-mucronal area of the tail valve, the lateral areas and the jugal parts of the central areas; arranged in forwardly diverging, curved, longitudinal series on the pleurae of the central areas. Girdle narrow, with a fringe of long, striated spines (fig. 88).

Description. — Tegmentum coarsely granulose, the granules roundish



Figs. 88-100. *Lepidochitona (L.) iberica* nov. sp. 88, Whole specimen, $\times 17.5$; 89, valve I, dorsal view, $\times 17.5$; 90, ditto, ventral view, $\times 17.5$; 91, valve IV, dorsal view, $\times 17.5$; 92, left half of valve IV, $\times 35$; 93, ditto, anterior view, $\times 17.5$; 94, valve VIII, dorsal view, $\times 35$; 95, ditto, ventral view, $\times 35$; 96, ditto, lateral view, $\times 17.5$; 97, dorsal view of girdle, calcareous corpuscles $\pm 50 \times 30 \mu\text{m}$, spicules $48 \times 12 \mu\text{m}$; 98, marginal spine, $152 \times 26 \mu\text{m}$; 99, ventral girdle scales, $36 \times 12 \mu\text{m}$; 100, part of radula row; 100a, cusp of major lateral tooth.

Figs. 88-100, 1200 m NW of El Grove, Ria de Arosa, Coruña, Spain, at 15 m depth, G. C. Cadée leg., sta. 1154; 88, holotype, RMNH 55384; 89-100, paratype, K 4710.

oval, convex-topped (fig. 128³), very small, in quincunx on the jugal parts of the intermediate valves, larger towards the side margins, where they form longitudinal curved chains, diverging from the diagonal ridge, separating the lateral areas from the central area, towards the front margin, which is rather deeply concave. Head valve semi-circular, posterior margin almost straight, weakly notched at the top (fig. 89). Intermediate valves strongly beaked, widely V-shaped posteriorly, very highly arched, concave anteriorly, the lateral areas decidedly raised (figs. 91-93), side slopes a little convex. Tail valve much smaller than the head valve, nearly twice as wide as long, the mucro not prominent, before the centre, posterior slope steep, straight (figs. 94, 96).

Articulamentum white to somewhat roseate, glossy, the insertion plates short, roughened on the outside, with 8 fairly equidistant slits in the head valve (fig. 90), one slit on either side of the intermediate valves, the apophyses short, regularly curved, jugal sinus concave, about one third of the width of the valves; slit rays distinct, punctate. The tail valve has the insertion teeth much reduced, very blunt, roughened, a little forwardly directed. There are 7-8 slits, the slit rays short (fig. 95). Head valve and intermediate valves with a strong, broad callus. Eaves porous.

Girdle rather narrow, dorsally densely covered with oblong calcareous corpuscles of different forms and sizes. Generally they are somewhat oval in diameter, about 1.5-2 times as large as broad, slightly narrowing towards the base, the heads somewhat roughened, brownish or white, the largest about $50 \times 30 \mu\text{m}$ (fig. 97). Among them small, cylindrical, bluntly pointed spicules are found, solitary or in small groups, 30-50 μm long. There is a beautiful marginal fringe of stout, straight, longitudinally sulcate spines, $\pm 150 \times 25 \mu\text{m}$ (fig. 98). Ventral scales flat, wedge-shaped, rounded at the base, pointed at the top, about three times as long as wide, arranged in closely set radial rows (fig. 99).

Rhachidian tooth of the radula with a narrow, inflected cusp, the first lateral tooth narrow, weakly S-shaped, the major lateral tooth with a tridentate cusp, the denticles rather blunt, the central one slightly larger (figs. 100, 100a).

Distribution. — N.W. Spain: Ria de Arosa, sublittoral. Recent.

Discussion. — In May 1963 the senior author received for identification a collection of Polyplacophora, collected in 1962 by Mr G. C. Cadée at many stations in the Ria de Arosa. Among them were the 9 specimens described above, which were provisionally identified as juveniles of *Tonicella rubra* (L.), with which they bear a superficial resemblance. On second examination, however, they appeared to belong to an unknown species of *Lepidochitona*,

fairly closely related to *L. canariensis* (Thiele), from which they differ by the relatively finer granulation and much higher elevation, the raised lateral areas, V-shaped intermediate valves and differently shaped insertion teeth, especially in the tail valve, which are alike those of *corrugata* and *piceola*.

The specimens were dredged along with 1 specimen of *Leptochiton cancellatus* (Sowerby) and 6 specimens of *Acanthochitona crinita* (Pennant).

Lepidochitona (L.) stroemfelti (Bergenhayn, 1931)

(figs. 101-112, 128⁵; map 3)

Ischnochiton stroemfelti Bergenhayn, 1931: 11, pl. 1 figs. 14-16, pl. 2 figs. 52-56; Leloup, 1968: 18. Type: NHRM 1323.

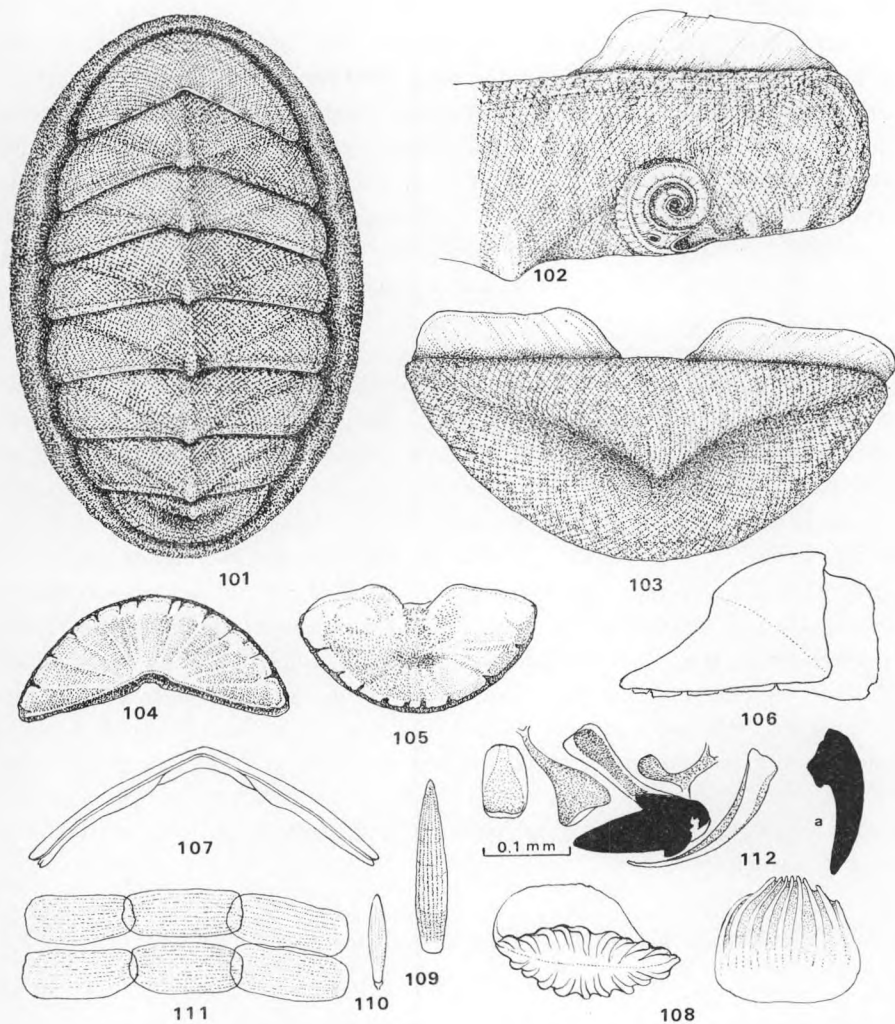
Material examined. — Canary Islands: Gran Canaria: San Augustin, intertidal, v.1971, F. Nolf leg., VB 2565a/many; K 4839/2; E. of San Augustin, beach with pebbles, 17.viii.1977, Cancap II: Tydeman Canary Ids. Exp., sta. K 5, RMNH/7; K 4876/2; Fuerteventura: N. of Punta Jandia, rocky littoral, 24-31.viii.1977, ditto, sta. K 11, RMNH/20; K 4877/4.

Description. — General aspect much like *L. cinerea* (L.). Animal of medium size, generally 12-18 mm long, maximum 24 × 15 mm, oval, moderately elevated, dorsal elevation 0.33, carinated, side slopes nearly straight (fig. 101). Colour generally greyish brown with almost imperceptible streaks of a lighter olivaceous hue, rarely a specimen has a lighter general shade and one specimen is of an outright orange brown tint.

Tegmentum evenly sculptured all over with fine, diamond-shaped granules arranged in crossing series so as to form a regular quincunx pattern (fig. 128⁵). Growth lines only discernible in large specimens. Head valve semi-circular in front, the posterior margin forming an obtuse entrant angle (fig. 104). Intermediate valves broadly rectangular, with a small but distinct apex, lateral areas hardly raised, separated from the central area by a weak diagonal fold (figs. 102, 107). Tail valve about two fifth of a circle, anterior margin straight, about twice as broad as long, the mucro rather sharp, not prominent, about central, postmucronal slope concave (figs. 103, 105, 106).

Articulamentum light bluish changing to roseate brown near the posterior part of the valves. Eaves spongy, insertion plates short, the head valve with 12-15 slits, intermediate valves with one slit on either side, posterior valve with 10-11 slits, the slit-rays clearly visible, the teeth a little roughened outside. Sutural laminae broadly rectangular, jugal sinus narrow, straight, one seventh to one sixth of the width of the valves.

Girdle dorsally clothed with slightly curved calcareous scales, a little wider than long, the base truncate, the top bluntly pointed, with about 8-10 riblets



Figs. 101-112. *Lepidochitona (L.) stroemfelti* (Bergenhayn, 1931). 101, Whole specimen, $\times 3.5$; 102, part of valve IV, $\times 8.4$; 103, valve VIII, dorsal view, $\times 8.4$; 104, valve I, ventral view, $\times 4.2$; 105, valve VIII, ventral view, $\times 4.2$; 106, ditto, lateral view, $\times 8.4$; 107, valve IV, anterior view, $\times 4.2$; 108, dorsal girdle scales, $\pm 72 \times 64 \mu\text{m}$; 109, marginal spine, $132 \times 24 \mu\text{m}$; 110, dorsal spicule, $25 \times 8 \mu\text{m}$; 111, ventral scales, $44 \times 18 \mu\text{m}$; 112, part of half radula row; 112a, cusp of major lateral tooth.

Figs. 101-112, San Augustin, Gran Canaria, Canary Is., Spain, V.1971, F. Nolf leg., VB 2565.

dentating the top of the scale, which measures about $70 \times 60 \mu\text{m}$. They are arranged in oblique series, hardly or not imbricating, becoming smaller towards the outer margin (fig. 108). Among them very small, weakly striate spicules are found, solitary or in pairs, about $25 \mu\text{m}$ long, sheathed in short chitinous cups (fig. 110). There is a marginal fringe of conical, pointed, longitudinally striate spines, about $130 \times 20 \mu\text{m}$ (fig. 109). Ventral scales rectangular, inconspicuously striate, $\pm 45 \times 20 \mu\text{m}$, arranged in radiating rows (fig. 111).

Rhachis of the radula rectangular, hardly twice as long as wide, with a very narrow inflected cusp, the major lateral tooth with a long, narrow, tridentate cusp, the central denticle long and rather sharply pointed, the side denticles very short, blunt (figs. 112, 112a).

Distribution. — *L. stroemfelti* is an endemic species, restricted to the Canary Islands, where it originally was found at Puerto Cabras in the isle of Fuerteventura, on stones at low water mark. Afterwards it was collected in Gran Canaria by Mr. F. Nolf, and by the Cancap II: Tydeman Exp., also intertidal. Geological distribution: Recent.

Discussion. — It is with much hesitation that we include *Ischnochiton stroemfelti* Bergenhayn into the genus *Lepidochitona*. In fact many characteristics are typical ischnochitonoid, as there are the rectangular shape of the ventral girdle scales, the radula, the number of slits in the anterior valve, the flat, curved, dorsal girdle scales, and the shape of the apophyses. On the other hand there are a number of facts pleading in favour of *Lepidochitona*, such as the possession of small spicules disposed at random amongst the dorsal girdle scales, which are not imbricating, the decidedly porous tegmentum, the short, somewhat rugose insertion teeth, and the uniform granulation of the tegmentum.

Lepidochitona* (L.) *furtiva (Di Monterosato, 1872)

(figs. 113-127; map 3)

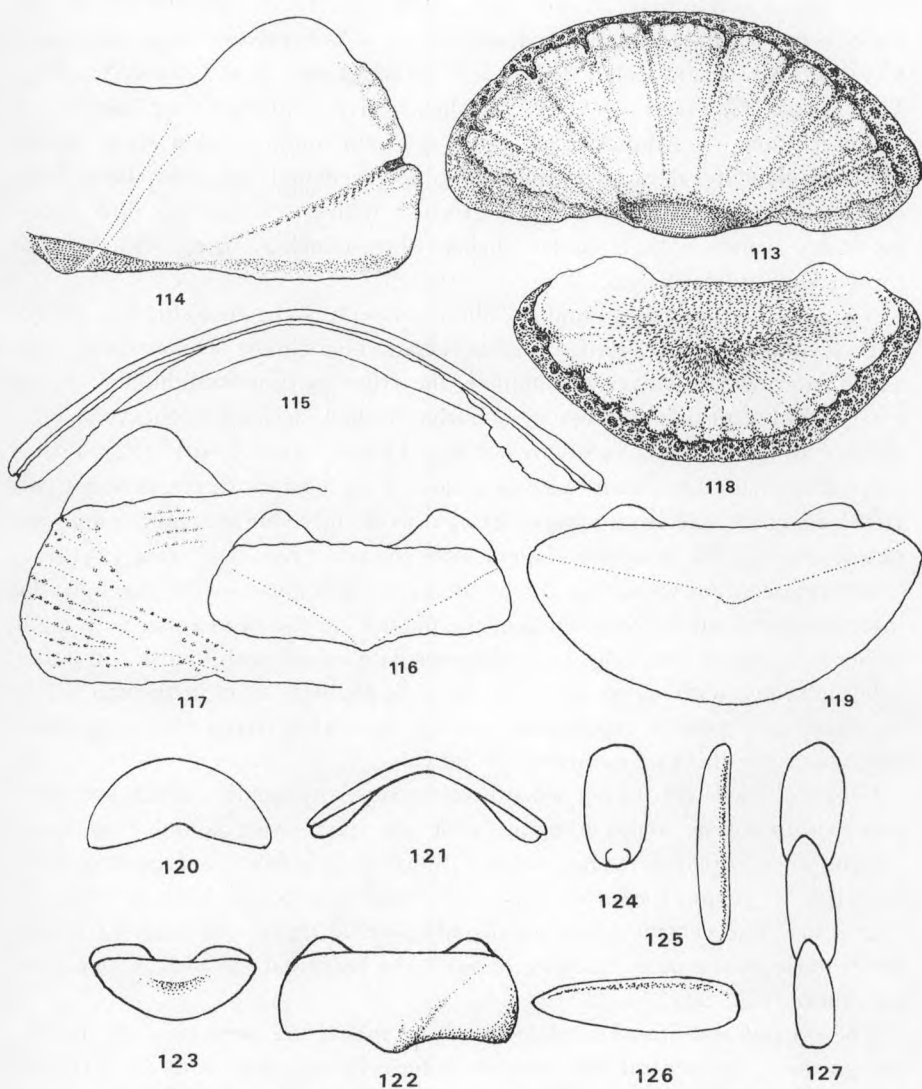
Chiton ruber (L.) Lowe, var. *furtivus* Di Monterosato, 1872: 29; 1875: 21. Type unknown.

Chiton furtivus; Aradas & Benoit, 1874: 312; Di Monterosato, 1878: 147; 1878a: 77; Tiberi, 1878: 150, 157; Di Monterosato, 1879: 11; Paetel, 1887: 612; Carus, 1889: 179; Pilsbry, 1893: 95; Sabelli, 1974: 74 [in synonymy of *Tonicella rubra* (Linnaeus, 1767)].

Chiton (? *Ischnochiton*) *furtivus*; Pallary, 1900: 366.

Trachydermon furtivus; Thiele, 1909: 15, pl. 2 figs. 6-13.

Material examined. — Sicilia: Palermo, Coll. Locard, ex coll. Di Monterosato, MNHN/1 specimen dry, $4.6 \times 2.8 \text{ mm}$; Palermo, ex coll. Di Monterosato, ZMHU 83311/2, dry, broken; 1 head valve, 1 intermediate valve,



Figs. 113-127. *Lepidochitona* (*L.*) *furtiva* (Di Monterosato, 1872) 113, Valve I, ventral view, $\times 32.5$; 114, part of an intermediate valve, ventral view, $\times 32.5$; 115, intermediate valve, anterior view, $\times 32.5$; 116, ditto, dorsal view, $\times 16.3$; 117, ditto, left half, $\times 32.5$; 118, valve VIII, ventral view, $\times 32.5$; 119, ditto, dorsal view, $\times 32.5$; 120, valve I, $\pm \times 12$; 121, valve V, anterior view, $\pm \times 12$; 122, ditto, dorsal view, $\pm \times 12$; 123, valve VIII, dorsal view, $\pm \times 12$; 124, dorsal girdle scale, $\pm 50 \mu\text{m}$ long; 125, dorsal girdle spicule, $\pm 70 \mu\text{m}$ long; 126, marginal spicule, $\pm 70 \mu\text{m}$ long; 127, ventral girdle scales, $\pm 40\text{-}50 \mu\text{m}$ long.

Figs. 113-119, Marzameni, Siracusa, Sicilia, Italy, 12.IX.1969, A. Verduin leg., coll. Verduin 0188. Figs. 120-127, Near Palermo, Sicilia, Italy, Di Monterosato leg., ZMHU 83311 (after Thiele, 1909).

1 tail valve; Marzameni, in shell sand, 12.ix.1969, Ir. A. Verduin leg. et coll. 0188/1 head valve, 16 intermediate valves, 2 tail valves (figs. 113-119); Corsica: WNW. of Calvi, 42°38'N 8°50'E, 35 m., 24.vi.1979, Wet. Exp. Univ. Luik (G. Poppe), VB 2727a/1 head valve, 2 intermediate valves.

Description. — Animal small, up to 7.5 mm long, 4.5 mm wide, rather flat and elongate, dorsal elevation 0.29, not carinated, the side slopes little convex. Colour variable, often pale greenish with roseate spots; other specimens are brown with irregular chalky white blotches, often with reddish brown longitudinal bands.

Tegmentum minutely granulate, almost smooth, somewhat shining, always with several concentric growth marks. Head valve almost semi-circular (fig. 120); intermediate valves rectangular, the front margin straight, the hinder margin with a pronounced apex, somewhat beaked, decidedly concave at both sides of it, lateral areas hardly or not raised (figs. 114-117, 121, 122). Posterior valve small, more than twice as wide as long, posterior margin about two fifth of a circle, the front margin straight to slightly concave, mucro anterior not prominent, the posterior slope a little concave (figs. 118, 119, 123).

Articulamentum white, the colour of the tegmentum showing through, the insertion plates short, roughened at the outside, in the head valve with eight rather equidistant slits (fig. 113). Intermediate valves with one slit on either side, tail valve with 10-13 slits, the slit rays distinct, short in the tail valve, the eaves very porous. Apophyses narrow, somewhat triangular, jugal sinus flat, about one third of the width of the valve.

Girdle clothed with rather smooth calcareous corpuscles, which are elongate oval in outline, about 20-25 μm wide and about twice as long (fig. 124). Among them isolated, rather large cylindrical spicules are found, distally rounded, $\pm 70 \mu\text{m}$ long (fig. 125). Marginal spicules as long, but thicker (fig. 126). The ventral scales are distally pointed, $\pm 40 \mu\text{m}$ long, 12-15 μm wide, those at the outer margin, beneath the marginal spicules, wider than the others (fig. 127).

The central and first lateral teeth of the radula are very thin and hardly recognizable, the central one narrow, anteriorly widened, with an inflected cusp, the anterior margin a little convex; first lateral very thin anteriorly, without an inflected cusp; major lateral with a tridentate cusp, the denticles about equal, short, bluntly rounded. Cusp of the minor lateral entire (Thiele, 1909).

Distribution. — Italy, Sicilia: near Palermo, in 20-30 m (Di Monterosato), Marzameni, loose valves in shell-sand (Verduin); Corsica: off Calvi, loose valves (G. Poppe); Algeria: Oran (Pallary). Geological distribution: Recent.

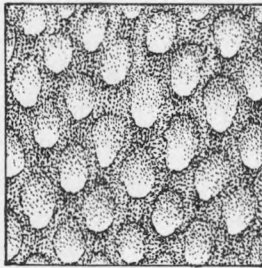
Discussion: Our description is for the greater part drawn from those of Di Monterosato (1879: 11), and Thiele (1909: 15), amplified by observations of our own.

L. furtiva was originally named by Di Monterosato (1872: 29) as a variety of *Tonicella rubra* (Linnaeus, 1767), without any description. The type lot consists of about 50 specimens, dredged alive at various occasions by fishermen in the neighbourhood of Palermo from a depth of 20 to 30 m. Di Monterosato reconsidered its status in 1878 (p. 147) when he wrote: "petite espèce qui a quelque analogie avec le *C. ruber* des Anglais, au point de vue du bord. Par les autres caractères et, notamment, par la coloration, il en diffère sensiblement." In 1879 (p. 11) the author supplies a short description, but only Thiele (1909: 15, pl. 2 figs. 6-13), to whom Di Monterosato had sent a few specimens, gave a full description and illustrations, not only of the valves, but also of the girdle elements and the radula, ranking it with *Trachydermon* (= *Lepidochitona*, ex parte).

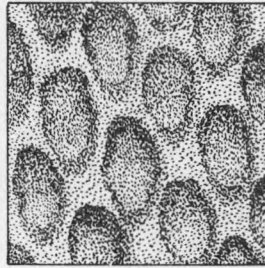
Since then the species has never been rediscovered, for all records in literature only refer to the original material of Di Monterosato. Sabelli (1974: 14) still believes that *C. furtivus* should be synonymized with *T. rubra*, but that species only inhabits the northern Atlantic and has never been found south of Great Britain and Ireland. Apart from that Di Monterosato's original supposition is quite conceivable, as *L. furtiva* is almost as smooth as *T. rubra*, its colour pattern is sometimes alike, and it always shows a series of growth lines, often visible as concentric riblets, on the intermediate valves, just as in *T. rubra*.

The structure of the valves, especially of the insertion plates, and the totally different perinotum elements, as they were shown by Thiele, reveal, however, that *L. furtiva* is a true *Lepidochitona*, related to *cinerea*, *canariensis*, and *iberica*, from which it is easily recognizable by its smooth, depressed valves, the anterior position of the mucro in the tail valve, its small size, and inconspicuous lateral areas.

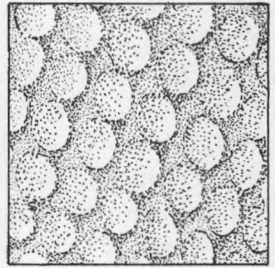
We were lucky enough to have an opportunity to study a lot of loose valves of this species, collected in 1969 by Ir. A. Verduin in shell sand from the beach of a small bay, some 5 km north of Marzameni, on the southeast coast of Sicilia, of which we pictured the only head valve, a tail valve and an intermediate valve (figs. 113-119). Although all the valves are more or less worn beach shells, they could easily be recognized as belonging to *L. furtiva*, corresponding in all respects to the given descriptions and to Thiele's figures (reproduced in figs. 120-123). The intermediate valve we figured (figs. 115-117) is less worn than the others, though the places of the original aesthetes are shown by series of small punctures, especially on the lateral



1° CINEREA w 8.7



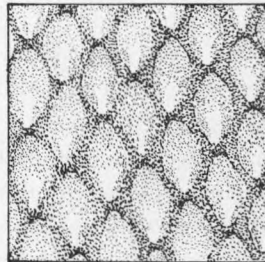
2° CANARIENSIS w 4.5



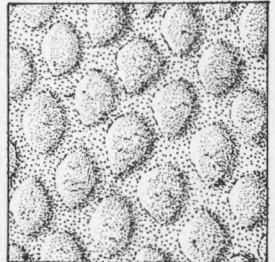
3° IBERICA w 1.8



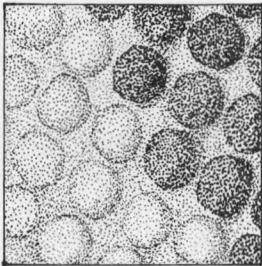
4° FURTIVA



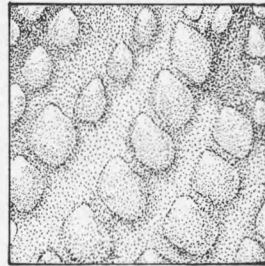
5° STROEMFELTI w 10.3



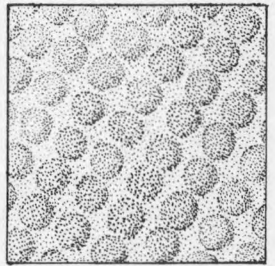
6° CORRUGATA w 5.1



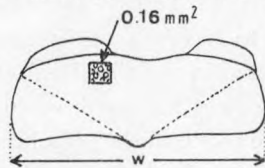
7° PICEOLA w 3.8



8° MONTEROSATOI w 3.4



9° SIMROTHI w 2.4



w = width of valve IV in mm

Fig. 128. Sculpture on the central area of valve IV of all species (somewhat idealized),
 X 85.

areas, fig. 117). This valve only shows a small apex, whereas all the other intermediate valves are rather strongly beaked.

After the manuscript was finished we received on loan two specimens and some loose valves of *L. furtiva* which are kept in the ZMHU, Berlin, by courtesy of Dr. R. Kiliias, whom we are greatly indebted. Almost simultaneously we had an opportunity to study another specimen, from the collection of A. Locard in the MNHN, Paris, for which we thank Dr. Ph. Bouchet of the Laboratoire de Malacologie of that institution. All these specimens once formed part of the original lot sampled at Palermo by Di Monterosato. We can only conclude that they are in perfect concordance with the description given above.

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