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Two new species of Lepidochitona Gray, 1821 (Polyplacophora: Ischnochitonidae) from Senegal and the Cabo Verde Archipelago

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For several years a few lots of *Lepidochitona* specimens from Senegal and from the Cabo Verde Archipelago in the Muséum National d'Histoire Naturelle (Paris), sent by Dr. Philippe Bouchet to the senior author (PK), as well as several other lots from the Cabo Verde Archipelago in the hands of the junior author (HLS), mostly collected by Dr. E. Rolan (Vigo, Spain), have defied identification with any known *Lepidochitona* species in the eastern Atlantic Ocean. The authors have now decided to describe this material as two species new to science.

Abbreviations. — IECI = I Expedición Cientifica Iberica al Archipielago de Cabo Verde; IFAN = Institut Fondamental de l'Afrique Noire, Dakar, Senegal; IICT = Instituto de Investigação Científica Tropical, Centro de Zoologia, Lisboa, Portugal; ITZ = Instituut voor Taxonomische Zoölogie (Zoölogisch Museum), Amsterdam; K = private collection of P. Kaas, now in RMNH, Leiden; MGMV = Museo Galego do Mar, Vigo, Spain; MNCN = Museo Nacional de Ciencias Naturales, Madrid; MNHN = Muséum National d'Histoire Naturelle, Laboratoire des Invertébrés Marins et de Malacologie, Paris; R = private collection of Dr. E. Rolan, Vigo, Galicia, Spain; RMNH = Rijksmuseum van Natuurlijke Historie, Leiden; S = private collection of H.L. Strack, Rotterdam; v = loose valve(s); VB = private collection of R.A. Van Belle, Sint-Niklaas, Belgium.

Lepidochitona (Lepidochitona) caboverdensis spec. nov. (figs. 1-15)

Type material. — Dakar, Senegal, 1942, M. Nicklès (IFAN) leg., MNHN, holotype 5.8 × 3.2 mm, preserved dry (fig. 2). Paratypes (if not otherwise stated, preserved in alcohol): Senegal: Dakar, 1942, M. Nicklès leg., MNHN/2 dry, RMNH K 5091/2 dry; Cap Vert, Pointe des Almadies, low tide, on calcareous algae, 30.VIII.1973, IFAN don., RMNH K 4940/2 dry. Cabo Verde Archipelago: Santa Luzia, Curral, c. 4 m, VIII.1981, E. Rolan leg., R 14400/1 dry; Santa Luzia, Agua Doce, c. 2-5 m, 19.VIII.1985, IECI leg., MNCN/1; São Vicente, Matiota, c. 0.5-4 m, 1980-1981, E. Rolan leg., R 12444/2 dry, S 931/5 dry, VB 2942a/1 dry; São Vicente, Calhão, on living *Thais nodosa*, intertidal, 17.VIII.1985, IECI leg., MNCN/2; São Vicente, Baía das Gatas, exposed rocky shore, 22.VI.1982, Cancap VI Expedition leg., Sta. 6.K21, RMNH/4; Boavista, Sal Rei, in shell sand, c. 0.5 m, 24-26.VIII.1985, IECI leg., MNCN/7v, S 936/2v; Branco, in shell sand, c. 25 m, 23.VIII.1985, IECI leg., MNCN/1v; Sal, Palmeira, Mordeira & Calhetinha, under stones, c. 1-2 m, VIII.1978, E. Rolan leg., R 7169/7 dry, S 932/7 dry; Sal, Palmeira, under stone on sand bottom, c 3 m, 9-10.VIII.1985, IECI leg., MGMV/1; do, on *Conus*, c. 4 m, 9-10.VIII.1985, IECI leg., MNCN/4 dry; do, in shell sand, c. 10-15 m, 9-10.VIII.1985, MNCN/1v; Sal, Mordeira, on *Conus cuneolus*, c. 3 m, 7-10.VIII.1985, IECI leg.,MNCN/1; Sal, Parda, on *Conus cuneolus*, c. 2-3 m, 12.VIII.1985,

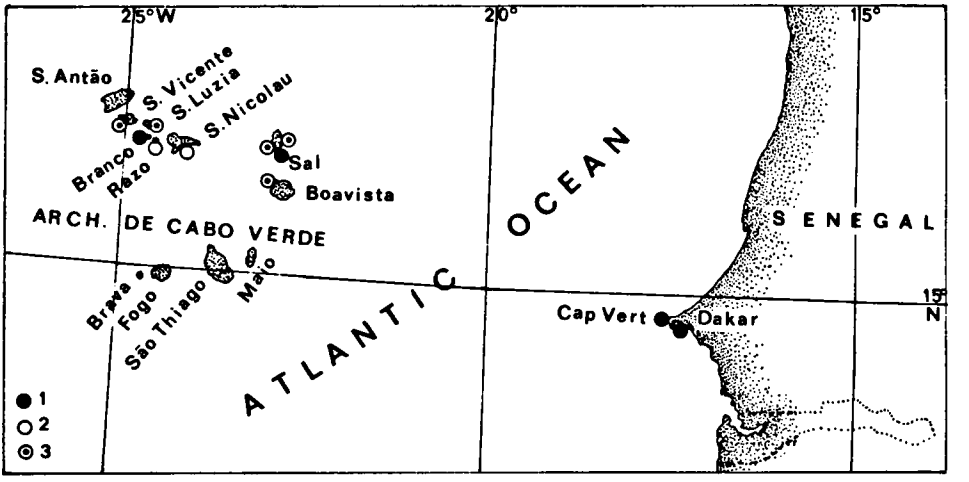


Fig. 1. Distribution of 1, *Lepidochitona caboverdensis* spec. nov., 2, *Lepidochitona rolani* spec. nov., 3, both species.

IECI leg., MNCN/4, S 933/2; Sal, Fontona, on *Conus* and under stones on sand bottom, c. 2-4 m, 13.VIII.1985, IECI leg., IICT/2, S 934/4; Sal, Rigona, on *Conus cuneolus*, c. 0.5 m, 9-10.VIII.1985, IECI leg., MNCN/3, S 943/1; do, in shell sand, c. 1 m, 9-10.VIII.1985, IECI leg., MNCN/3v; do, in shell sand, c. 10 m, 9-10.VIII.1985, IECI leg., MNCN/95v, S 937/18v; Sal, Punta Preta, in shell sand, c. 0.5-1 m, 6.VIII.1985, IECI leg., MNCN/13v; Sal, Joaquín Petinha, c. 2-3 m, 8.VIII.1985, IECI leg., IICT/2; Sal, Santa Maria, 18.VI.1955, J. Cadenat leg., MNHN/4 dry, RMNH K 5090/2 dry; do, under stone on sand bottom, c. 1-2 m, 11-12.VIII.1985, IECI leg., S 935/1; Sal, Pesqueiro do Aires, on small *Conus* shells, c. 0.5 m, VIII.1985, IECI leg., MNCN/1.

Diagnosis. — Animal small, up to 12 mm long, 7 mm wide, elongate oval, moderately elevated, back regularly arched, side slopes convex. Lateral areas of intermediate valves hardly raised, the valves slightly beaked. Tail valve more than twice as wide as long, the mucro about central, post-mucronal slope straight to a little convex. Tegmentum finely and regularly quincuncially granulated, either uniformly dark brown, or dark brown with cream spots, sometimes the cream colour predominates, but then the back with two brown stripes. Articulamentum rather thick, bluish to brownish grey; apophyses triangular in II, trapezoid in III-VIII, sinus wide, flat to somewhat convex. Insertion plates short, blunt, somewhat roughened outside, with 8-11/1/8-12 slits, slit-rays distinct. Eaves porous. Girdle narrow, clothed with juxtaposed, cylindrical, longitudinally grooved, bluntly pointed spicules, interspersed with slender, whitish needles. Radula with a tricuspid head on the major lateral tooth, the denticles short, bluntly rounded.

Description. — Animal small, generally 5-8 mm long, largest specimen observed measuring 12 × 7 mm, oval to elongate oval, the width c. 55% of the length. Young specimens little elevated, the back rounded, dorsal elevation c. 0.20, larger specimens tend to be more elevated and subcarinated, dorsal elevation c. 0.20-0.40 (fig. 6); side slopes convex.

Head valve (fig. 3) semicircular, posterior margin widely V-shaped, notched at the apex. Intermediate valves rectangular, the length about 36% of the width in valves III-VI (fig. 5); valve II (fig. 4) relatively much longer than the others. Anterior margin straight to somewhat concave, except at the jugal sinus, which is slightly convex. Posterior margin a little concave at both sides of the slightly beaked apices. Lateral areas weakly raised in II-IV, hardly or not in V-VII. Length of the tail valve 45% of the breadth (figs. 7-8), posterior margin one third of a circle, anterior margin about straight; mucro small, not swollen, in young specimens slightly anterior, in older ones central; posterior slope straight to little convex.

Tegmentum very finely granulated all over in quincunx, the granules roundish to oval, well separated, hardly rising above the surface. Lateral areas and end valves with several well marked growth-lines, some of which crossing the central areas. Large specimens from Santa Maria, Sal, Cabo Verde Archipelago, show 23-30 very fine radial riblets on the head valve, 3-5 on the lateral areas and 20-30 on the post-mucronal area of the tail valve. Two specimens with more pronounced sculpture show c. 10 short longitudinal series of larger and more elevated granules on the pleural areas, just before the diagonal lines. Colour of the tegmentum mostly dark brown, either uniformly or variegated with cream spots on some or all of the valves. In other specimens the cream colour predominates, but then there are two brown stripes on the jugum.

Articulamentum rather strongly developed, insertion plates short, with 8-11/1/8-12 slits, the teeth blunt, a little roughened outside, slit-rays distinct, finely porous; jugal area not porous. Apophyses triangular in valve II, trapezoid in II-VIII, jugal sinus rather wide, more or less convex. Colour of the articulamentum bluish grey at the apophyses, becoming brownish towards the apex and the posterior margin. Eaves very finely porous.

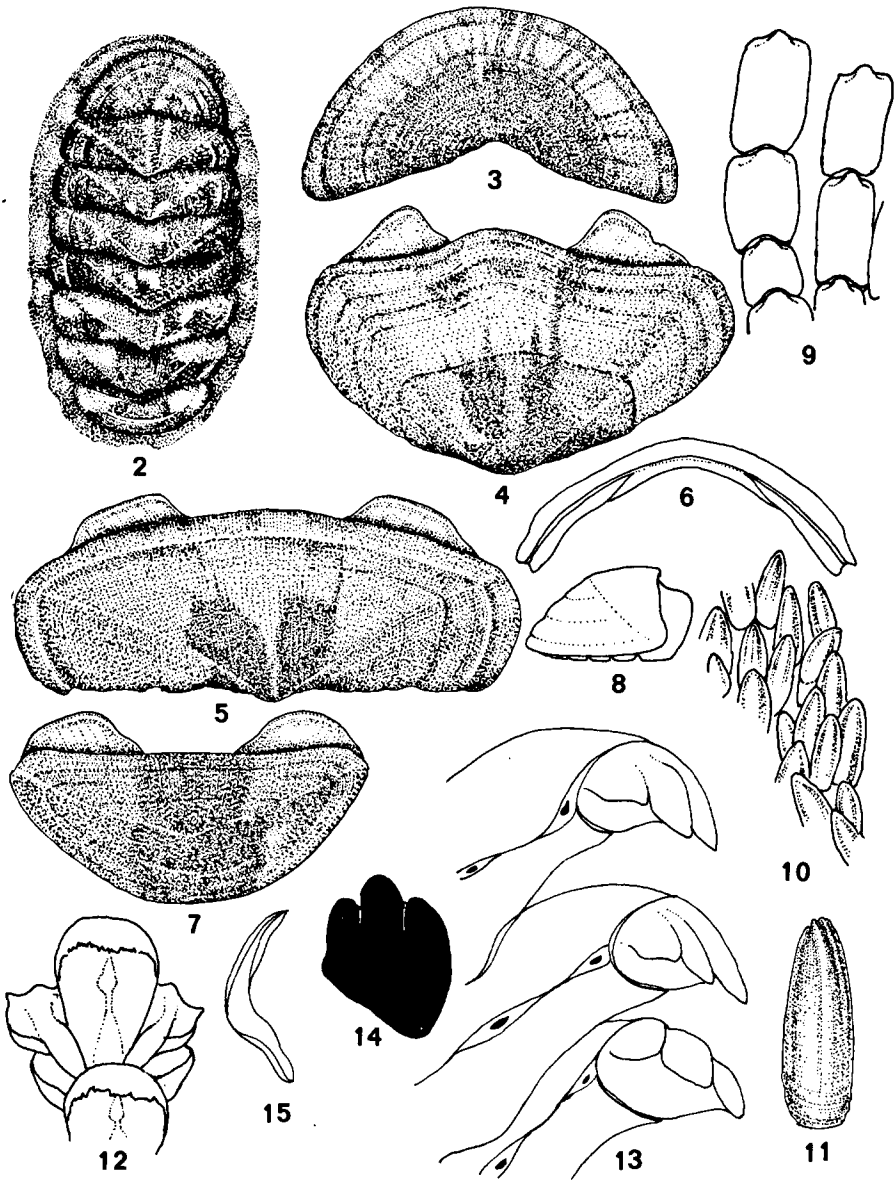
Girdle rather narrow, dark brown, sometimes with lighter bands, dorsally densely clothed with juxtaposed, elongate, bluntly pointed, yellowish brown spicules, generally 50 µm long, 12 µm thick, up to 60 × 25 µm, invariably ornamented with 3-5 longitudinal sulci on the visible side (fig. 10); the intersegmental spicules larger, blunt and only weakly grooved (fig. 11). They are interspersed with white, slightly bent, smooth, slender and sharply pointed needles, 88-100 µm long, 10 µm thick. Ventrally the girdle is covered with close-set transverse rows of imbricating, flat, white scales, distally very bluntly pointed, somewhat emarginate at the base, c. 44 × 22 µm on mid-girdle, shorter towards the inner, longer towards the outer margin (fig. 9). There is a fringe of marginal spicules, 70-90 µm long, 20 µm thick, more or less torpedo-shaped, with 3 or 5 riblets of which the median one is most pronounced; they are only present in juvenile specimens.

Gills holobranchial, abanal, with 18-22 ctenidia on both sides.

Radula (figs. 12-15) with the central tooth ovoid, bearing a decidedly recurved, half oval blade, longer than wide; first lateral teeth without a blade, distally somewhat bifurcating, with a short exterior appendix; major laterals with a tricuspid blade, the denticles short, blunt, the central one somewhat longer than the others.

Distribution. — *L. caboverdensis* seems to be restricted to the coast of Senegal and the Cabo Verde Archipelago (fig. 1).

Habitat. — Under stones, in rock crevices and on living *Conus* and *Thais* shells, mostly found in the sublittoral zone from just below LWM to a depth of c. 4 m. Loose valves are common in depths up to 10 m, occasionally even deeper.



Figs. 2-15. *Lepidochitona* (*Lepidochitona*) *caboverdensis* spec. nov. 2, complete specimen (holotype), dorsal view, × 9.6; 3-15, disarticulated paratype from Sta. Maria, Ilha do Sal, Cabo Verde Archipelago, 18.VI.1955, J. Cadenat (IFAN) leg., MNHN: 3, valve I, dorsal view, × 14; 4, valve II, dorsal view, × 14; 5, valve IV, dorsal view, × 14; 6, do,, camera lucida sketch, rostral view, × 10; 7, valve VIII, dorsal view, × 14; 8, do., camera lucida sketch, lateral view, × 10; 9, ventral girdle scales, × 200; 10, dorsal spicules, × 200; 11, isolated spicule from perinotum tongue, × 340; 12, central and first lateral radula teeth, × 280; 13, major lateral teeth in situ, × 280; 14, head of major lateral tooth, × 280; 15, spatulate uncinal tooth, × 280.

Biology. — Four specimens from four localities have been found with clusters of eggs in the branchial grooves; no metamorphosed young have been observed. Obviously *L. caboverdensis* is a brooder, like the Mediterranean *L. corrugata* (Reeve, 1848) and some species on the west coast of the United States (vide Eernisse, 1986).

Observations. — *L. caboverdensis* differs from all other species of *Lepidochitona* known from the eastern Atlantic. *L. canariensis* (Thiele, 1909) from the Canary Islands differs from it in the much coarser granulation of the tegmentum, and, especially, in the covering of the girdle and in the radula, which has a tricuspid head with sharply pointed denticles. *L. stroemfelti* (Bergenhayn, 1931), also endemic to the Canary Islands, has much in common with *Ischnochiton* s.s., especially in its girdle covering, which is scaly instead of spiculose. *L. piceola* (Shuttleworth, 1853) has a much wider girdle, covered with densely striated spicules.

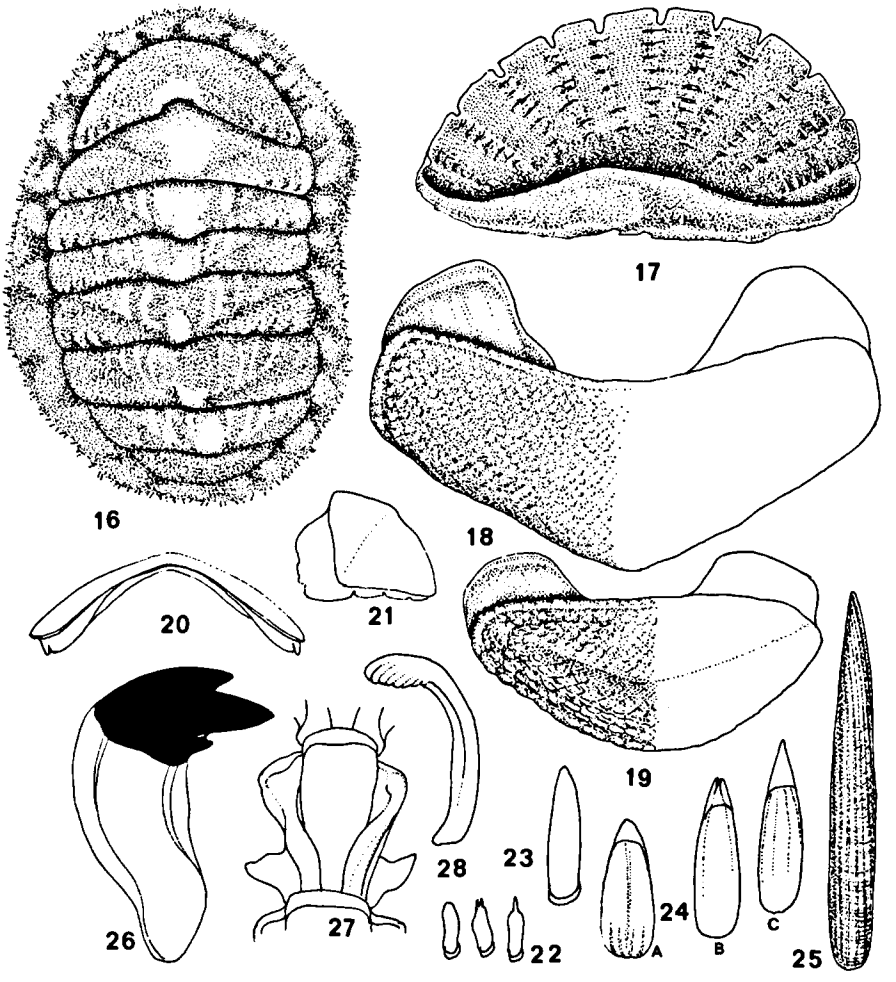
The record of *L. canariensis* from the Cabo Verde Archipelago (Leloup, 1968: 10; Kaas & Van Belle, 1981: 14, and 1985: 97) most probably refers to *L. caboverdensis*. *L. canariensis* has never been encountered south of the Canary Islands.

Lepidochitona (Lepidochitona) rolani spec. nov. (figs. 1, 16-28)

Type material. — Cabo Verde Archipelago, São Vicente, Calhão, on *Thais nodosa*, intertidal, 17.VIII.1985, IECI leg., MNCN, holotype, preserved dry. Paratypes (if not otherwise stated preserved in alcohol): Cabo Verde Archipelago: São Vicente, Calhão, on *Thais nodosa*, intertidal, 17.VIII.1985, IECI leg., MNCN/1, RMNH/1, dry (fig. 16); São Vicente, Matiota, c. 0.5-4 m, 1980-1981, E. Rolan leg., R 14400/1 dry, S 1026/1 dry; Sal, Mordeira, on *Conus* sp., c. 3 m, 7-10.VIII.1985, IECI leg., MNCN/1; Sal, Palmeira, on *Conus* sp., c. 3 m, 9-10.VIII.1985, IECI leg., IICT/1 dry; Sal, Praia do Cascalho, 2-4 m, 19.I.1986, J. Vermeulen leg., ITZ/5v; Sal, Rigona, in shell sand, c. 1 m, 9-10.VIII.1985, IECI leg., MGMV/7v; do., in shell sand, c. 10 m, 9-10.VIII.1985, IECI leg., MNCN/180v, S 1027/30v; Sal, Punta Preta, in shell sand, c. 0.5-1 m, 6.VIII.1985, IECI leg., MNCN/16v; Boavista, Sal Rei, in shell sand, c. 0.5 m, 24-26.VIII.1985, IECI leg., MNCN/15v; do., in shell sand, c. 4 m, 24-26.VIII.1985, IECI leg., MNCN/1v; São Nicolau, Tarrafal, in shell sand, c. 4 m, 23.VIII.1985, IECI leg., MNCN/1v; do., in shell sand, c. 10 m, 23.VIII.1985, IECI leg., MNCN/2v; Santa Luzia, on *Fissurella alabastrites*, VIII.1981, E. Rolan leg., VB 2943a/1 dry; SW coast of Ilha Razo, rocky littoral, 15.VI.1982, Cancap VI Expedition leg., Sta. 6.K.13, RMNH/2; without exact locality and date, on *Thais nodosa*, E. Rolan leg., R/1 dry, S 1037/1 dry.

Diagnosis. — Animal very small, up to 5 mm long, 3 mm wide, oval, little elevated, back regularly arched, side slopes convex, lateral areas not raised, the valves not or slightly beaked. Tail valve more than twice as wide as long, the mucro about central, postmucronal slope straight to little convex. Tegmentum regularly quincuncially granulated, whitish variegated with pink, red or brown. Articulamentum rather thick, whitish; apophyses triangular in valves II-IV, more or less trapezoid in V-VIII, sinus wide, concave to straight. Insertion teeth blunt, roughened outside, with 8-10/1/6-9 slits, slit-rays distinct. Eaves porous. Girdle narrow, dorsally clothed with juxtaposed cylindrical, smooth or distally sulcate, round-topped to pointed spicules, interspersed with slender, bluntly pointed needles. Radula with a tricuspid head on the major lateral tooth, denticles short, central one longer than the others.

Description. — Animal (fig. 16) very small, usually 4 mm long, largest specimen observed 4.8 × 2.8 (according to sizes of loose valves the maximum length may be estimated to about 6 mm), oval, little elevated (dorsal elevation 0.26-0.33), back rounded, side slopes convex (fig. 20).



Figs. 16-28, *Lepidochitona* (*Lepidochitona*) *rolani* spec. nov. 16, complete specimen (3.5 × 2.4 mm) from Calhão, São Vicente, Cabo Verde Archipelago, intertidal, 17.VIII.1985, E. Rolan leg., RMNH (paratype); 17-28, disarticulated paratype from Batiota, São Vicente, Cabo Verde Archipelago, 0.5-4 m, 1980-81, E. Rolan leg., S 1026; 17, valve I, ventral view, × 37.5; 18, valve IV, dorsal view, × 37.5; 19, valve VIII, dorsal view, × 37.5; 20, camera lucida sketch of valve IV, rostral view, × 37.5; 21, do., valve VIII, lateral view, × 37.5; 22, dorsal girdle spicules, × 375; 23, do., occasional large spicule, × 375; 24, ventral spicules-scales, × 750, A near inner margin, B from mid-girdle, C near outer margin; 25, marginal spicule, × 280; 26, major lateral radula tooth, × 375; 27, central and first lateral radula teeth, × 375; 28, spatulate uncinal tooth, × 375.

Head valve semicircular, posterior margin widely V-shaped. Intermediate valves rectangular, with a small apex in unworn specimens, anterior margin of valves III-VI concave, lateral areas poorly defined (fig. 18), only in valve II weakly raised. Tail valve (figs. 19, 21) rather small, width about 78-88% of that of the head valve, the length 40-46% of the breadth, mucro ill marked, about central, postmucronal slope straight to little convex.

Tegmentum finely granulated all over in quincunx, granules round, convex. Colour of tegmentum whitish variegated or lengthwise striped with pink, red or brown; sometimes these colours predominating, rarely with a few little blue spots.

Articulamentum rather thick, white, insertion plates with blunt teeth, roughened outside. Slit formula 8-10/1/6-9; about 80% of all studied head and tail valves (N = 50) correspond with a slit formula of 9/1/7, slit-rays distinct, not or finely porous. The head (fig. 17) and intermediate valves with a strong callus. Apophyses triangular in valves II-IV, trapezoid in V-VIII, jugal sinus wide, concave to straight. Eaves finely porous.

Girdle narrow, whitish with pink bands, dorsally clothed with juxtaposed, cylindrical, smooth or distally sulcate, more or less pointed spicules, usually about 25 × 12 µm (range c. 20-35 × 10-14 µm) (fig. 22), occasionally interspersed with straight or slightly bent, smooth, bluntly pointed needles, c. 50 µm long, 7-10 µm thick (fig. 23). Ventrally the girdle is covered with close set spicules-scales, round at the base, pointed at the top, slightly striated, usually about 30 × 10 µm (range c. 20-40 × 10-12 µm) (fig. 24A-C). There is a fringe of straight, longitudinally grooved spines, about 90-130 µm long, 18-22 µm in diameter (fig. 25).

Gills holobranchial, abanal, with 10-12 ctenidia on each side.

Central tooth of the radula (figs. 26-28) rectangular, twice as long as wide, with a slightly convex blade. First laterals rather narrow, embracing the central tooth, with a small blade and a triangular, wing-like projection towards the base. Major laterals with a tridentate head, the denticles sharp, the central one longest; spatulate uncinal teeth with a small, pectinate blade.

Distribution. — *L. rolani* has hitherto only been found in the Cabo Verde Archipelago (fig. 1).

Habitat. — On shells (*Conus, Thais, Fissurella*) and probably under stones and in rock crevices, intertidally down to 4 m deep; loose valves found in depths of up to 10 m.

Observations. — One specimen (from São Vicente, Matiota) must be considered as an aberrant form of *L. rolani*, as it has different shell characteristics, but completely identical girdle elements. The main differences are: granules of central areas forming more or less longitudinal rows, anterior margin of valves II-VII slightly convex, lateral areas more pronounced by diagonal folds, mucro of tail valve anterior, articulamentum thin, apophyses wider, sinus relatively narrower; tail valve with 12 slits (slit formula 9/1/12).

L. rolani differs from *L. caboverdensis* in colour, in its smaller size and in the very different girdle covering, with cylindrical dorsal and marginal spicules and narrower, sharply pointed, ventral scales. *L. rolani* is closely related to *L. simrothi* (Thiele, 1902) from the Azores, from which it may be distinguished by its smaller size, by its dorsal girdle spicules which remain much smaller (about half the size), and by the absence of bunches of long dorsal spines.

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SUMMARY

Three species of *Lepidochitona* Gray, 1821, have so far been known from northwestern Africa, viz., *L. piceola* (Shuttleworth, 1853), *L. canariensis* (Thiele, 1909) and *L. stroemfelti* (Bergenhayn, 1931), all from the Canary Islands. Two more species are described here as new to science: *L. caboverdensis* (Senegal and Cabo Verde Archipelago) and *L. rolani* (Cabo Verde Archipelago).

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