

New species of *Assiminea* (Gastropoda, Rissooidea) from the tropical and subtropical East Atlantic

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Keywords. Gastropoda, Rissooidea, *Assiminea*, West Africa, new species.

Abstract. The species of the genus *Assiminea* from the occidental African coast are studied, and comparisons with those previously known are presented. In the absence of definitive proof, it is assumed that *Assiminea hessei* O. Boettger, 1887 is applicable to the Angolan populations. Five new species are described.

Resumen. Se estudian las especies del género *Assiminea* de la costa africana occidental, comparándolas con las previamente conocidas. Ante la carencia de pruebas seguras se supone que la especie previamente conocida como *Assiminea hessei* O. Boettger, 1887 puede corresponderse con las poblaciones encontradas en Angola. Se describen cinco especies nuevas.

INTRODUCTION

The genus *Assiminea* H. & A. Adams, 1865 is cosmopolitan. The European species were studied by Paladilhe (1875, 1877). A revision of the genus was made by Boettger (1887) presenting and giving the description of 72 species, most of them from Indo-Pacific (Asia and Oceania), but also some from European and Macaronesian waters, and one from West Africa. Fukuda & Mitoki (1995, 1996a, 1996b) revised the species in the Yamaguchi Museum, separating them into several genera.

Recently, the species occurring in northern Europe, the Atlantic archipelagos and Mediterranean were studied by Aartsen (2008), who commented on the older taxa and described four new species.

The East Atlantic taxa in the latter work are:

1- *Assiminea grayana* Fleming, 1828, which is a species distributed between Arcachon, France and Denmark, including The Netherlands and Great Britain (Fretter & Graham, 1978).

2- *Assiminea eliae* Paladilhe, 1875. Aartsen (2008) mentioned the distribution area as La Rochelle and Bayonne (France) and the Gulf of Gascogne, Spain. It is also mentioned from Coimbra (Portugal), which is not possible, since this locality is far from the sea; this is probably a case of confusion with a fresh water species of *Pseudamnicola* or *Mercuria*. Its taxonomic status is dubious.

3- *Assiminea ostiorum* (Bavay, 1920), from the Bassin of Arcachon, lectotype and paralectotypes in MNHN (designated by Aartsen, 2008). The species is doubtful,

because the type material is eroded; the species has not been collected recently.

4- *Assiminea recta* Mousson, 1874 and *Assiminea adriatica* Clessin, 1878 are treated by Aartsen (2008), and they are not actually recognized species.

The new species described by Aartsen (2008) are:

5- *Assiminea gittenbergeri* Aartsen, 2008. Types in RMNH; type locality: Sfax, Tunisia. Other shells collected in Italy.

6- *Assiminea avilai* Aartsen, 2008. Types in RMNH; type locality: Terceira Island, the Azores Archipelago.

7- *Assiminea rolani* Aartsen, 2008. Types in RMNH and paratypes in SE and MHNS; type locality: Funchal, Madeira Island. Rolán & Templado (2000) represented this species from Madeira as *Assiminea* cf. *grayana*.

8- *Assiminea glaubrechti* Aartsen, 2008. Holotype in ZMB and paratypes in RMNH and in MHNS; type locality: Bayonne, France; also collected in Vegadeo, northern Spain.

A drawing of the animal of an *Assiminea* species was figured in Graham (1971: figs. 36B) but shows only a small portion of the soft parts and the shell (fig. 56). Probably it is the same species figured in Rolán (1987: 241, fig. 2).

In some lists from west African faunas, *Assiminea* species were mentioned: *Assiminea* sp. in Fernandes & Rolán (1993: 34) for São Tomé and Príncipe and Angola (Rolán & Ryall, 1999: 27).

Since Aartsen (2008) focused on Europe and the Macaronesian islands, it was necessary to complete the study of this group in the remainder of the eastern Atlantic, mainly the West African coast. The work of Boettger (1887) was a worldwide revision, but only one African species was mentioned: *Assiminea hessei* O. Boettger, 1887. Its type locality is West Zaire, behind the English trade house at Banana. The species is figured in the original description and recorded from Nigeria by Brown, who illustrated the radula (Brown, 1980: fig. 44).

Abbreviations

MHNS: Museo de Historia Natural, Santiago de Compostela.

MNHN: Muséum National d'Histoire Naturelle, Paris.

MNCN: Museo Nacional de Ciencias Naturales, Madrid.

RMNH: National Museum of Natural History Naturalis, Leiden.

SMF: Senckenberg Natur-Museum, Frankfurt.

ZMB: Museum für Naturkunde der Humboldt Universität zu Berlin, zoologisches Museum.

sp: specimen with soft parts.

s: empty shell.

f: fragment.

j: juveniles.

SYSTEMATICS

Genus *Assiminea* Fleming, 1828

Type species by original monotypy: *Assiminea grayana* Fleming, 1828, Recent, SE England.

Remarks. The purpose of this work is to present the species collected by the author during trips to the West African coast over several years. They all will be included in the single genus *Assiminea* based on these characters of the type material:

Assiminea Leach *in* Fleming, 1828

Type species: *Assiminea grayana* Fleming, 1828.

Size height: 4-5 mm.

Form: conical with high spire.

Whorls: 5-7.

Profile of the whorls: almost flat.

Umbilicus: none.

Protoconch: 1 ¾ whorls.

Radula: rachidian tooth exhibits basal denticles.

Paludinella Pfeiffer, 1841

Type species: *Paludinella littorina* (delle Chiaje, 1828).

Size height: 2 mm.

Form: almost spherical, short spire.

Whorls: 3.

Profile of the whorls: convex.

Umbilicus: yes.

Protoconch: ½ whorl.

Radula: rachidian tooth lacks basal denticles.

Thiele (1935) stated that the rachidian tooth of the genus *Assiminea* has "...in most cases with 3 posterior cusps", which means that it is not always so. Brown (1980) explained that the species of the genus *Assiminea* can have basal denticles in the rachidian tooth of the radula or not.

Regardless of this opinion, in the present situation, placement of any new species in one or other genus must be based on conchological characters before resorting to those of the radula, on which there is not enough information, especially none that encompasses all the species. There is absolutely no unequivocal proof that a character (such as the basal denticles of the rachidian tooth of the radula) is more important than any other to establish generic placement. In this situation we have decided to include all the species here described in the genus *Assiminea* because they are quite similar in shell morphology. Other species from this area, tentatively included in the genus *Paludinella*, will be described in a forthcoming paper.

Assiminea cf *hessei* O. Boettger, 1887

Figures 1A-E

Assiminea hessei O. Boettger, 1887: 180, tab. 6, fig. 7. [Type locality: mouth of Congo River, West Zaire, swamp behind the English trade house at Banana].

Type material. The type material is in SMF (pers. comm. Dr. Ronald Janssen).

Other material examined. 1 s, 3 j (Fig. 1A) in MNCN (15.05/60068) (j with good protoconch); MNHN (IM-2012-39, 11 sp in alcohol); MHNS (100587, 16 sp in alcohol); 4 sp from the Namibe broken for radular study; 25 sp and j, from Namibe, Angola (MHNS); 16 sp, 3 j, from Luanda, Angola (MHNS).

Description. Shell (Figs. 1A-B) small, solid, globose with somewhat pointed spire.

Protoconch (Figs. 1C-E) with about 1 ¾ whorls and a diameter of about 340 µm; divided into two very well differentiated parts: the first embryonic one has a nucleus 65-70 µm in diameter, extending for ½ whorl at least; this part has a microsculpture with very minute rounded pits. The second part has about 12-14 poorly marked spiral lines; the end of the protoconch is clearly separated from the teleoconch by a small smooth depression and a previous thickening. The teleoconch usually has 4 whorls, nearly 5 in some populations; it is smooth with only slightly prosocline growth lines, slightly convex at the periphery. The suture is distinct, slowly descending. Aperture ovoid, with a narrow external border; the columella is a little wide, having an expansion which occludes the umbilical

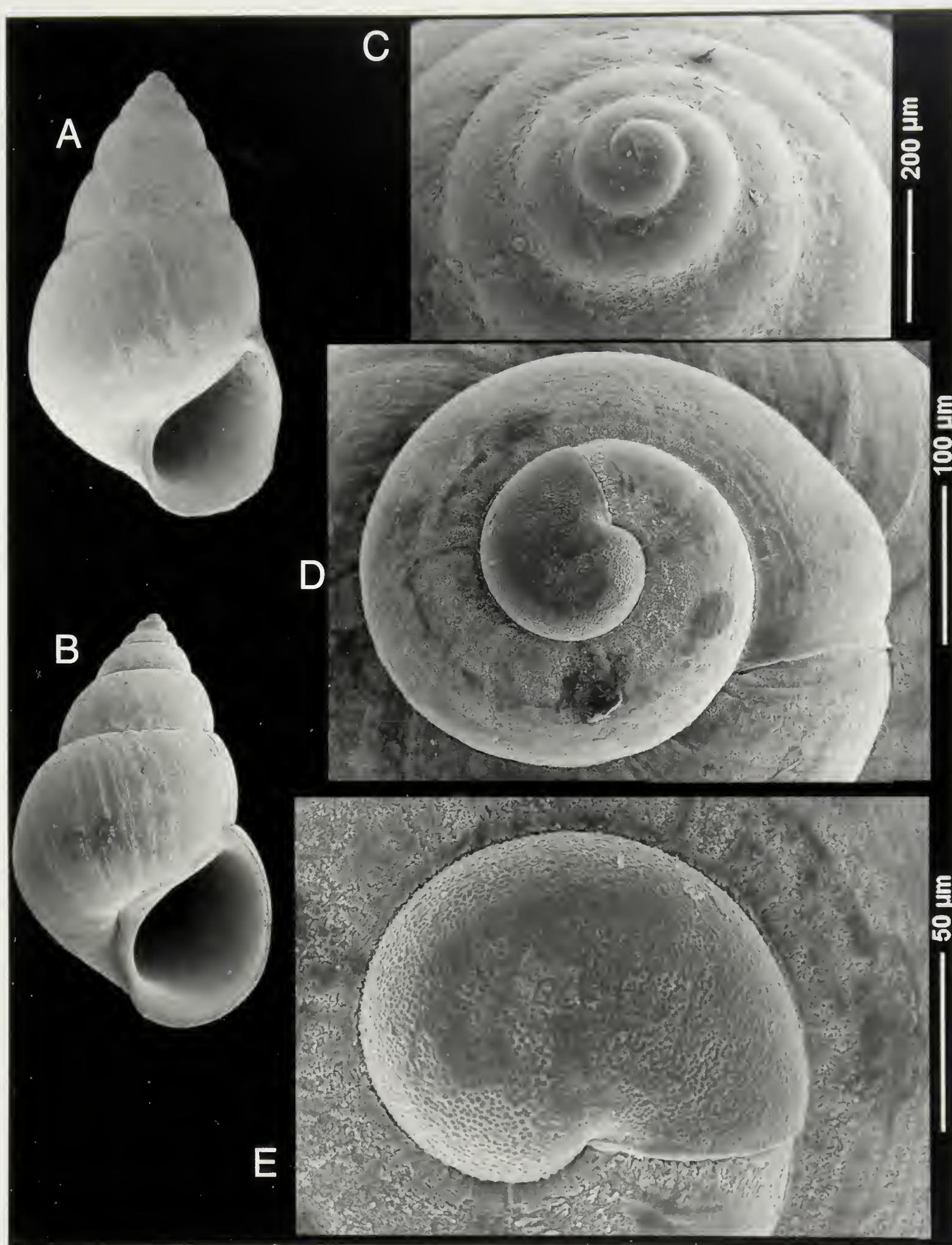


Figure 1. *Assimineia cf. hessei* O. Boettger, 1887. **A.** Shell, 4.0 mm, Namibe, Angola (MNCN); **B.** Shell, 3.4 mm, Luanda, Angola; **C-E.** Protoconch and detail of the micro sculpture.

area. Umbilicus imperforate or reduced to a narrow fissure.

Animal (from field notes; Fig. 8A from preserved animals): The soft parts visible through the shell are apparently totally black; the mantle is totally grey-black with only in the anterior light border; the head is black and white, with moderately long white retractable tentacles, extending to the eyes. The black colour around the tentacles extends to the mouth; below the tentacles there is a small black area. The foot is white, its anterior part is rounded and bilobulated; a large penis is bent back behind the head. Operculum ovoid, almost transparent, with a subcentral nucleus.

Dimensions: The holotype is 4.0 mm high. Most shells are little smaller.

Radula (Fig. 9D): Rachidian tooth elongate, without any basal denticle and on the cutting edge there are 5-7 cusps, the central one being larger and wider and the others towards the periphery smaller. The lateral tooth is rather similar to the central, and the marginal ones have many smaller cusps: about 10-12 on the outer one and 5-6 only on the innermost, but wider, tooth.

Habitat. "Mangrove swamp in Nigeria, with *Melampus* on a sandy substratum near the upper tidal limit" (Brown, 1980). The specimens collected in Angola were found under rocks and plants at the limit of the low tide, in an area with brackish water.

Distribution. The range of this species is not really known. Isolated reports from fresh waters are not plausible since *Assiniinea* species are exclusively marine. The record of Cameroon (Bandel & Kowalke, 1999) is not secure since comparison to the original population with respect to protoconch, radula or DNA was not made. The same applies to the material collected in Port Harcourt (Nigeria) mentioned in Brown (1980). If the populations included in this work are the true *A. hessei*, the distribution of the species would be in Zaire and Angola (Luanda and Namibe).

Remarks. The species was described from the type locality, and there are only the dubious records already mentioned. So, actually we have the populations from the original description and two more in the present work. The type material is corroded at their apices (pers. comm. Ronald Janssen, SMF):

1- The population from Banana, West Zaire, on which the description is based has possibly been extirpated because the area is polluted, and the species has not been collected since 1890 (<http://www.iucnredlist.org/details/175138/0>)

At present only known from the type material in SMF.

2- The population from Luanda, Angola, apparently rather similar to the following one, with a similar

protoconch and radula. It is about 300 kms southern from the type locality of *Assiniinea hessei*.

3- The population from Namibe (old Moçamedes) Angola, which agrees with the description and photographs in the present paper. It was collected more than 1200 Kms south of the type locality for *Assiniinea hessei*.

The problem with the comparison of the Angolan populations and the type series is that the shells of the species of this genus are very similar; the protoconch in the type material is not in good condition; and there is no information on the soft parts. The radula is mentioned by Brown (1994) as being similar to that of *Assiniinea bifasciata* Nevill, 1880 from Durban. The drawing of this radula differs from that of the Angolan population in several details, but it is difficult to accept these differences as evidence for specific separation.

So, lacking other possibilities for comparison, we have provisionally included the three populations in this existing taxon while waiting for topotypical material to study.

All the species of this genus are very similar conchologically. We have alluded to this problem in the comparison above with *A. ostiorum* and *A. eliae* since these two species are very dubious, and most of the characters, protoconch, and radula are not known, not to mention their geographic remoteness. *Assiniinea* cf. *hessei* may be distinguished from other species:

Assiniinea grayana Fleming, 1828 (after Fretter & Graham, 1978) is larger, up to 5 mm (even 7.5 mm after Adam, 1960), with 6-7 whorls, with some indefinite spiral lines on the older whorls, a protoconch with two whorls. The animal head is totally black except the extreme of the tentacles where the eyes are. The radula (after Aartsen, 2008) has 3 basal tubercles at each side of the central tooth, but we have found 4 and 5 (Figs. 9A-B).

Assiniinea gittenbergeri Aartsen, 2008 has a protoconch of only one smooth whorl and only 250 µm in diameter. The same can be said for *A. rolani* Aartsen, 2008, with only one smooth protoconch whorl (Rolán & Templado, 2000) and basal cusps in the rachidian tooth.

Assiniinea glaubrechti Aartsen, 2008 has a similar protoconch but with a larger diameter (about 430 µm) and spiral sculpture.

Assiniinea avilai Aartsen, 2008 has a shorter protoconch of only one whorl (see Aartsen, 2008, fig. 11) and 240 µm in diameter, and the radula has a rachidian tooth with three basal denticles on each side.

Assiniinea rolani Aartsen, 2008 has a wider protoconch of only one whorl, a spiral groove below the suture and the rachidian tooth has three basal denticles.

For a comparison with other species see below.

Assimineia principensis spec. nov.
Figs. 2A-F

Material. Holotype (Fig. 2A) in MNCN (15.05/60069H) and 14 paratypes in MNCN (15.05/60069P, 3 sp, 11 j, Figs. 2B-C). Other paratypes: MHNS (100588, 60 sp, about 70 j); MNHN (IM-2012-40, 15 sp).

Type locality. Santo Antonio, Príncipe Island: on green algae on and under rocks in the small river in the town near the sea.

Etymology. The species is named after Príncipe Island, the type locality.

Description. Shell (Figs. 2A-C) small, solid, globose, whitish or cream in colour, with spire slightly pointed. Protoconch (Figs. 2D-F), almost always eroded, formed by two very well differentiated parts: the embryonic one with about one whorl, beginning by a nucleus with about 80 µm with a microsculpture formed by minute rounded pits; the larval part occupies roughly another whorl with about 8 spiral threads. In total, the protoconch has a little more than 2 whorls (2 1/8) and a diameter of 360-400 µm. The teleoconch usually has about 4 whorls; its surface is smooth, with slightly prosocline growth lines only, and frequently with eroded areas; it is slightly convex at the periphery. The suture is distinct, slowly descending. Aperture ovoid, with a narrow external border; the columella is a little wider, opisthocline, occluding the umbilical area. Umbilicus not existent or reduced to a narrow fissure.

Dimensions: The holotype is 3 mm high; most of the shells are slightly smaller.

Animal: Black, but not examined directly before fixation. The head is gray with a darker line which extends behind the tentacles and between them. The rectum forms an oblique loop.

Radula (Figs. 9E-F): Typical of the genus, but the rachidian tooth lacks a basal tubercle, having 7 cusps on the cutting edge. The inner marginal tooth has only 6-7 wide cusps, and the outer marginal one has more numerous and smaller cusps (about 14-16).

Remarks. The differences from other congeneric species are:

Assimineia grayana Fleming, 1828 (after Fretter & Graham, 1978) is larger, up to 5 mm, with 6-7 whorls, a protoconch with two whorls. Furthermore the radula has a rachidian tooth with basal denticles on each side, and has a subsutural spiral thread.

Assimineia gittenbergeri Aartsen, 2008 has a protoconch with only one smooth whorl and basal denticles on the rachidian tooth.

Assimineia glaubrechtii Aartsen, 2008 has a protoconch with 1 1/2 whorls and a diameter of 430 µm.

Assimineia rolani Aartsen, 2008 has a protoconch with only one smooth whorl and the radular rachidian tooth

with 3-4 basal denticles at each side (Rolán & Templado, 2000).

Assimineia avilai Aartsen, 2008 has a shorter smooth protoconch with a diameter of 240 µm, and the radula has three basal denticles on each side of the rachidian tooth.

Assimineia cf hessei has a rather similar shell, but is a little larger, the protoconch is 3/8 of whorl shorter, and it has a well-defined embryonic shell with more fine grooves on the larval part. The animal is darker without a light line between tentacles.

Assimineia saotomensis spec. nov.
Figs. 3A-J

Type material. Holotype (Fig. 3A) in MNCN (15.05/60070H) and 5 paratypes in MNCN (15.05/60070P). Paratypes: MNHN (IM-2012-8000, 10 sps), MHNS (100589, 30 sps).

Type locality. São Tomé Island, Agua Izé, at the limit of the low tide, on wood, plants, and rocks (7/02/1990).

Etymology. Named after São Tomé Island, the type locality.

Other material studied. São Tomé: 7 sp, from type locality (MHNS); 13 j, from Praia Sant'Ana (MHNS).

Description. Shell (Figs. 3A-E) ovoid-conical, robust, globose, spire slightly pointed, whitish or cream in colour. Protoconch (Figs. 3F-H) usually eroded, with 1 3/4 whorls, a nucleus of about 75 µm, and a diameter of about 320 µm. In some juveniles spiral lines could be observed. The teleoconch usually distinct at the beginning with about 5 whorls, which are smooth, convex, with prosocline growth lines which extend into the umbilical depression. Suture not deep. Aperture ovoid, a little pyriform, external border sharp, columella slightly curved, almost vertical and thickened, completely occluding the umbilicus. Under high magnification (Fig. 3I) a fine microsculpture can be seen; with even larger magnification (Fig. 3J) the surface is rough.

Dimensions: The holotype is 3.8 mm high.

Animal: With short and rounded tentacles, totally white, the black eyes almost on their extremities. The dorsum of the head is dark coloured except the tentacles and near the border of the snout; the colour extends to near the base of the tentacles and behind them, the middle of the head at the level of the tentacles being white. This colouration is rather uniform (Fig. 8D).

Radula (Figs. 10C-D): The radula has a rachidian tooth with only 5 cusps, the central one larger and wider; no basal denticles; the lateral has 5-7 very pointed cusps; the inner marginal has 5-6 cusps and the outer marginal has 17-19 very small cusps.

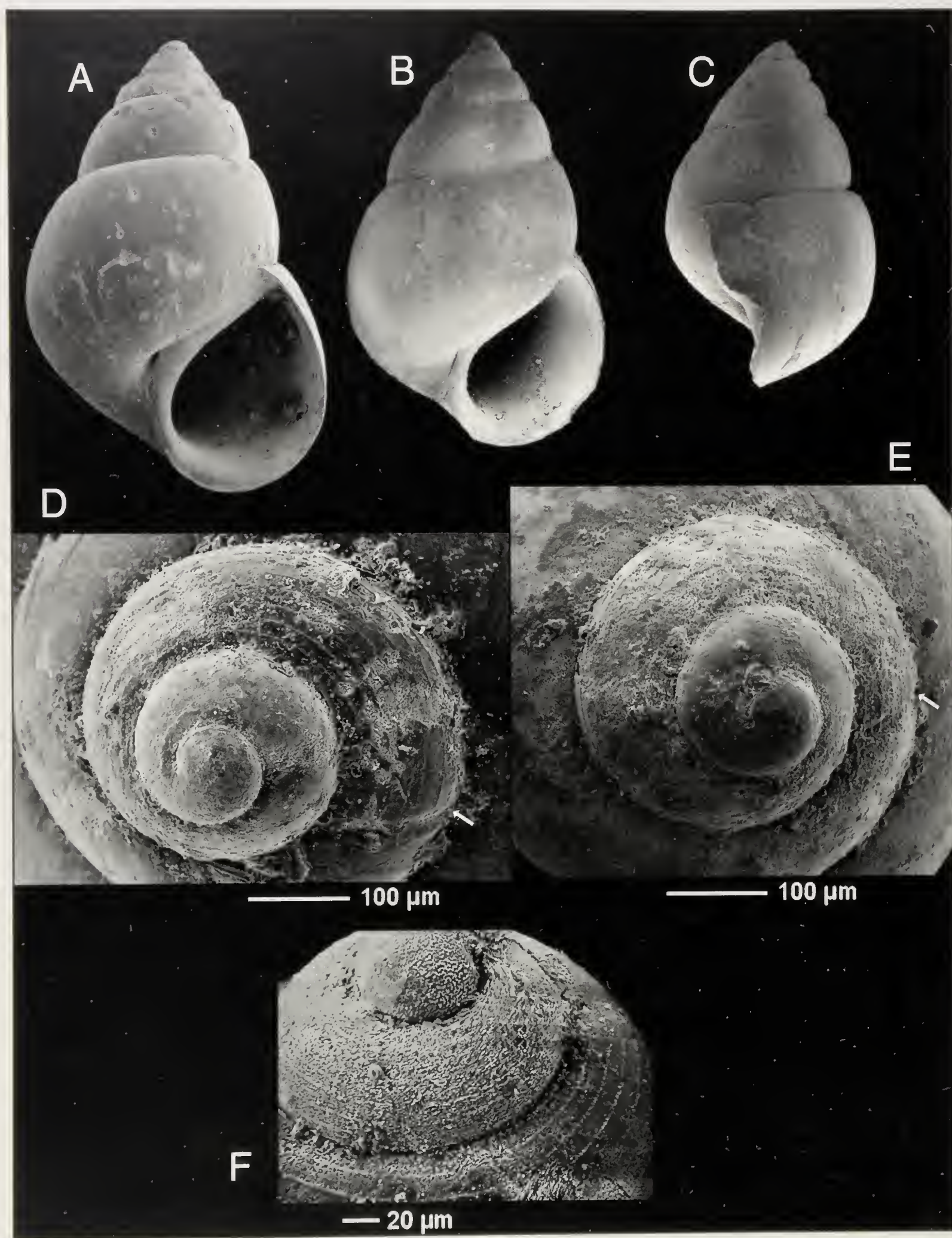


Figure 2. *Assiminea principensis* spec. nov. A. Holotype, 3.0 mm, (MNCN), Santo Antonio, Príncipe. B-C. Paratypes, 2.7, 2.3 mm (MNCN); E-F. Protoconchs.

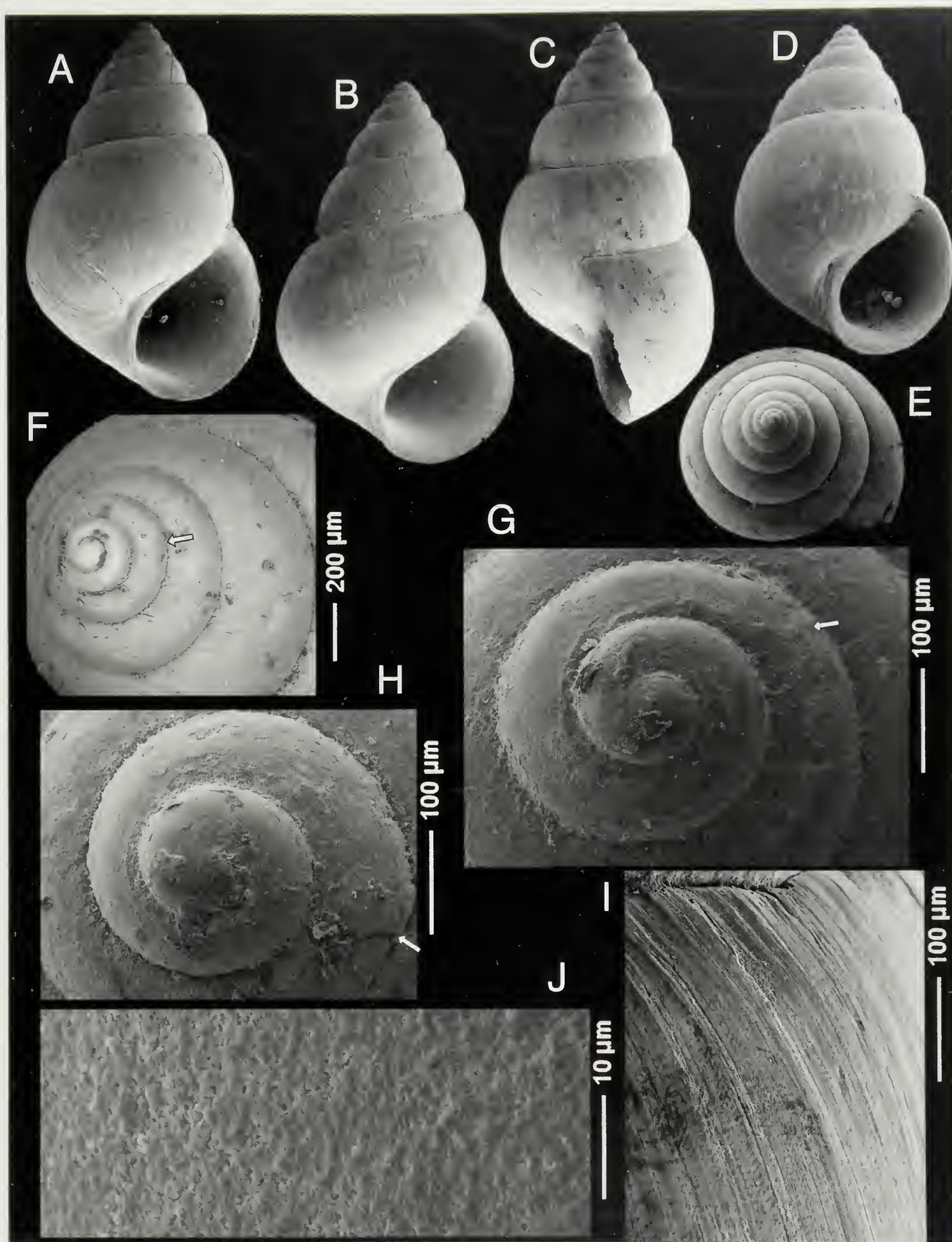


Figure 3. *Assiminea saotomensis* spec. nov. **A.** holotype, 3.8 mm (MNCN); **B-E.** Paratypes, 3.8, 3.6, 2.9, 3.1 mm (MNCN); **F-H.** Protoconchs (the beginning of the teleoconch is marked); **I-J.** Detail of the micro sculpture, Agua Izé, São Tomé.

Habitat. At the limit of the low tide, on wood, plants and rocks, and on mangrove roots (7/02/1990).

Remarks. The differences with other congeneric species are as follows:

Assiminea grayana Fleming, 1828 (after Fretter & Graham, 1978) is larger, up to 5 mm, with 6-7 whorls, a protoconch with two whorls. The radula has a rachidian tooth with basal denticles at both sides.

Based on the morphology of the radula, this new species can be separated from *Assiminea gittenbergeri* Aartsen, 2008, *A. avilai* Aartsen, 2008 and *A. rolani* Aartsen, 2008. Also the latter have a protoconch of only one whorl.

Assiminea glaubrechti Aartsen, 2008 has a smaller shell and shorter protoconch with a larger diameter.

Assiminea cf. *hessei* has a rather similar shell, but the protoconch is more finely sculptured, the embryonic shell well delimited, and with fine microsculpture. In contrast the shell of *A. saotomeensis* has microsculpture on the teleoconch, and its animal is darker without a white line between the tentacles.

Assiminea occulta spec. nov.

Figures 4A-E

Type material. Holotype (Fig. 4A) in MNCN (15.05/60071). Paratypes: MNHN (IM-2012-8001, 1 sp); MHNS (100590, 6sp).

Type locality. São Tomé Island, Agua Izé, in the same area as the previous species.

Other material examined. Ghana: about 130 sp and j, Pumpuni, on rocky walls near de sea (14/03/1993) (MHNS); + 165 sp and j, intertidal, Miamia (MHNS); 5 sp, Bobowasi Island, in front Axim (21/03/1993) (MHNS).

Etymology. The specific name alludes to the fact that these specimens of this species were found mixed with those of the previous species on São Tomé Island.

Description. Shell (Figs. 4A) ovoid-conical, robust, globose, spire slightly pointed, whitish or cream in colour. Protoconch (Figs. 4B-E) with about one whorl, a nucleus of about 110-120 µm, and a diameter of about 300 µm. The teleoconch usually distinguishable at its beginning, with about 4 whorls, which are smooth, convex, with prosocline growth lines which terminate in the umbilical depression. Suture not deep. A fillet is present just below the suture throughout. Aperture ovoid, a little pyriform, external border sharp, columella slightly curved, almost vertical below, opisthocline on its upper part and thickened, almost completely occluding the umbilicus.

Dimensions: The holotype is 2.18 mm high; other shells were of similar size. The population from Ghana has slightly smaller shells.

Animal: from São Tome, only observed in fixed samples: body mostly black, only the anterior part of the foot and a circle around the eyes and tentacles are white. Animal from Miamia, Ghana: Short and rounded tentacles, the eyes almost on their extremities. The entire animal is white and in the area between the eyes; by illumination a pink elongate color stripe can be seen. The external border of the tentacles has an constant short black part. A penis can be seen on the dorsum behind the eyes. The curved intestinal lumen containing fecal pellets can be observed by transillumination.

Operculum: transparent with a light yellow tone.

Radula (Figs. 10A-B): Central tooth with 7 cusps, the middle one the largest; at the base there are two groups of denticles laterally aligned with 3 or 4 cusps; the lateral tooth has 6-7 cusps, the middle one also the largest. The inner marginal with about seven cusps, the central ones larger, the outer ones smaller; the outer marginal ones are spoon shaped and the cutting edge has numerous (between 17-20) elongated and very fine cusps, except the outer ones, which are wider.

Habitat. Found in Agua Izé with *A. saotomeensis* (see above) at low tide, in brackish water. In the area there were *Melaupus* sp., *Truncatella* sp. and *Pedipes* sp.

Distribution. Known from Agua Izé in São Tomé and from several places in Ghana.

Remarks. We have considered the populations from São Tomé and those from Ghana conspecific due the similarity of the shell and protoconch, existence of a subsutural spiral thread, etc. However, we found some differences in the colouration of the soft parts and in the radula: The population of *A. occulta* spec. nov. from São Tomé has an almost totally black animal, while that from Ghana is practically white with a pink area in the middle of the head. The rachidian tooth of the former population had 3 basal cusps at each side while that from Ghana had 4; also the outer marginal tooth of the specimens from São Tomé had more than 25 cusps. Anyway, these characters were not examined in detail and in only a few specimens from both populations to be considered significant, so we consider them as simple intraspecific variations.

In São Tomé this species lives in the same habitat as the species described above (*A. saotomeensis*); see below for their separation.

The most important difference with the other congeneric species is the spiral fillet on the upper part of the whorls, which most other African species lack. Furthermore, the protoconch is short, with only one whorl and a wide nucleus.

By its short protoconch and the spiral cordlet near the upper suture, this species can be separate from most of the European species except *A. grayana* and *A. rolani*, but these two species have a protoconch of about 350-400 µm in diameter, a nucleus of 130 µm, and the soft

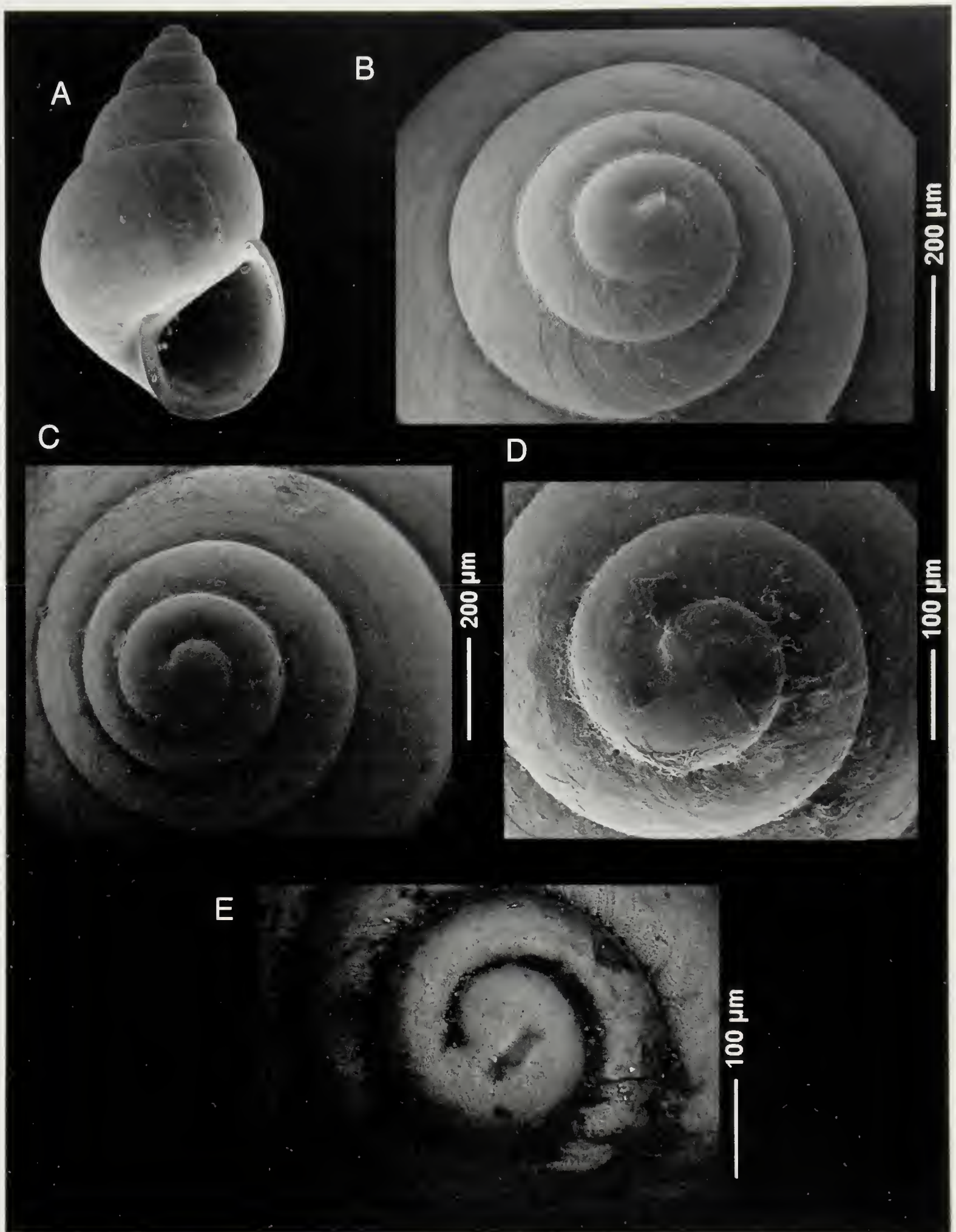


Figure 4. *Assiminea occulta* spec. nov. **A.** Shell, 2.2 mm, Agua Izé, São Tomé (MNCN); **B-E.** Apex, protoconch and details.

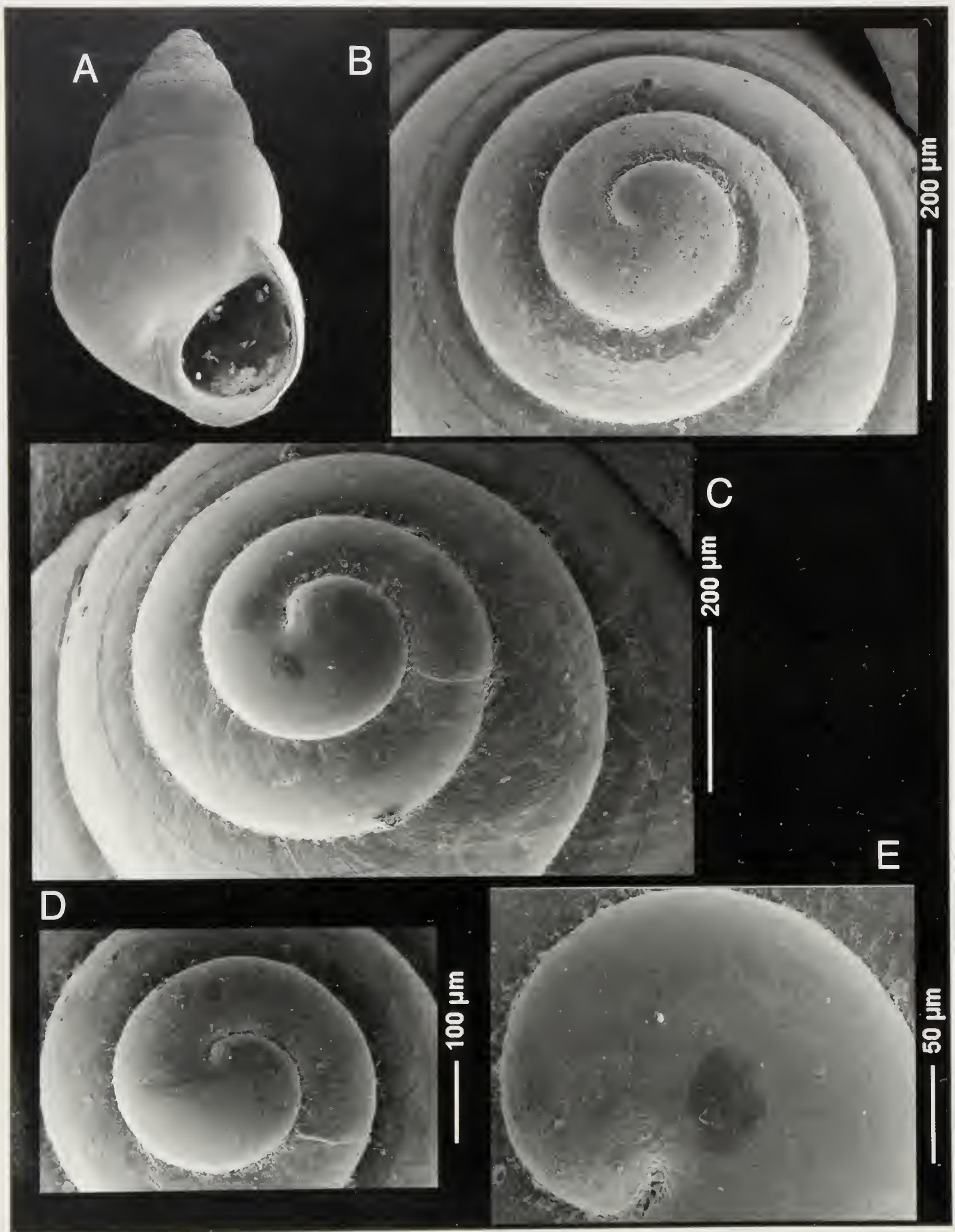


Figure 5. *Assimineea occulta* spec. nov. **A.** Holotype, 2.18 mm, Agua Izé, São Tomé (MNCN); **B-E.** Apex, protoconch and details.

parts are white with black between the tentacles and in the top of them.

In the other African species, the rachidian tooth lacks basal denticles.

Assimineea senegalensis spec. nov.
(Figs. 6A-G)

Type material. Holotype (Fig. 6A) in MNCN (15.05/60072). Paratypes: MNHN (IM-2012-8002, 3 sp, 5 j, Fig. 6B); MHNS (100591, 74 sp, 43 j) all from type locality.

Type locality. Senegal, Ziguinchor region, in the town Ziguinchor, Casamance River, about 50 kms to the sea (12/11/2008).

Other material examined. Senegal: 7 sp, 5 j, Ossouye, Hotel Las Bolonas, intertidal near the manglar roots (14/11/2008) (MHNS); 3 sp, Enampour, intertidal (13/11/2008) (MHNS); 25 j, Ziguinchor, Casamance River (MHNS); 12 sp, Kaoland, delta of the Saloum (MHNS).

Etymology. The specific name refers to the country in which the species was collected.

Description. Shell (Figs. 6A-B) ovoid-conical, robust, globose, whitish or cream in colour, spire slightly pointed. Protoconch (Figs. 6D-G), with about two whorls, a nucleus of about 90 µm, an irregular rough surface on the nucleus, and 7-9 spiral threads on the subsequent whorls. Its diameter is 360-400 µm. The teleoconch is appreciable at its beginning because the spiral cordlets of the protoconch terminate at that point. It has about 4 smooth whorls, which are convex with prosocline growth lines terminating in the umbilical depression. Suture not deep. No spiral sculpture. Aperture ovoid, a little pyriform, external border sharp, columella slightly curved, opisthocline and scarcely thickened, occluding the umbilicus, which is only a small fissure.

Dimensions: The holotype is 3.0 mm high.

Animal: Short and rounded tentacles, eyes small, almost at their ends. All the animal is black except the border of the tentacles and the anterior part of the snout, which are white.

Radula (Figs. 10A-B): The rachidian tooth lacks basal denticles; its cutting edge presents 7 cusps, the central one larger; the lateral also has 7 cusps; the inner marginal one has 8-9 and the outer marginal 17-20.

Operculum: Transparent with a light yellow tone.

Habitat. Under rocks in the upper limit of the high tide, in areas of brackish water.

Distribution. Only known from the Senegal area.

Remarks. Comparison with the European and Macaronesian species is not necessary because all but

one of them have denticles on the base of the rachidian tooth of the radula and most of them only one protoconch whorl. So, only *Assimineea glaubrechti* Aartsen, 2008 has a similar radula, but it has a smaller shell and a shorter protoconch (with only 1 ½ whorls) of greater diameter.

Among the African species, none of them has 2 protoconch whorls; the most similar is *A. saotomensis*, which has a protoconch of 1 ¾ whorls, with a smaller diameter and a different micro-sculpture of the shell. The animal lacks the white colour between the eyes.

Assimineea cf. *hessei* has 1 ¾ protoconch whorls with an evident and rougher embryonic shell, a smaller nucleus, smaller diameter of the protoconch, and sculpture with grooves instead of cordlets. The outer marginal teeth have fewer cusps.

Assimineea moroccoensis spec. nov.
Figure 7A-F

Type material. Holotype (Fig. 7A) in MNCN (15.05/60073); Paratypes in the following: MNHN (IM-2012-8003, 7 sp), MHNS (100592, 16 sp, 2 j).

Type locality. Morocco: Oualidia, under the rocks on the high tidal limit (20/09/1991).

Etymology. The specific name refers to the country in which the species was collected.

Description. Shell (Figs. 7A-C) ovoid-conical, robust, globose, whitish or cream in colour, spire slightly pointed. Protoconch (Figs. 7D-E), with 1 ½ whorls, a nucleus of about 100 µm with a rough surface and a diameter of about 350 µm. Small spiral threads seem to be present but are usually eroded. The teleoconch frequently shows erosions. It has 3 slightly convex whorls; the suture is distinct but not deep and there is no other sculpture other than the strongly prosocline growth lines. Aperture ovoid, a little pyriform, external border sharp, columella slightly curved, prosocline below and opisthocline above, scarcely thickened, occluding the umbilicus, which is only a small fissure.

Dimensions: Holotype 3.0 mm high. Other paratypes are smaller.

Animal: Totally white with a small reddish patch between the eyes, which are large.

Operculum transparent.

Radula (Figs. 11C-D): It has an elongate rachidian tooth with about 12 rounded denticles on its cutting edge. No basal denticles. The lateral teeth are narrow and elongate also with small denticles in the border (8-10 in number); the marginal ones, are very different, the internal one narrow with about 6-8 denticles and the outer, wider, with up to 23 small denticles.

Remarks. It is the only species with 1 ½ protoconch whorls except *A. glaubrechti*, but the latter has a wider

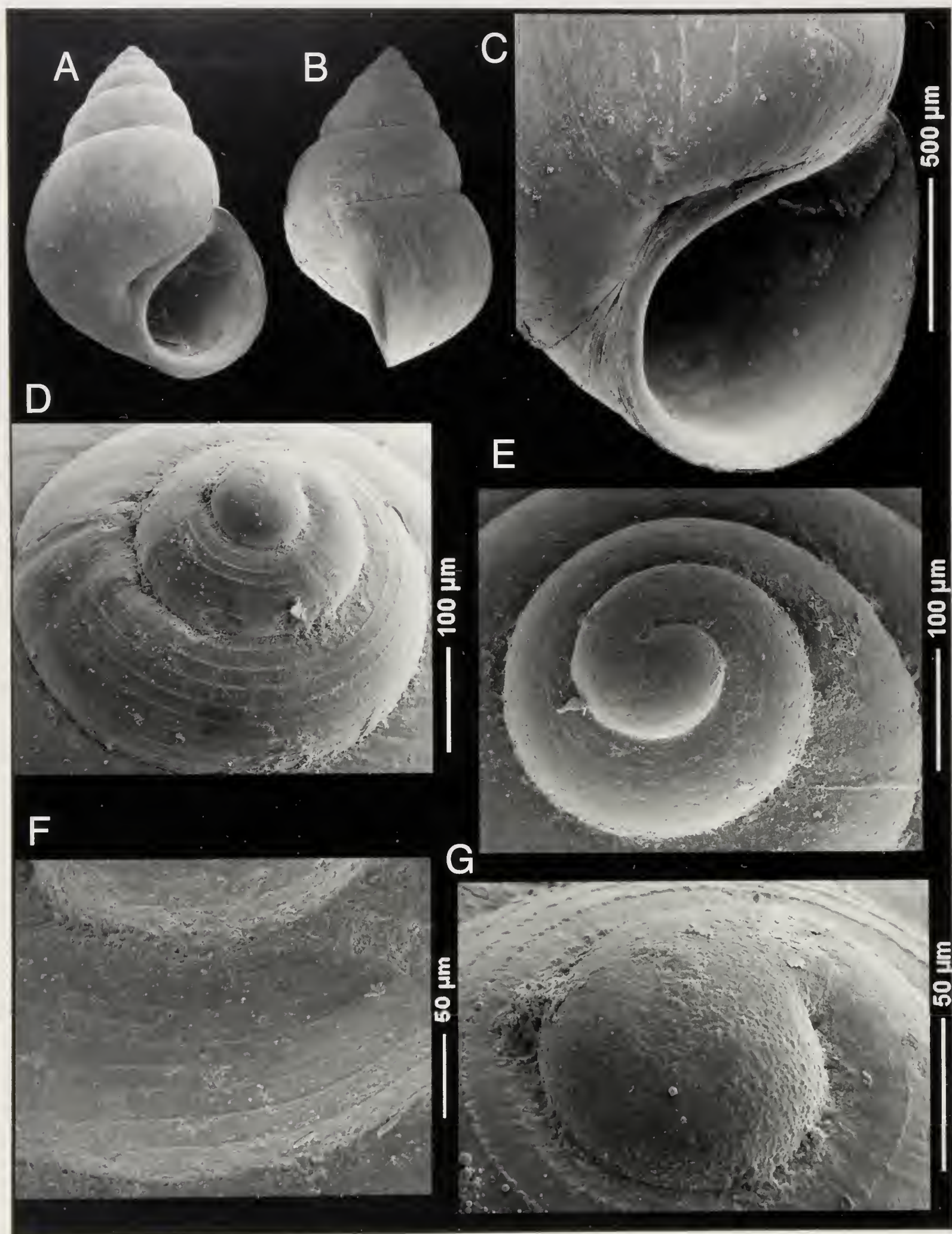


Figure 6. *Assimineea senegalensis* spec. nov. **A.** Holotype, 3.0 mm, Ziguinchor, Senegal (MNCN); **B.** Paratype, 2.8 mm; **C.** Detail of the aperture; **D-G.** Protoconchs and details.

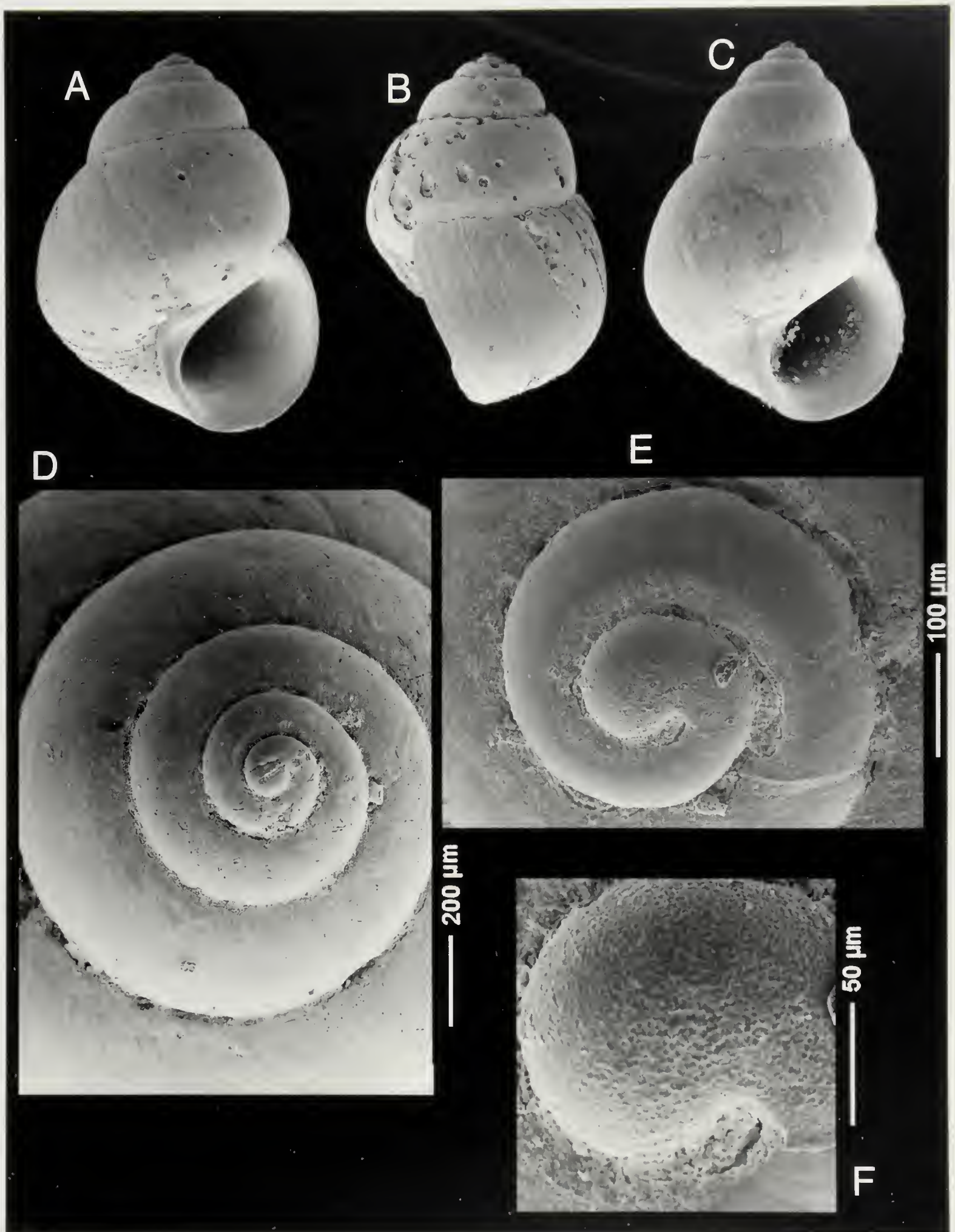


Figure 7. *Assimineia moroccoensis* spec. nov. **A.** Holotype, 3.0 mm (MNCN); **B-C.** Paratypes, 2.7, 2.9 mm (MHNS and MNHN respectively); **D-F.** Apical view, protoconch and detail, Oualidia, Morocco.

protoconch and the radula has a rachidean tooth with a short number of denticles on the cutting edge and in the outer margin. Because of its small size it could be considered as a *Paludinella* species, but in any case different from *Paludinella littorina* (delle Chiaje, 1828) or *P. sicana* (Brugnone, 1876) whose protoconchs, which were shown in Aartsen (2008: figs. 22 and 24), are different.

The closest ones are the African species, but the radula is very different from all them, having a cutting edge with small number of denticles which are not very uniform.

CONCLUSION

The genus *Assiminea* appears to include numerous species, but it has been poorly studied up to now. It is very likely that more species are waiting to be studied and named.

All these species have been included in one genus, but two groups were mentioned by Fukuda & Ponder (2003: 2017), those with basal denticles in the rachidian tooth and those which lack them:

Group 1. (most of the European and Macaronesian): *Assiminea grayana*, *A. gittenbergeri*, *A. avilai* and *A. rolani*; among the African species only *A. occulta*.

Group 2. *A. glaubrechti* (the only European); West African: *Assiminea* cf. *hessei*, *A. principensis*, *A. saotomensis*, *A. senegalensis* and *A. moroccoensis*.

The protoconch whorls are variable:

1. With only one: three in European and Macaronesian: *Assiminea gittenbergeri*, *A. avilai*, *A. rolani*; and only one in the African ones: *A. occulta*.
2. Between 1 and 2: curiously most of the species are of the group 2 [above]: *Assiminea glaubrechti* (1 ½); *A. moroccoensis* (1 ½); *A. cf. hessei* (1 ¾); *A. saotomensis* (1 ¾).
3. Two or more whorls: *Assiminea grayana* (2); *A. senegalensis* (2); *A. principensis* (2 1/8).

The shell usually has a teleoconch without spiral sculpture, but in three cases a subsutural cordlet exists: *A. grayana*, *A. rolani*, *A. moroccoensis*.

To arrive at further conclusion, a wide revision studying some populations which are not well known actually would be necessary.

ACKNOWLEDGEMENTS

The micrographs by Scanning Electron Microscopy of the shells and radulae of the species shown in this work were made by Jesus Méndez and Inés Pazos of the Centro de Apoyo Científico y Tecnológico a la Investigación (CACTI) of the University of Vigo. The material was collected in the company of Francisco Fernandes (†) in Angola and in São Tomé and Príncipe, Peter Ryall in Ghana, and Serge Gofas and

José Templado in Morocco. Information on the type material of *Assiminea hessei* in SMF was obtained from Ronald Janssen. The English corrections were made by António A. Monteiro and Harry G. Lee.

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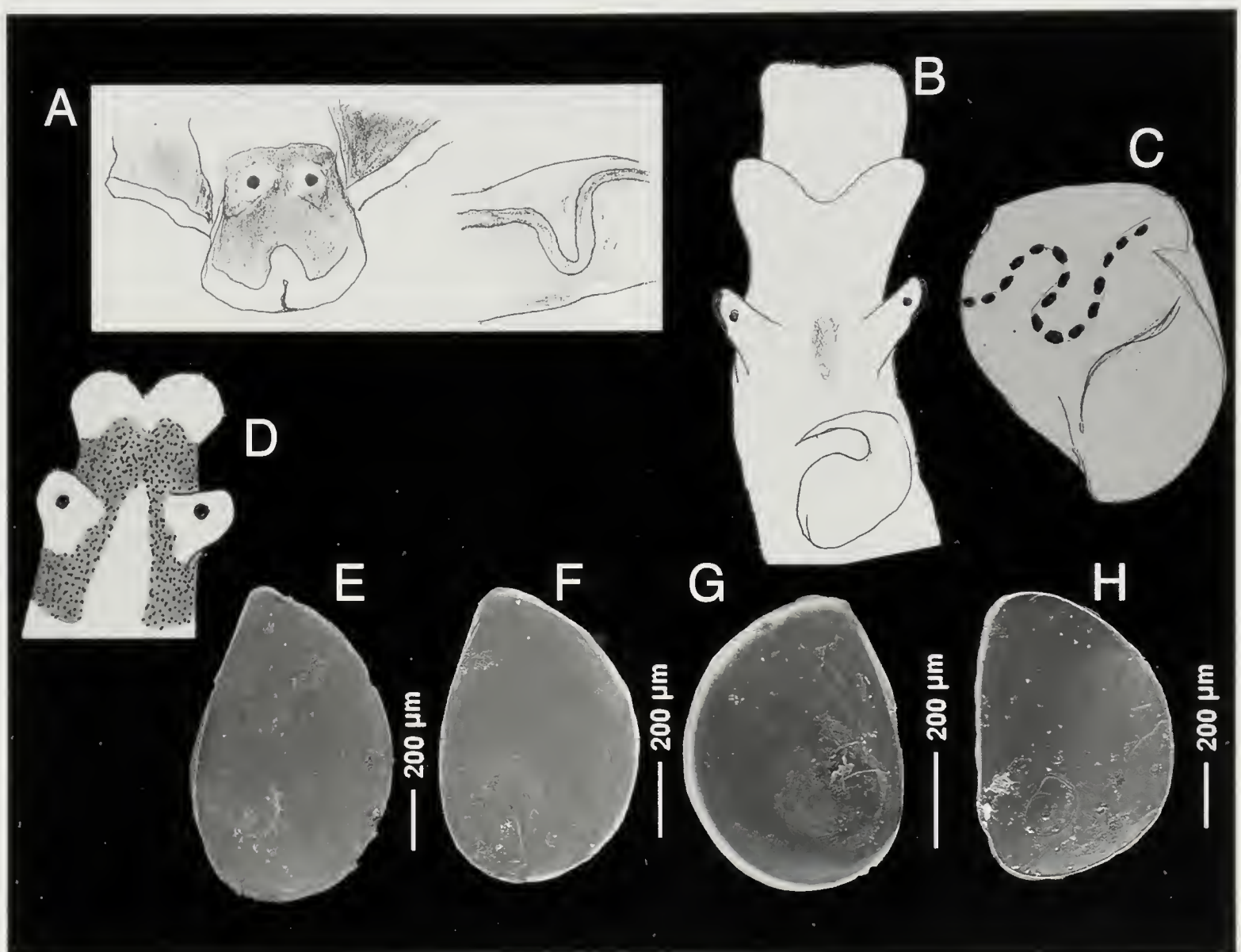


Figure 8. Drawing of the soft parts. **A.** *Assiniinea* cf. *hessei* O. Boettger, 1887, Corimbo, Angola, from preserved animals; **B-C.** *Assiniinea occulta* spec. nov., Miamia, Ghana, from notes of the land-book; **D.** *Assiniinea saotomensis* spec. nov. from field notes, Agua Izé, São Tome. **E-H.** Operculum. **E.** *Assiniinea saotoutensis*; **F.** *Assiniinea occulta*, both São Tomé; **G.** *Assiniinea occulta*, Ghana; **H.** *Assiniinea moroccoensis*, Oualidia, Morocco.

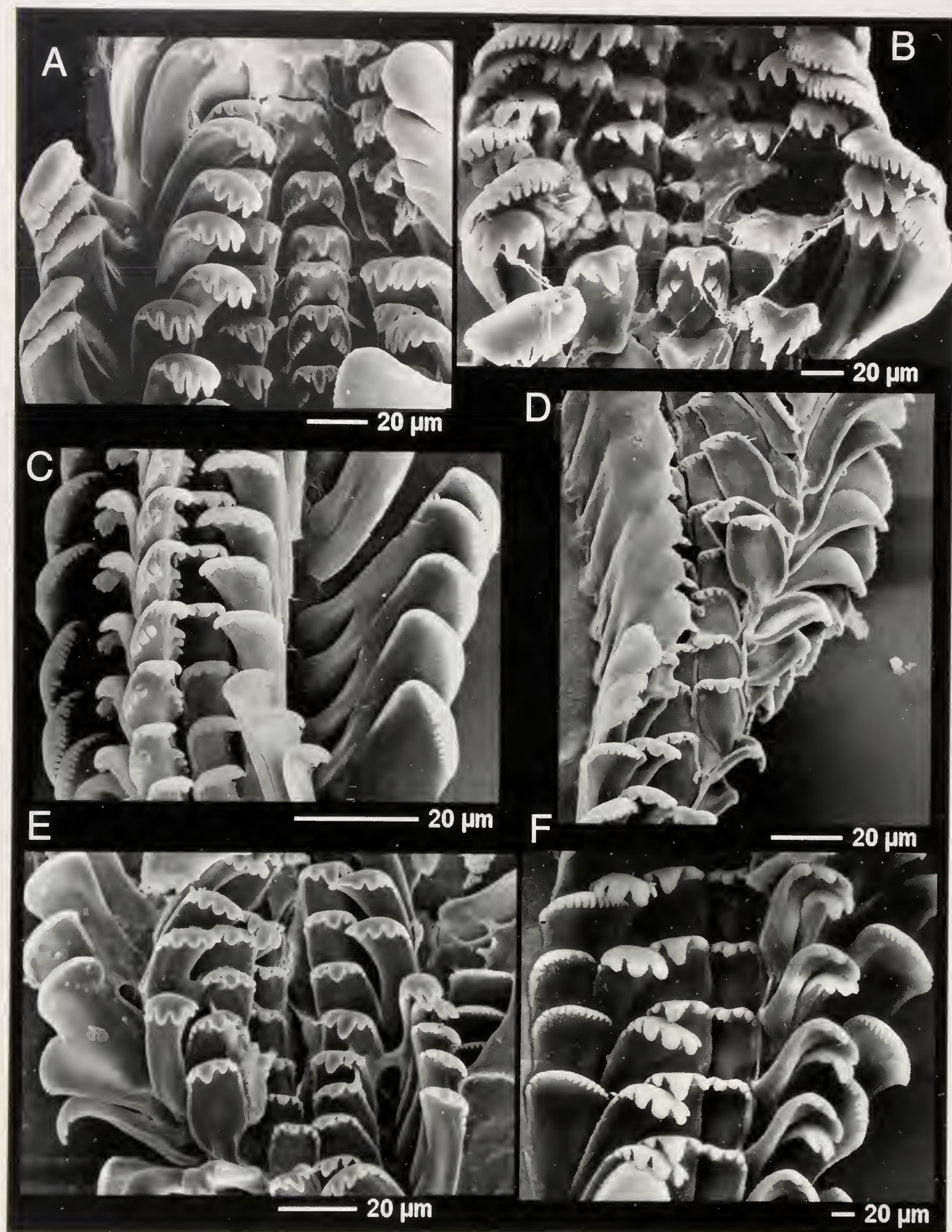


Figure 9. Radulae of *Assiminea*. **A.** *Assiminea grayana* Fleming, 1828, Belgium; **B.** *Assiminea grayana*, England; **C.** *Assiminea rolani* Aartsen, 2008, Madeira; **D.** *Assiminea* cf. *hessei*, Corimbo, Luanda, Angola; **E-F.** *Assiminea priucipensis* spec. nov., Santo Antonio, Príncipe.

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Table 1. Comparison of the characters of the African species of *Assiminea*.

species	<i>A. moroccoensis</i>	<i>A. senegalensis</i>	<i>A. occulta</i>	<i>A. saotomensis</i>	<i>A. principensis</i>	<i>A. cf. hessei</i>
Protoconch whorls	1 ½	2	1	1 ¾	2 1/8	1 ¾
Diameter of the nucleus	90-100 µm	90 µm	110-120 µm	75 µm	80 µm	65-70 µm
Diameter of the protoconch	350-400 µm	360-400 µm	300-350 µm	320 µm	360-400 µm	340 µm
Microsculpture of the nucleus	rough	rough	Rough very fine	Rough very fine	Rounded pits	Rounded pits
Microsculpture of the remaining part of the protoconch	Fine spiral	Evident spiral cords	No	Spiral striae	Evident spiral cords	Small lines
Embryonic part in protoconch	yes	Yes, scarcely evident	No	Probably yes	Probably yes	Very evident
Separation the protoconch and teleoconch	Clear Not thick	Clear Not thick	Clear Not thick	Clear; Not thick	Clear; Not thick	Very evident with a thick lip
Teleoconch sculpture	No	No	Subsutural cordlet	Rough surface	No	Growth lines
Umbilicus	No	Narrow	No	No	Narrow?	fissure
Animal colour	White	Mostly black	White	Mostly white	Mostly black	Mostly black
Central tooth, basal denticles	No	No	Yes	No	No	No

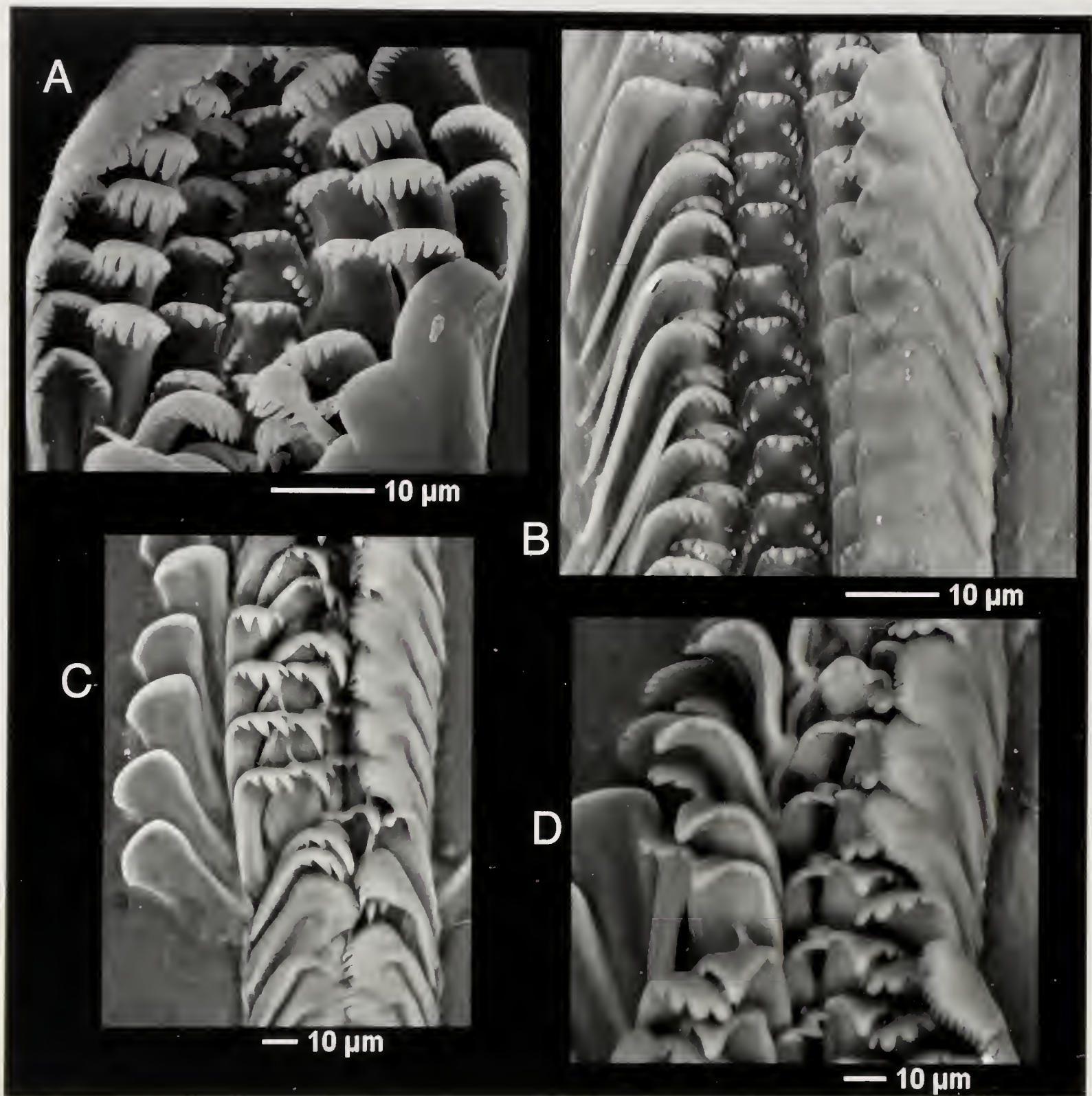


Figure 10. Radulae of *Assimineia*. **A-B.** *Assimineia occulta* spec. nov. **A.** Agua Izé, São Tomé I; **B.** population of Miamia, Ghana; **C-D.** *Assimineia saotomensis* spec. nov., Agua Izé, São Tomé.

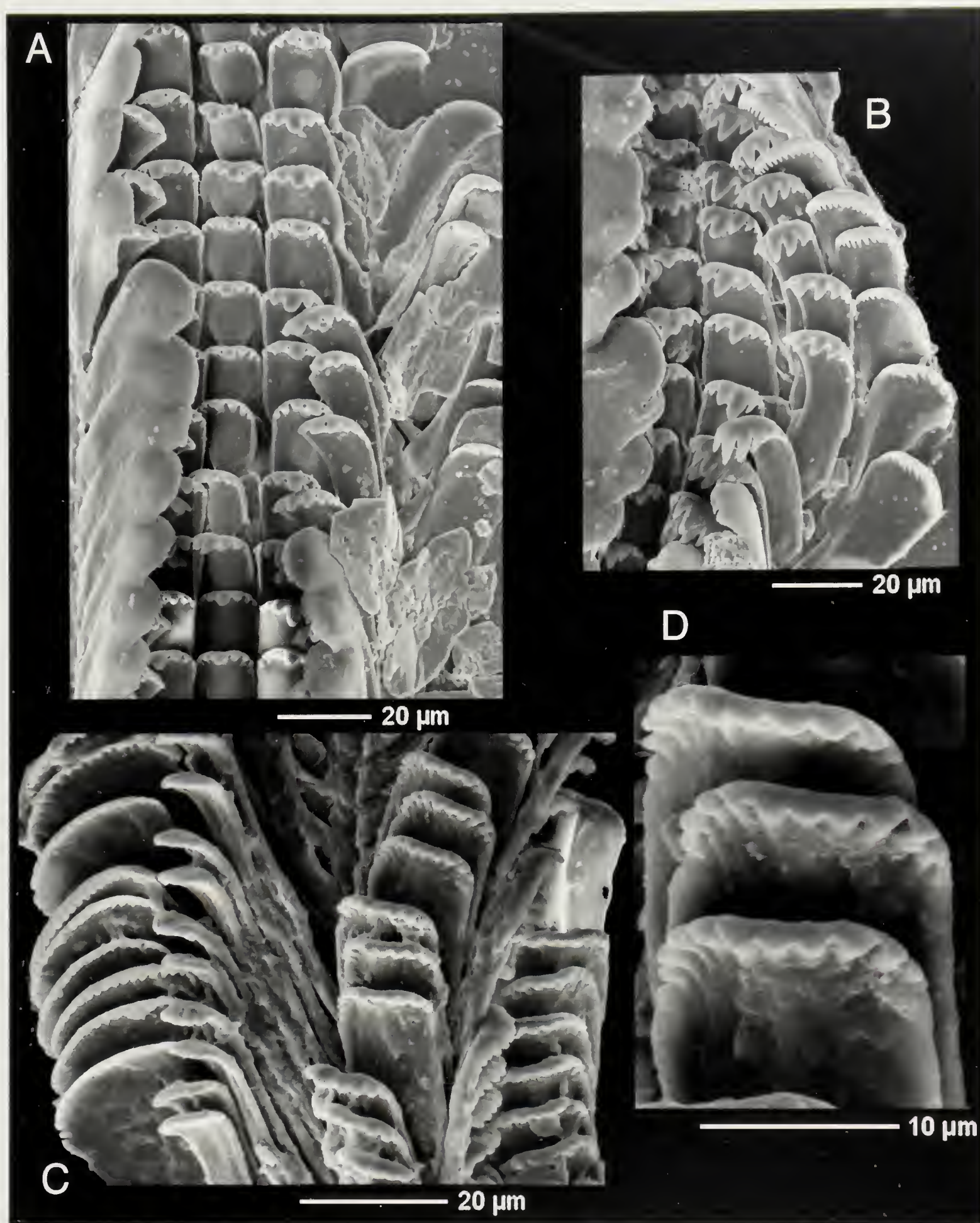


Figure 11. Radulae of *Assiminea*. **A-B.** *Assiminea senegalensis* spec. nov., Ziguinchor, Senegal; **C-D.** *Assiminea moroccoensis* spec. nov., Oualidia, Morocco.