

A Review of the Scissurellidae (Mollusca: Gastropoda) of the Red Sea.

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(With 8 Plates)

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Introduction

Although the molluscan fauna of the Red Sea has been quite extensively investigated during more than two centuries, following the initial exploration carried out in 1761 by the Royal Danish Expedition headed by NIEBUHR and FORSKÅL, little attention has been devoted to the Archaeogastropod family Scissurellidae. Records of Scissurellidae from the Red Sea in the scientific literature have been meagre and occasional, and much of the material which has accumulated over the years in various collections has remained unprocessed and unpublished.

The present review is intended to summarize all available literature records on Scissurellidae in the Red Sea and to report on material in prominent collections, in which material from the Red Sea is stored. For the purpose of this review the limits of the Red Sea are set at the Bab el Mandeb Straits in the South and Port Said at the northern exit from the Suez Canal.

In the systematic part, which follows, the systematics of Scissurellidae outlined by KEEN in MOORE (1964) are adopted in preference to those of HABE and KOSUGE (1964). The original nomenclature of the literature source is given, but localities recorded are presented in the latest accepted transcription. For each species the literature records are cited chronologically. Collection localities for material in collections are listed from North to South, beginning with the Gulfs of Aqaba and Suez, followed by the northern Red Sea proper (including the southern tip of the Sinai Peninsula) and the southern Red Sea. With regard to material in collections, the following abbreviations are used:
BMNH — British Museum (Natural History), London, England.
HUJ — Zoological Museum, Mollusca Section, Hebrew University of Jerusalem, Jerusalem, Israel.

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- IY — I. Yaron collection, Beer-Sheva, Israel.
 IGPT — Issel collection, Istituto di Geologia, Paleontologia e Geografia Fisica, Torino, Italy.
 MHNP — Muséum National d'Histoire Naturelle, Paris, France.
 NHMW — Naturhistorisches Museum, Wien, Austria.

No specimens of Scissurellidae from the Red Sea are present in the collections of the U. S. National Museum of Natural History — Smithsonian Institution (HOUBRICK in litt.), the Zoological Museum, University of Copenhagen (SCHLÖTTE in litt.), the Zoological Museum, Amsterdam (MOOLENBEEK in litt.), the Museo Civico di Storia Naturale "Giacomo Doria", Genova (ARBOCCO in litt.), the Academy of Natural Sciences of Philadelphia, Philadelphia (ROBERTSON in litt.), and the Department of Zoology, Tel-Aviv University (BARASH in litt.).

Systematic Part

Family Scissurellidae GRAY, 1847

Genus *Scissurella* d'ORBIGNY, 1824

Subgenus *Scissurella* s. str.

Scissurella (Scissurella) reticulata PHILIPPI, 1853

(Plate 1)

Original description: "Sc. testa ovata, modice depressa, lineis tenuissimis longitudinalibus et transversis decussata; spira convexiuscula; umbilico mediocri; apertura transversim ovata." PHILIPPI, 1853: 38, No. 11.

Description: Shell minute, ovate, thin, subdiaphanous. Spire small, depressed; spiral whorls scalariform; body whorl broad, convex, constitutes major part of shell; sutures incised. Protoconch of $1\frac{1}{2}$ convex whorls, sculptured with sharp, raised radial threads, separated by broad interspaces. First $1\frac{1}{4}$ postnuclear whorls convex, sculptured with numerous microscopic growth striae, which regularly thicken to prominent axial threads; threads on later part of whorl intersected by spirale ostae, intersections knobbed. On shoulder of remaining $1\frac{1}{2}$ whorls rather narrow and concavely excavated selenizone, set off from the whorl by raised, narrow edges; terminates at the outer lip in a long, narrow slit. On the postnuclear whorls above the selenizone about thirty narrow, recurved radial threads which intersect with three sharp spiral threads; intersections thicken to sharp, projecting nodules. Base rounded, sculptured below selenizone with twelve spiral threads and intersecting radial costae, which become obsolete near the umbilical area and at the inner lip. Umbilicus shallow, narrow, semilunar, smooth. Aperture ovate, oblique; outer lip sharp, cut by slit, projects over parietal wall; paries fused to body whorl; columella curved, reflected over umbilicus. Color white. Operculum and soft parts not known.

Habitat: Under boulders on shore-fringing and lagoon-fringing reefs in shallow water, population density ca. 0.01 individuals per sq. m. (MASTALLER, 1979: 242, Tab. 13).

Literature records for the Red Sea:

- Scissurella decussata* AUDOUIN, 1826: 42; 1828: 183, ex SAVIGNY, 1817: pl. V, fig. 29.
Scissurella reticulata PHILIPPI, 1853: 38, Tab. 6, fig. 11. Maksur and other localities, leg. HEMPRICH and EHRENBERG.
Scissurella reticulata PHILIPPI; MUNIER—CHALMAS, 1862: 395.
Scissurella reticulata PHILIPPI; ISSEL, 1869: 227, 346. Suez, fossil from raised coral beaches.
Scissurella reticulata PHILIPPI; PILSBRY in TRYON, 1890: 51, figs. 49, 50, 51. Red Sea.
Scissurella reticulata PHILIPPI; STURANY, 1905: 146. Jeddah, leg. JICKELI.
Scissurella reticulata PHILIPPI; PALLARY, 1926: 82, ex SAVIGNY, 1817: pl. V, fig. 29.
Scissurella reticulata PHILIPPI; FRANC, 1956: 22. Abulat Is., in coral sand from Cap Nord, leg. CHERBONNIER, 4 sp.
Scissurella reticulata PHILIPPI, 1827; MASTALLER, 1979: 29, 242, Tab. 13. Aqaba, under boulders.
Scissurella reticulata PHILIPPI, 1853; BOUCHET & DANRIGAL, 1982: 14, fig. 62, re SAVIGNY; 1817: pl. V, fig. 29.

Material in collections:

Gulf of Aqaba: Elat, Beit Williams, May 1949, leg. G. HAAS, 1 sp. (HUJ 20.316); Bir es Suweir, beach, 6. 8. 1971, leg. I. YARON, 1 sp. (IY 2306), 5. 4. 1975, leg. I. YARON, 9 sp. (IY 4433); Ras Burqa, beach, 2.—6. 4. 1980, leg. I. YARON, 5 sp. (IY 4892). Gulf of Suez: Suez?, leg. J. C. SAVIGNY, 4 sp. (MHNP), fossil, raised coral beaches, 1 sp. (IGPT). Northern Red Sea: Sinai Peninsula, Ras Muhammad, beach, 11. 4. 1976, leg. I. YARON, 10 sp. (IY 4298); Egypt, Ghardaqa, 1958, in 2 m, leg. E. STÜBER, 3 sp. (NHMW 62.379), 1958, in 3 m, leg. E. STÜBER, 1 sp. (NHMW 62.528) — both lots labelled *S. hoernesii* SEMPER, 1865. Southern Red Sea: Jeddah, leg. C. F. JICKELI, 1 sp. labelled *S. dohrniana* (DUNKER, 1861) (NHMW 39.954); Port Sudan, 3 sp. (BMNH WINCKWORTH coll. No. 1838); Abulat Is., as per FRANC, 1956: 21 (MHNP).

Remarks: — This species was first figured in SAVIGNY, 1817: pl. V, fig. 29. According to PALLARY, 1932: 320, SAVIGNY collected his specimens from the Red Sea at Suez. They were wrongly attributed by AUDOUIN to *S. decussata* d'ORBIGNY, 1824, a fossil species, and were later renamed by PHILIPPI. Since it is not possible to identify any of SAVIGNY's specimens now in the Muséum National d'Histoire Naturelle, Paris, with that illustrated in his pl. V, fig. 29, the specimen figured by BOUCHET & DANRIGAL (1982: fig. 62) is hereby designated as the lectotype of both *S. decussata* AUDOUIN, 1826 (non d'ORBIGNY, 1824) and *S. reticulata* PHILIPPI, 1853. The other specimens in this lot thus become paralectotypes. Suez, at the head of the Gulf of Suez, should be considered the type locality.

In the collection of the Naturhistorisches Museum, Wien, are also 19 specimens collected at Ain Sukhna, Persian Gulf, by KÜMEL (NHMW 59.002) and erroneously labelled as *S. hoernesii*. Thus, the presently known range of distribution of this species is the Red Sea and the Persian Gulf.

Scissurella (Scissurella) dorbignyi AUDOUIN, 1826
(Plate 2)

Original description: Absent. Subsequently described by PHILIPPI (1853: 38, No. 10) as follows: "Sc. testa ovata, vertice planiuscula, infra carinam cingulis duobus lineisque pluribus elevatis in basi circumdata, striis tenuioribus longitudinalibus decussata; apertura transversim ovata".

Description: Shell minute, globose, compressed, thin, subdiaphanous. Spire small, whorls scalariform, rapidly expanding, body whorl forms major part of shell; sutures deeply incised. Protoconch of about $1\frac{1}{2}$ convex, planorbid, smooth whorls, terminates in varix. First $1\frac{1}{4}$ whorls of teleoconch convex, microscopically striate with growth lines, each fourth or fifth more-or-less regularly thickened to a radial riblet. On further $1\frac{1}{4}$ whorls a rather broad, shallowly excavated selenizone with blunt, rounded edges on shoulder of whorls; selenizone quite regularly sculptured with widely spaced, curved riblets; terminates in a long, narrow slit at the margin. Whorls above selenizone moderately convex at suture and inflected at shoulder; sculptured with about thirty five more-or-less evenly and widely spaced curved weak axial threads, which intersect some seven fine spiral threads; in interspaces numerous dense microscopic growth lines. Below the selenizone spiral whorls concave, lined with axial threads and microscopic growth lines. On body whorl below selenizone three prominently elevated spiral carinae and a secondary spiral cord midway between the selenizone and the upper carina; interspaces broad, concave, sculptured with widely spaced axial threads and numerous dense, microscopic growth lines. Base flattened, bearing five spiral cords, which become obsolete at inner lip, and curved axial threads and growth striae. Umbilicus rather narrow, quite deep, semilunar, set off from base by spiral cord, lined within with curved growth lines. Aperture ovately subrectangular, oblique; outer lip sharp, incised by slit, projects over parietal wall; paries fused to body whorl; columella curved, reflected over umbilicus. Color milky white. Operculum and soft parts not known.

Habitat: Not known.

Literature records from the Red Sea:

- Scissurella dorbignii* AUDOUIN, 1826: 42; 1828: 183, ex SAVIGNY, 1817: pl. V, fig. 30.
Scissurella d'orbignyi AUDOUIN; PHILIPPI, 1853: 38, Tab. 6, Fig. 10. Gumfudde, leg. HEMPRICH and EHRENBERG.
Scissurella orbignyi AUDOUIN; MUNIER-CHALMAS, 1862: 395.
Scissurella orbignyi AUDOUIN; ISSEL, 1869: 228.
Scissurella dorbignyi AUDOUIN; PILSBRY in TRYON, 1890: 50—51, figs. 85, 86, 87. Red Sea.
Scissurella d'orbignyi AUDOUIN; STURANY, 1905: 146. Jeddah, leg. JICKELI.
Scissurella orbignyi AUDOUIN; PALLARY, 1926: 82, ex SAVIGNY, 1817: pl. V, fig. 30.
Scissurella orbignyi AUDOUIN; FRANC, 1956: 21. Abulat Is., in coral sand from Cap Nord, leg. CHERBONNIER, 3 sp.
Scissurella orbignyi AUDOUIN, 1827; MASTALLER, 1979: 29.
Scissurella dorbignii AUDOUIN, 1826; BOUCHET & DANRIGAL, 1982: 12, fig. 63, re SAVIGNY, 1817: pl. V, fig. 30.

Material in collections:

Gulf of Aqaba: Elat, May 1949, leg. G. HAAS, 3 sp. (HUJ 20.314); Bir es Suweir, beach, 6. 8. 1971, leg. I. YARON, 3 sp. (IY 2306a, IY 2884, IY 2886), 5. 4. 1975, leg. I. YARON, 4 sp. (IY 4534); Ras Burqa, beach, 2.—6. 4. 1980, leg. I. YARON, 5 sp. (IY 4890); Shurat el Gharqana, beach, 10. 4. 1976, leg. I. YARON, 1 sp. (IY 4269). Gulf of Suez: Suez?, leg. J. C. SAVIGNY, 5 sp. (MHNP). Northern Red Sea: Sinai Peninsula, Ras Muhammad, beach, 11. 4. 1976, leg. I. YARON, 1 sp. (IY 4921); Egypt, Ghardaqa, 1958, in 2 m, leg. E. STÜBER, 1 sp. (NHMW 62.608), 1958, in 3 m, leg. E. STÜBER, 1 sp. (NHMW 69.874) — both lots labelled *S. reticulata* PHILIPPI, 1853. Southern Red Sea: Jeddah, leg. C. F. JICKELI, 1 sp. (NHMW 39.955); Abulat Is., as per FRANC, 1956: 21 (MHNP).

Remarks: — This species was also first figured in SAVIGNY, 1817: pl. V, fig. 30. It was named by AUDOUIN (1826: 42) without a description, which was later provided by PHILIPPI (1853: 38). As in the case of *S. reticulata*, it is not possible to identify any of SAVIGNY's specimens in the collection of the Muséum National d'Histoire Naturelle, Paris with the specimen figured by him. Therefore, I hereby designate as the lectotype the specimen figured in BOUCHET & DANRIGAL (1982: fig. 63), and propose to consider all the other specimens of the lot as paralectotypes. Suez, Gulf of Suez, is selected as the type locality.

One specimen of this species was collected by FAUROT in coral sand at Obock, Gulf of Aden (JOUSSEAUME, 1888: 194). The known present range of distribution of this species is, therefore, the Red Sea and the Gulf of Aden.

Scissurella dohrniana (DUNKER, 1861) nomen dubium.

Original description: "Testa globosa, tenuissima, subdiaphana, concentric tenerrimeque striata, anguste umbilicata; anfractus 3 carinati, spira parvula scalata; rima haud profunda, carinam anfractuum tenens; labrum tenue acutum; apertura obliqua, suborbicularis, paene elliptica." DUNKER, 1861: 35.

Literature records from the Red Sea:

Anatomus dohrnianus DUNKER, 1861: 35. "E Mari Erythraeo".

Scissurella dohrniana DUNKER; MUNIER-CHALMAS, 1862: 396.

Scissurella dohrniana DUNKER; ISSEL, 1869: 228.

Scissurella dohrniana DUNKER; PILSBRY in TRYON, 1890: 60.

Anatomus dohrnianus DUNKER; STURANY, 1905: 146. Jeddah, leg. JICKELI.

Scissurella dohrniana DUNKER; THIELE, 1912: 11.

Remarks: — DUNKER's description, which was not accompanied by an illustration, is too general and vague to permit recognition of the species. Neither PILSBRY, nor THIELE, who have monographed the Scissurellidae, have seen DUNKER's type specimens, and have not figured the species in their respective monographs. Moreover, THIELE (1912: 11) remarked, that no specimens of this species could be found in DUNKER's collection, and that it was, therefore, impossible to determine whether it was separable from *S. reticulata*.

HABE and KOSUGE (1964: 3) have assigned it to their genus *Sukashitrochus*, whose distinguishing features are the presence on the body whorl of three strong spiral cords and a small arrow-shaped pit on the shoulder. However,

there is no reference to such morphological features in DUNKER's description, and, therefore, such generic assignment cannot be accepted. Furthermore, it is doubtful whether these authors have had the opportunity to examine DUNKER's type specimens, which, as was mentioned above, have not been located so far.

In the collection of the Naturhistorisches Museum, Wien, are three specimens collected by JICKELI at Jeddah (NHMW 39.954) and labelled as *Scissurella dohrniana*. Examination of the specimens revealed, that one of them is not a Scissurellid at all, another is a fragmented specimen of *S. reticulata*, while the beach-eroded third one is a *Sinezona* species, described herebelow as *S. armillata*.

Thus, in the absence of an original illustration and of type specimens, in view of the very vague and general original verbal description, and in the absence of any additional material from the area of the Red Sea, which could conform with the description, we must consider DUNKER's taxon as nomen dubium.

Scissurella (Scissurella) rota sp. n.

(Plate 3)

Diagnosis: Shell minute, globose, apically compressed, thin, subdiaphanous; selenizone on shoulder, bordered by produced edges, which bear short, prominent radial riblets; slit long; on whorls above selenizone strong, widely spaced axial ribs which do not extend to edge; below selenizone very prominent curved axial ribs, which are pendantly nodulose at junctions with spiral cords; umbilicus rather large, shallow; aperture rounded, columella reflected; color white.

Description: Shell minute, globose, apically compressed, thin, fragile, subdiaphanous. Spire small, spiral whorls scalariform, rapidly expanding; body whorl constitutes major part of shell; sutures deeply incised. Protoconch of about one whorl, planorbid, convex, overlapped by subsequent whorls, prominently sculptured with about sixteen rather thin radial riblets, which commence at some distance below the sutures, and terminate in arched bifurcations; set off from postnuclear whorls by prominent varix. First whorl of teleoconch convex, sculptured with numerous dense, microscopic growth striae and about fifteen prominent, rounded, widely spaced, rather straight axial ribs. On next $1\frac{1}{2}$ whorls rather broad, quite deeply excavated selenizone with produced, raised, thickened edges at shoulder, terminates in long, narrow slit at margin; selenizone regularly lined with prominent, widely spaced axial ribs. Above the selenizone whorls rounded, strongly concave at shoulder; sculpture of numerous dense, curved, microscopic striae and about twenty quite regularly and widely spaced prominent, rounded, slightly curved axial ribs, which do not extend to shoulder, but terminate at edge of selenizone; midway on whorls one or two faint spiral threads, at intersections with which the axial ribs thicken; edges of selenizone lined with short, prominent axial

riblets, which are usually twice as numerous as the main ribs. On the spire below the selenizone and the rather vertically descending edge the whorls are convex and carry strong axial ribs which correspond in number and position to those above the selenizone. The body whorl below the selenizone is rounded; there are about twenty widely spaced, very strong, diagonally curved, elevated axial ribs, which are more prominent at the margin, and become obsolete near the umbilical rim; also thirteen spiral threads, which are secondary to the axial ribs near the selenizone, but gradually become the major sculptural element closer to the umbilical area; at junction of spiral and radial ribs the latter thicken, particularly in their upper part, to pendant, bulbous nodules, and generally have a fluted appearance; in the interspaces between the ribs numerous, dense, microscopic growth lines. Umbilicus rather broad, shallow, funnel-shaped, semilunar, set off from base by spiral cord, lined within with axial growth lines. Aperture ovate-oblong, oblique; outer lip sharp, incised with slit, projects over parietal wall; paries fused to body whorl; columella curved, reflected over umbilicus. Color white. Operculum and soft parts not known.

Habitat: Not known.

Type material: Holotype — Abulat Is., southern Red Sea, leg. CHERBONNIER (MHNP). Paratypes — Ghardaqa, Egypt, northern Red Sea, leg. STÜBER, one (NHMW 62.594), Ain Sukhna, Persian Gulf, leg. KÜMEL, five (NHMW 58.902).

Type locality: Abulat Is., southern Red Sea.

Literature records from the Red Sea:

Schismope padangensis THIELE; FRANC, 1956: 21. Abulat Is., in coral sand from Cap Nord, leg. CHERBONNIER, 1 sp.

Schismope padangensis THIELE, 1912; MASTALLER, 1979: 29.

Material in collections:

Gulf of Aqaba: Bir es Suweir, beach, 6. 8. 1971, leg. I. YARON, 1 sp. (IY 2797); Ras Burqa, beach, 2.—6. 4. 1980, leg. I. YARON, 5 sp. (IY 4891); Shurat el Gharqana, beach, 10. 4. 1976, leg. I. YARON, 2 sp. (IY 4266, IY 4912). Northern Red Sea: Egypt, Ghardaqa, 1958, in 3 m, leg. E. STÜBER, 1 sp. (NHMW 62.594), identified as *Scissurella costata* d'ORBIGNY, 1823. Southern Red Sea: Abulat Is., in coral sand, leg. CHERBONNIER, 1 sp. (MHNP), identified as *Schismope padangensis* THIELE, 1912.

Remarks: — This species has apparently been erroneously identified by FRANC as *S. padangensis*. The latter species, which was described by THIELE (1912: 25, Tab. 3, figs. 23, 24) from Padang, Sumatra, has a rather elongate, cuneiform foramen close to the margin, and is a *Sinezona*. Examination of one of THIELE's type specimens has revealed, that it further differs from *Scissurella rota* in the sculpture of the body whorl, having numerous sharp axial riblets, and lacking the prominent, fluted ribs with pendant nodules at the intersections with the spiral threads, so characteristic of the latter. Moreover, its spiral sculpture is barely visible, except at the base.

The identification of the specimens in the collection of the Naturhistorisches Museum, Wien, both from the Red Sea and from the Persian Gulf, with *Scissurella costata* d'ORBIGNY, 1823 seems likewise to be erroneous. This species has previously been reported from the Atlantic Ocean (Canary Islands, Bermuda) and from the Mediterranean. The specimens of *S. rota* differ from typical specimens of *S. costata* (e. g. from Dalmatia, Palermo and Algeri — all in the COEN collection, H U J), in having a more solid and less diaphanous shell, with a more regular and prominent axial sculpture, and mainly in having on the axial ribs of the body whorls those pendant projections, which give the shell its remarkable nodulose appearance.

In the collection of the Naturhistorisches Museum, Wien, are five specimens, collected by KÜMEL at Ain Sukhna, Persian Gulf (NHMW 58.902). Thus, the presently known range of distribution of this species is the Red Sea and the Persian Gulf.

Subgenus *Anatoma* WOODWARD, 1859
Scissurella (Anatoma) jacksoni MELVILL, 1904
 (Plate 4)

Original description: "S. testa parva, profunde umbilicata, oblongo-ovata, undique alba, tenuissime delicata, anfractibus 5, quorum apicalis parvus, globularis, hyalinus, caeteris ad medium bicarinatis, suturis compressis, arctissime omnino longitudinaliter liratis, liris supra carinas curvatis, infra rectis, ultimo anfractu infra, usque ad basim, obscure spiraliter striato, inter carinas sinu angusto, sed longo, apertura rotundata, labro ad sinum paulum incrassato, margine columellari supra umbilicum extenso." MELVILL, 1904: 160. Tab. 10, fig. 5.

Description: Shell minute, globose, thin, fragile, subdiaphanous. Spiral whorls rapidly expanding, body whorl forms major part of shell; sutures incised, submerged. Protoconch planorbid, convexly depressed, of one smooth whorl, followed by another half whorl with more-or-less evenly spaced thin, curved radial threads. On remaining $2\frac{3}{4}$ whorls broad, concavely excavated selenizone on periphery of whorls, set off by sharp, produced edges, which give the periphery a carinated appearance; selenizone sculptured with regular, curved riblets; slit long, extends to outer lip. On whorls above selenizone numerous prominent, sharp, curved radial threads, and in interspaces about twelve thin spiral lirae; below selenizone whorls mostly absorbed in subsequent ones. Base of body whorl rounded, deeply and rather narrowly umbilicated, reticulately sculptured with numerous spiral and radial sharp costae of almost equal strength. Aperture ovate, flaring over base; paries fused to body whorl; columella reflected over umbilicus. Color white. Operculum and soft parts not known.

Habitat: Not known.

There are no known literature records for this species from the Red Sea.

Material in collections:

Gulf of Aqaba: Elat, harbor, 1969, dredged in 80 m, 6 sp. (H.U.J.), opposite electric power station, 9. 2. 1970, bottom grab in 320 m, leg. D. ZALCMAN, 1 sp. (IY 5012); off Nuweiba el Tarabeen, St. 39, 8. 10. 1969, triangular dredge, 75–80 m, leg. Ch. LEWIN-SOHN, 1 sp. (IY 5017).

Remarks: — This is the first record of this species in the Red Sea. In the BLOK collection, Hebrew University of Jerusalem, there is a specimen of this species collected in the Gulf of Oman, MELVILL's type locality, at a depth of 156 fathoms (H.U.J. — BLOK 4924).

Scissurella ? sp.

(Plate 5)

Description: Shell minute, globose, delicate, semidiaphanous, externally glossy. Protoconch of about $1\frac{1}{2}$ whorls, depressed, overlapped by subsequent whorls; whorls strongly convex, carrying closely spaced, S-shaped sharp axial threads, set off from underlying suture by an elevated spiral cord. Post-nuclear whorls strongly convex, rapidly expanding; first $1\frac{1}{2}$ whorls of teleoconch carry sharp, prominent, curved axial threads, in the broad interspaces between which are microscopic growth striae and after about one whorl also a few spiral threads. On remaining $1\frac{1}{2}$ whorls broad selenizone on periphery of whorl; this is bordered by two thin spiral cords, and sculptured with curved, dense growth striae, which regularly thicken into costae. Above the selenizone halfway to the incised suture are four thin spiral threads, which do not form knobs or nodules at junctions with the widely spaced, curved axial threads. Below the selenizone are about nine closely set thin spiral threads, irregularly diagonally crossed by axial threads and microscopic growth lines. On the body whorl below the selenizone the base is globose, carrying numerous closely set spiral threads, crossed by axial striae, which become prominent near the outer lip. At the base is a funnel-shaped, rather broad, deep umbilicus, set off by a thin cord, and lined within with axial growth lines. Aperture oval, outer lip entire, except for slit; paries fused to body whorl; columella curved, reflected over umbilicus. Color milky white. Operculum and soft parts unknown.

Habitat: Not known.

Material in collections:

Gulf of Aqaba: Elat, May 1949, leg. G. HAAS, 1 sp. (H.U.J. 20.315).

Remarks: — This specimen does not seem to resemble any known species, and probably has not been described so far. However, since this beach-collected specimen has a somewhat fractured outer lip and a very short fractured slit, it is not possible with certainty to place it in either *Sinezona* or *Scissurella*. Furthermore, in my opinion it would not be productive to institute a new taxon on the basis of a single, and, moreover, somewhat damaged specimen. I, therefore, defer the naming of this species to such occasion, when additional specimens may be available for further study.

Genus *Sinezona* FINLAY, 1827*Sinezona armillata* sp. n.

(Plate 6)

Diagnosis: Shell minute, globose, thin; spiral whorls biconcave; selenizone at shoulder of whorls; foramen cuneiform, at outer lip; on whorls above selenizone sculpture of intersecting radial and spiral costae; on body whorl below selenizone strong spiral cords and radial lamellae in interspaces; umbilicus deep, narrow; columella reflected over umbilicus. Color greyish-white.

Description: Shell minute, globose-ovate, fragile. Spiral whorls bicarinate, rapidly expanding; body whorl constitutes major part of shell; sutures deeply incised. Protoconch convex, depressed, of about $1\frac{1}{2}$ whorls, regularly sculptured with thin, sharp radial costae; in the interspaces dense, microscopic growth lines. First postnuclear whorl concave, sculptured with numerous microscopic growth lines and widely spaced thin radial threads. On remaining $1\frac{1}{4}$ whorls rather broad, concave, shallowly excavated selenizone at shoulder of whorls, regularly sculptured with sharp, curved lines; set off from shoulder by projecting edges. Above selenizone almost flat, sloping whorls, sculptured with about forty prominent, curved, radial costae, and five intersecting spiral threads; intersections obsoletely nodulose; in interspaces dense, microscopic growth lines. Below selenizone whorls biconcave, bearing midway a sharp, prominent carina, and regularly sculptured with widely spaced radial costae. On body whorl below selenizone straight, vertically descending band, which bears three spiral threads and thin, widely spaced radial costae; below band five broad, prominent spiral cords, separated by broad concave interspaces, which are sculptured with diagonally slanting, strong axial riblets. Foramen cuneiform, proximate to margin. Base rounded, bearing five prominent spiral cords and about forty radial costae; interspaces concave. Umbilicus deep, rather narrow, funnel-shaped, semilunar, sculptured within with microscopic growth lines. Aperture ovate, oblique, projects over parietal wall; outer lip entire; paries fused to body whorl; columella curved, reflected over umbilicus. Color greyish-white. Operculum and soft parts not known.

Habitat: Not known.

Type material: Holotype — Jeddah, leg. C. F. JICKELI (NHMW 39.954). Paratype — Jeddah, leg. C. F. JICKELI, 1 sp. (NHMW 39.956).

Type locality: Jeddah, Red Sea.

Remarks: — The holotype has been erroneously identified as *Scissurella dohrniana* (DUNKER, 1861), and has been recorded as such by STURANY (1905: 146). The paratype has likewise been erroneously identified as *Scissurella reticulata* PHILIPPI, 1853. However, in both specimens the slit does not extend to the outer lip. The presence on the selenizone of a cuneiform foramen indicates that this species belongs to *Sinezona*. Within the latter genus I cannot find any other species, which is similarly girdled on the body whorl below the selenizone with such prominent spiral cords, and with the interspaces bearing similar

diagonally slanting axial lamellae. Indeed, this distinguishing feature is so remarkable, that I have no reservations in naming this species, although only two specimens in a rather poor state of preservation are available at present.

Sinezona tricarinata sp. n.

(Plate 7)

Diagnosis: Shell minute, globose, compressed, thin, subdiaphanous; whorls scalariform, sutures deeply impressed; protoconch planorbid, smooth; selenizone broad, concave, at shoulder of whorls; postnuclear whorls above selenizone almost straight, below selenizone on body whorl tricarinate due to two sharp spiral folds; on whorls microscopic growth lines, regular, widely spaced axial costae, and occasional spiral threads; umbilicus narrow, deep; aperture subrectangular, entire, columella curved, reflected; color white.

Description: Shell minute, globose, apically compressed, thin, subdiaphanous. Spire small, spiral whorls scalariform, rapidly expanding, body whorl constitutes major portion of shell; sutures deeply impressed. Protoconch of about one whorl, planorbid, smooth, convex, overlapped by subsequent whorls, terminates in prominent varix. First $1\frac{1}{4}$ whorls of teleoconch convexly rounded, sculptured initially irregularly with widely spaced, thin, sharp radial riblets, some of them continuous, other interrupted; in interspaces dense, microscopic growth lines. On remaining $1\frac{1}{4}$ whorls of shell broad, concavely excavated selenizone at shoulder, set off from whorl by sharp, elevated edges; within the selenizone regular, widely spaced, prominent, curved riblets; foramen proximate to margin, rather short, cuneiform. Above selenizone whorls inflect from distinctly convex at sutures to strongly concave at edge of selenizone; sculpture of about thirty widely spaced, regular, curved, thin, prominent axial costae intersecting near the selenizone with three spiral threads; interspaces microscopically striate with growth lines. Below selenizone whorls concave, bearing widely spaced axial costae and microscopic striae in interspaces. Body whorl strongly compressed; below selenizone two prominent, sharp spiral folds, giving whorl tricarinate appearance. Interspaces between folds deeply concave; in median part of each interspace one or two thin spiral threads, intersected by widely spaced, quite regular oblique axial threads; intersections obsoletely knobbed. Base flatly convex, with four pronounced spiral cords, which become obsolete at inner lip, and numerous, curved, thin axial threads. Umbilicus deep, rather narrow, funnel-shaped, bordered by ultimate spiral cord, sculptured within with alternating axial striae and riblets. Aperture subrectangular, oblique, entire, projects over parietal wall; outer lip sharp, entire; paries fused to body whorl; columella curved, reflected over umbilicus. Color white. Operculum and soft parts not known.

Habitat: Not known.

Type material: Holotype — Ghardaqa, Egypt, leg. STÜBER (NHMW 62.639a). Paratypes — Ghardaqa, leg. STÜBER, one (NHMW 62.639b); Gulf of

Aqaba, Shurat el Gharqana, leg. YARON, one (IY 4910); Persian Gulf, Ain Sukhna, leg. KÜMEL, six (NHMW 59.004).

Type locality: Ghardaqa, Egypt, northern Red Sea.

Remarks: — In the collection of the Naturhistorisches Museum, Wien, the specimens from Ghardaqa and from Ain Sukhna have been identified as *Schismope atkinsoni* (TENISON-WOODS, 1877). The type locality of the latter species is Tasmania, and its range of distribution is from New South Wales, Australia to Tasmania at depths from 6 to 155 m (HABE & KOSUGE, 1964: 3). It has been figured, inter alia, by THIELE (1912: Tab. 3, fig. 26) and by MACPHERSON & GABRIEL (1962: fig. 46). From these figures a certain resemblance may be noted with *S. tricarinata*. However, the latter species is considerably more compressed, with the body whorl below the selenizone pronouncedly more tricarinate, and with a much more prominent reticulate sculpture of axial and spiral threads on the whorls.

TENISON-WOODS (1877: 149) in the discussion of his taxon, remarks: "After a careful comparison, I must say that the species is so near the British *S. crispata* that the differences are almost inappreciable . . . I separate the Tasmanian species from the British one only to promote further investigation". This statement raises serious doubts about the identification of *Sinezona atkinsoni*. *Scissurella crispata* FLEMING, 1828, is a well known circumpolar species, most thoroughly described and illustrated for example in FRETTER and GRAHAM (1976: 2—4, figs. 1, 2). If it is indistinguishable from *Sinezona atkinsoni* sensu TENISON-WOODS, then the species figured in THIELE (1912) and MACPHERSON & GABRIEL (1964) must be a different one altogether. The elucidation of the correct identity of *S. atkinsoni* warrants further investigation, but, unfortunately, is beyond the scope of the present work.

Superficial resemblance may be noted of *S. tricarinata* also with *S. carinata* (A. ADAMS, 1862), which was originally described from Japan. It was later reported by SMITH (1910: 207) from Natal, South Africa. In the Muséum National d'Histoire Naturelle, Paris, there is a specimen from Djibouti, Somalia, identified as *S. carinata* (BOUCHET in litt.). The former species differs from it in being less globose and ovate, more depressed, and having a stronger spiral sculpture of carinae on the body whorl below the selenizone.

The presently known range of distribution of this species is the Gulf of Aqaba, the northern Red Sea, and the Persian Gulf.

Sinezona sp.
(Plate 8)

Description: Shell minute, globose, compressed, opaque, relatively solid. Protoconch eroded, probably consisting of $1\frac{1}{2}$ whorls. Teleoconch of about two, rapidly expanding, roundly convex whorls; sutures incised. Rather broad selenizone with sharply raised, produced edges at periphery; foramen on body whorl cuneiform, elongate, somewhat removed from margin. Sculpture on

whorls above selenizone consists of numerous, recurved, rather sharp axial riblets and intersecting spiral threads; junctions obsolete nodulose; below selenizone whorls almost completely absorbed in subsequent whorls. Base of shell rounded, imperforate, carrying numerous closely set, axial lamellae and intersecting spiral cords; intersections nodulose. Aperture ovate, entire, projecting over parietal wall; columella reflected over base. Color light brown. Operculum and soft parts unknown.

Habitat: Not known.

Material in collections:

Gulf of Aqaba: South of Nuweiba, Menzies trawl, 550—700 m, leg. D. ZALCMAN, 1 sp. (IY 5003).

Remarks: — This species has a general appearance of a *Scissurella* (*Anatoma*) on account of the rather high spire and the selenizone being situated midway on the periphery of the whorls. However, in view of the presence of a foramen rather than of a slit extending to the outer lip, one can place it without hesitation in *Sinezona*. I cannot find any species in the latter genus which would resemble it in morphology, and presume that it is another so far undescribed species. Unfortunately, only a single, rather eroded specimen is known at present, and I hesitate, therefore, to name the species until further material is available for study.

Discussion

Prior to the present review, the presence was known from literature records of four Scissurellid species in the Red Sea. Among these, the occurrence of *Scissurella reticulata* and *S. dorbignyi* has been documented on the basis of specimens collected by SAVIGNY, HEMPRICH and EHRENBURG, JICKELI and the "Calypso" expedition, that of *S. dohrniana* from JICKELI's collection, and that of *Sinezona padangensis* from a single specimen found by the „Calypso" expedition. This study has shown, that the records for the latter two species have been based on misidentifications. *S. padangensis* is not found in the Red Sea. The specimen collected by the "Calypso" expedition, together with additional specimens from the Gulf of Aqaba and the northern Red Sea, belong to a new species — *Scissurella* (*Scissurella*) *rota*, representatives of which have also been found in the Persian Gulf. *S. dohrniana* is shown to be a nomen dubium. A new taxon — *Sinezona armillata* has been instituted for JICKELI's specimens from Jeddah.

This review also constitutes the first records of the presence in the Red Sea of four additional species, namely *Scissurella jacksoni*, previously reported from the Gulf of Oman, *Sinezona tricarinata* sp. n., *Scissurella* sp., and *Sinezona* sp., the latter two possibly hitherto unnamed species, represented each by a single specimen.

Scissurellidae, because of their minute dimensions, have been frequently overlooked. It may be expected, that with additional collecting and more

careful attention to material collected, additional locality data and possibly even some more Scissurellid species from the Red Sea area will come to light.

On the basis of critically revised literature records and material in collections, the distribution of Scissurellidae in the four regions of the Red Sea and beyond it is summarized in the following table.

	Gulf of Aqaba	Gulf of Suez	Northern Red Sea	Southern Red Sea	Other localities
<i>Scissurella reticulata</i>	+	+	+	+	Persian Gulf
<i>Scissurella dorbignyi</i>	+	+	+	+	Gulf of Aden
<i>Scissurella rota</i>	+		+	+	Persian Gulf
<i>Scissurella jacksoni</i>	+				Gulf of Oman
<i>Scissurella</i> sp.	+				
<i>Sinezona armillata</i>				+	
<i>Sinezona tricarinata</i>	+		+		Persian Gulf
<i>Sinezona</i> sp.	+				

In view of the limited amount of information available, it would be premature to draw any conclusions of zoogeographical significance from this table. However, it seems to indicate which species should be excepted to be present in the respective regions of the Red Sea.

It should be remarked, that even with the presently limited amount of information available, the Red Sea is seen to possess a rich Scissurellid fauna, consisting of at least eight species, some of them possibly endemic. This should be compared to the five species, inhabiting the entire western North American coast from Alaska to Baja California (McLEAN, 1967), six found along the eastern North American coast from the Arctic to the West Indies (ABBOTT, 1974), and four species in the entire Mediterranean (NORDSIECK, 1968).

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Captions for Figures

Plate 1

Scissurella (Scissurella) reticulata PHILIPPI, 1853. Specimen from Ras Burqa, leg. I. YARON (IY 4892). Scanning electron photomicrographs by SEM unit, Ben-Gurion University of the Negev.

- Fig. 1. General view of shell from above.
 Fig. 2. Protoconch and early postnuclear whorls.
 Fig. 3. Base, aperture, and umbilical area.

Plate 2

Scissurella (Scissurella) dorbignyi AUDOUIN, 1826. Specimen from Ras Burqa, leg. I. YARON (IY 4890). Scanning electron photomicrographs by SEM unit, Ben-Gurion University of the Negev.

- Fig. 1. General view of shell from above.
 Fig. 2. Protoconch and early postnuclear whorls.
 Fig. 3. Base, aperture and umbilical area.

Plate 3

Scissurella (Scissurella) rota sp. n. Holotype from Abulat Is., leg. CHERBONNIER (MHNP). Scanning electron photomicrograph by Centre de Microscopie, Bd. Raspail, Paris.

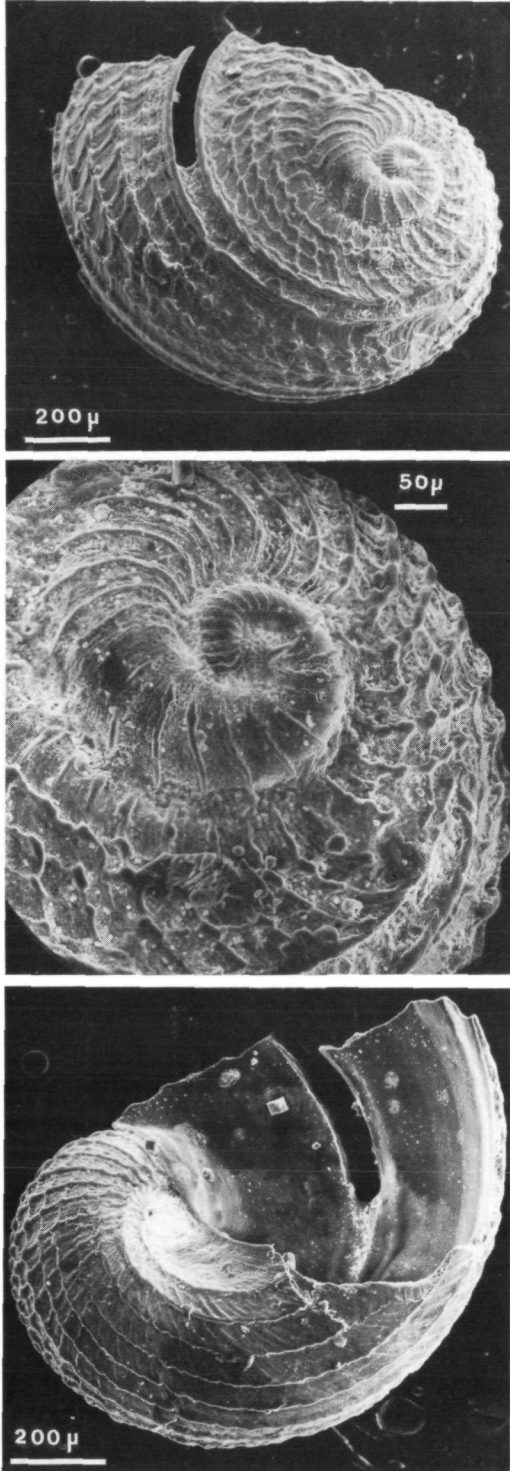
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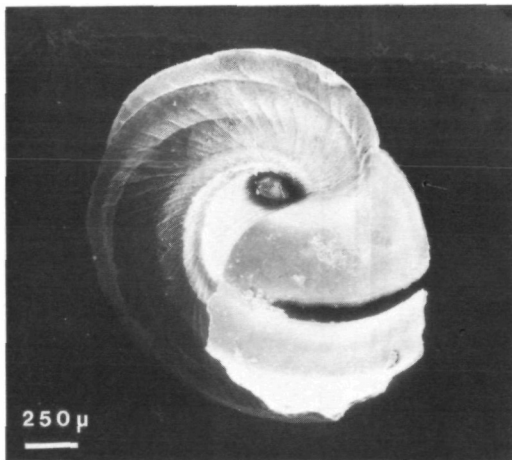
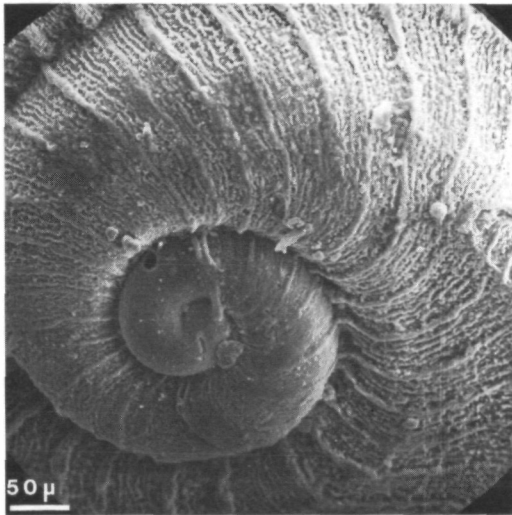
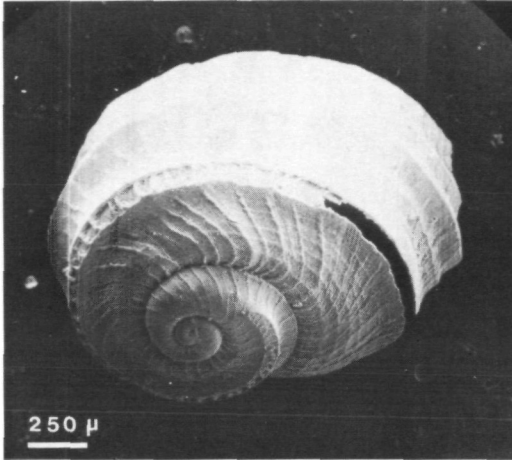
- Fig. 2. Protoconch and early postnuclear whorls.
 Fig. 3. Detail of sculpture of whorl and edge of selenizone.
 Fig. 4. Base, aperture and umbilical area.
 Fig. 5. Detail of sculpture on base of body whorl.

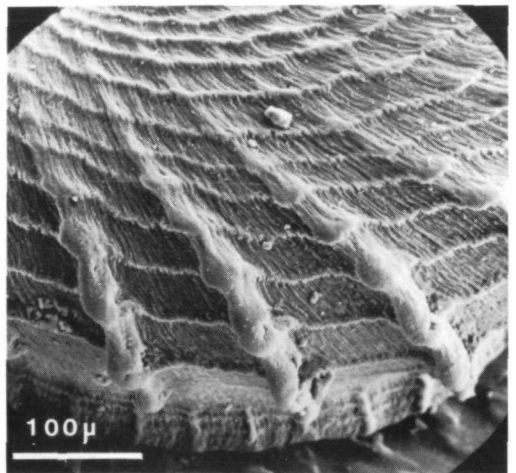
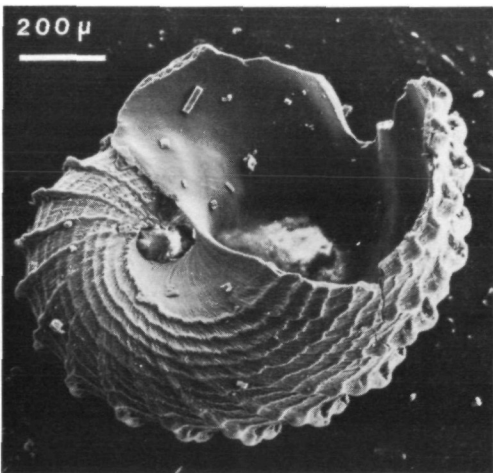
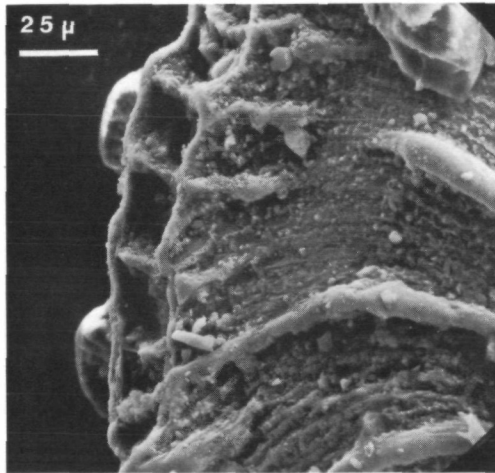
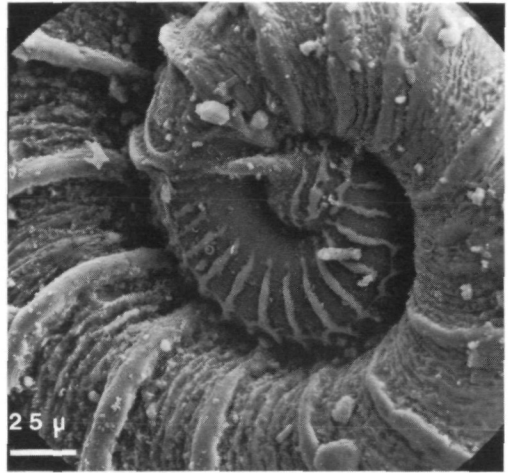
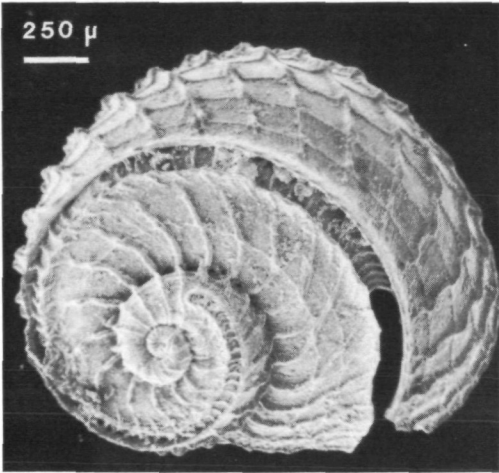
Plate 4

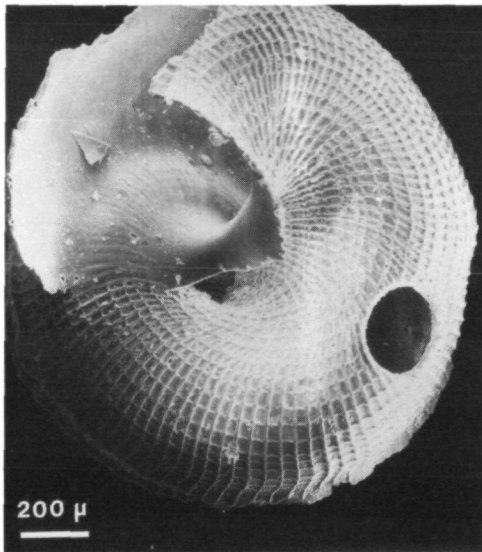
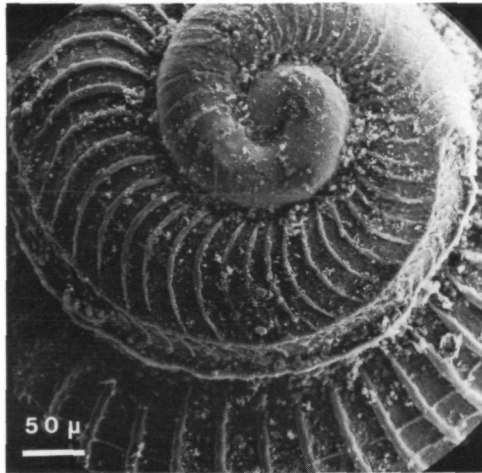
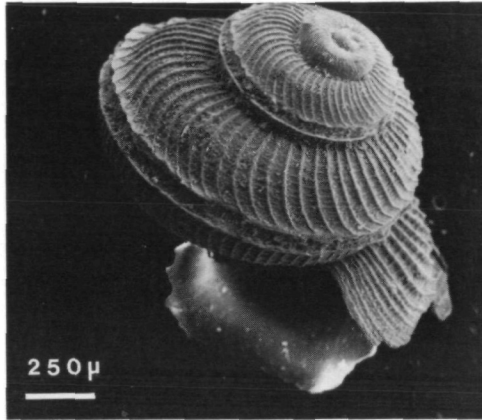
Scissurella (Anatoma) jacksoni MELVILL, 1904. Specimen from Elat harbor (HUJ) Scanning electron photomicrographs by SEM unit, Ben-Gurion University of the Negev

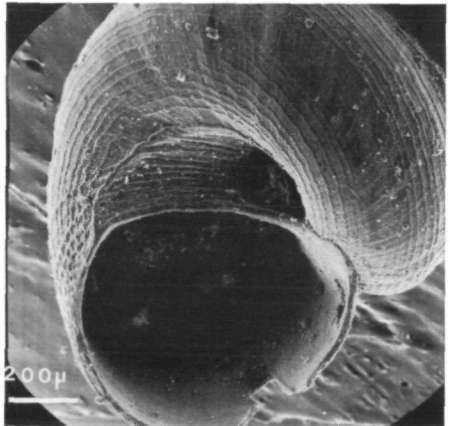
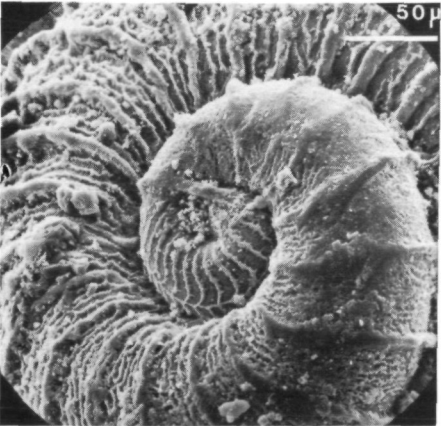
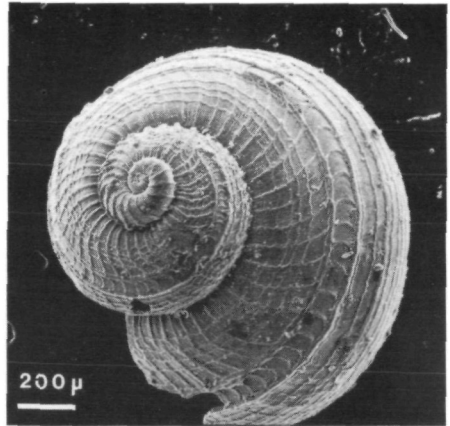
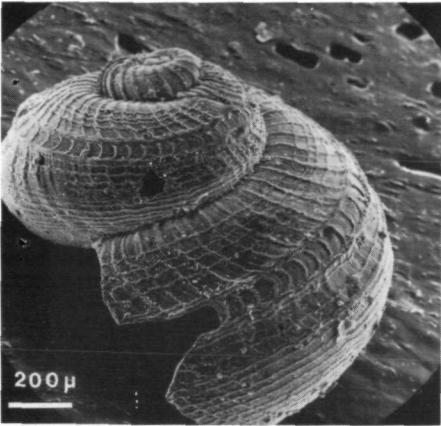
- Fig. 1. General view of shell.
 Fig. 2. Protoconch and early postnuclear whorls.
 Fig. 3. Base, aperture and umbilical area.

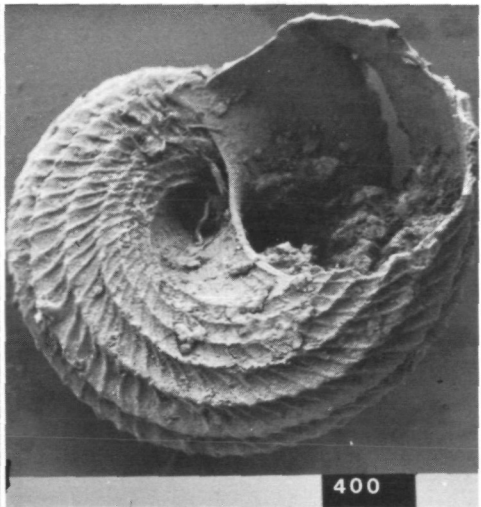
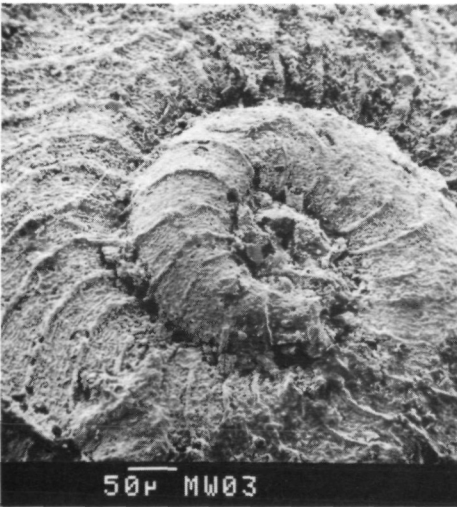
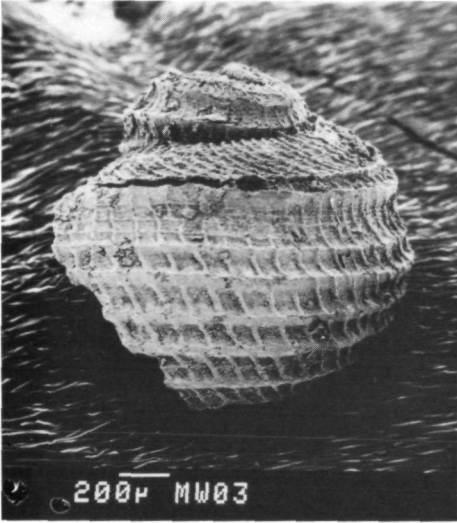


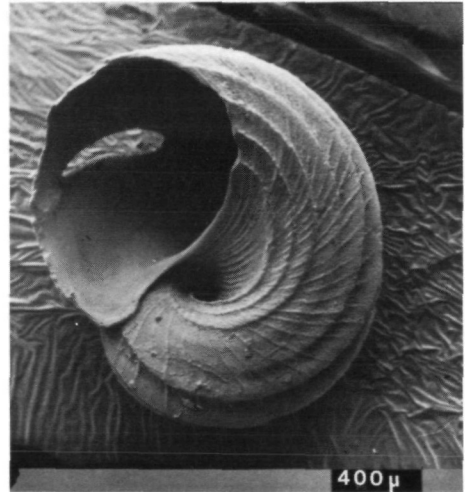
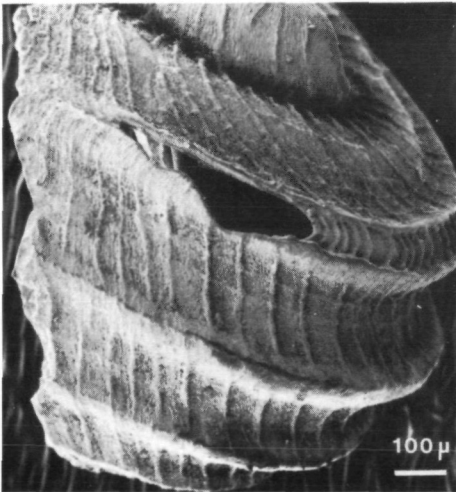
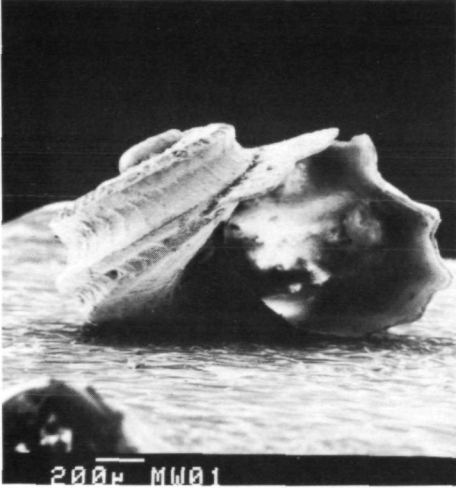












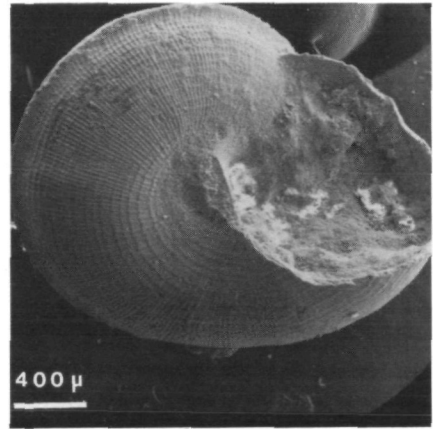
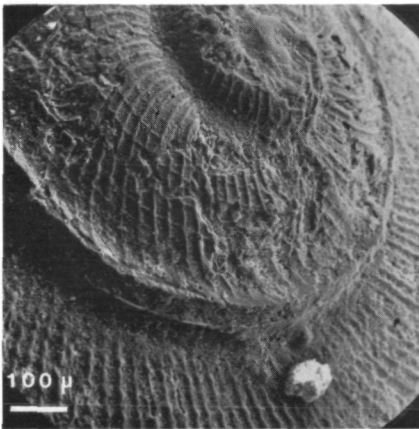
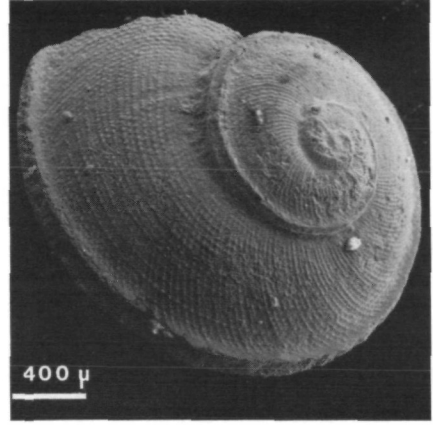
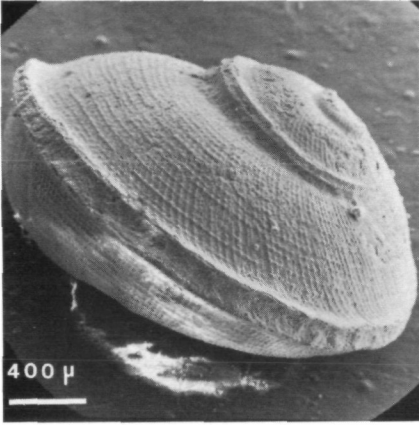


Plate 5

Scissurella ? sp. Specimen from Elat, leg. G. HAAS (HUJ 20.315). Scanning electron photomicrographs by SEM unit, Ben-Gurion University of the Negev.

- Fig. 1. General side view of shell.
- Fig. 2. General view of shell from above.
- Fig. 3. Protoconch and early postnuclear whorls.
- Fig. 4. Base, aperture, and umbilical area.

Plate 6

Sinezona armillata sp. n. Holotype from Jeddah, leg. C. F. JICKELI (NHMW 39.954). Scanning electron photomicrographs by E. WAWRA, Naturhistorisches Museum Wien.

- Fig. 1. General side view of shell.
- Fig. 2. General view of shell from above.
- Fig. 3. Protoconch and early postnuclear whorls.
- Fig. 4. Base, aperture and umbilical area.

Plate 7

Sinezona tricarinata sp. n. Paratype from Ain Sukhna, Persian Gulf, leg. KÜMEL (NHMW 59.004). Scanning electron photomicrographs by E. WAWRA, Naturhistorisches Museum Wien.

- Fig. 1. General side view of shell.
- Fig. 2. Protoconch and early postnuclear whorls.
- Fig. 3. Detail of foramen and carinae on body whorl.
- Fig. 4. Base, aperture and umbilical area.

Plate 8

Sinezona sp. Specimen from south of Nuweiba, leg. D. ZALCMAN (IY 5003). Scanning electron photomicrographs by SEM unit, Ben-Gurion University of the Negev.

- Fig. 1. General side view of shell.
- Fig. 2. General view of shell from above.
- Fig. 3. Protoconch and early postnuclear whorls.
- Fig. 4. Base, aperture and umbilical area.

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