

A NEW SPECIES OF *COELOPLEURUS* (ECHINOIDEA) FROM THE MIOCENE OF MALTA

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ABSTRACT. *Coelopleurus melitensis* sp. nov. is described from the Lower Miocene of Malta. The genus has not previously been recorded from the Miocene of the Mediterranean region.

A PART from a few Quaternary deposits, all the rocks that outcrop on Malta are marine sediments that are now thought to be Lower Miocene in age (Eames *et al.* 1962). The new species was found just beneath the transition strata known as the Scutella Bed, overlying the lowest formation, the Lower Coralline Limestone, at Qammieh, on the north-west coast of Malta, on the edge of a raised platform, about 5 m. above sea-level and 180 m. west of slipway (grid reference 4395.3981). *Coelopleurus* was previously considered (Mortensen 1935) to have disappeared from the Mediterranean region in the Oligocene. The specimen was found attached to an irregular, brownish-grey, bryozoa- and cirripede-encrusted nodule, though it was not buried in the nodule.

DESCRIPTION

Family ARBACIIDAE Gray 1855

Genus COELOPLEURUS Agassiz 1840

Coelopleurus melitensis sp. nov.

Plate 6 and text-fig. 1

Derivation of name. After the Island of Malta (Latin: Melita).

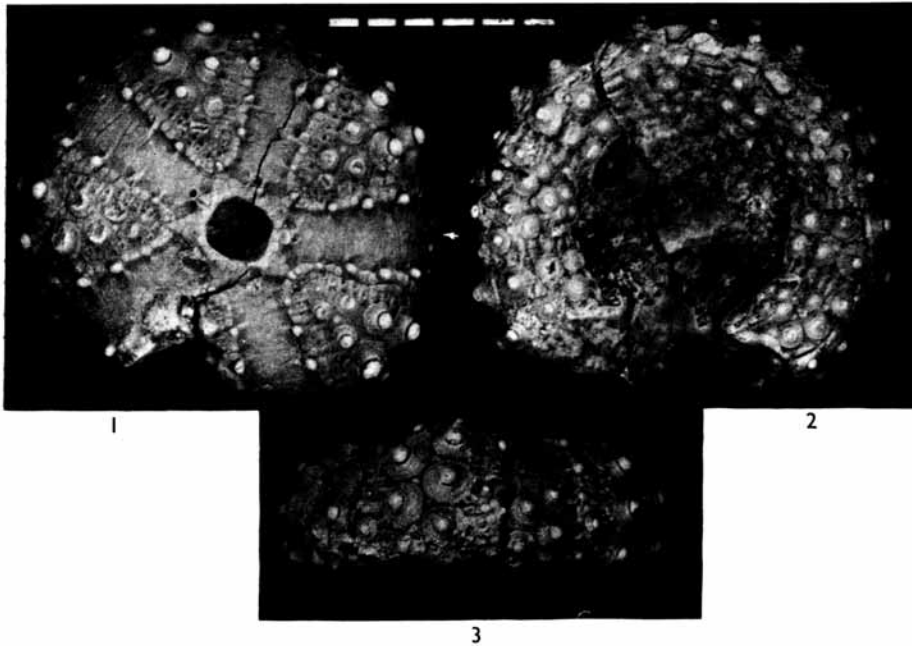
Holotype (monotype). Natural History Museum, Malta, MM/E 300.

Diagnosis. On its apical disc the species has a distinctive star-shaped raised area with arrowhead-like promontories protruding into the naked bands on the inter-ambulacra. These naked areas are bordered by prominent protuberant tubercles and are decorated with zigzag grooves, striae, lateral ditches, oblique ridges, and microscopic granulations.

Description. Test. Small, low hemispherical, with a somewhat flattened apical region. Oral surface mainly flat, but concave round the peristome. Peristome 5.3 mm. diameter (just under one-half diameter of test). The presence of 3-4 sphaeroidal pits along the median suture of each ambulacrum helps to distinguish the genus from *Arbacia* (one pit) and from *Arbia* (none). Test subpentagonal in outline with a maximum diameter of 10.9 mm., height 4.3 mm. The width of ambulacra at ambitus is 3.5 mm., whilst that of interambulacra at ambitus is 2 mm.

Apical system. Dicyclic. The apical disc has a highly characteristic star-shaped raised area and well-developed exserted ocular plates that end in a protuberance. This raised area protrudes deeply into the naked areas on the interambulacra in the form of five arrow-
[Palaeontology, Vol. 12, Part 1, 1969, pp. 42-7, pl. 6.]

head promontories with slightly concave sides. The arrowhead shape is due to the characteristic quadrangular depression on either side of each promontory. Genital plates are large. The genital pores are five large openings aboral to the arrowhead promontory, and suggest full sexual maturity. The periproct, which is large and central, lacks a prominent ring-like edge. It is polygonal (min. diam 1.0 mm., max. diam. 1.5 mm.) and about one-tenth diameter of test. There is a circle of 10 small tubercles (0.2 mm. diam.) in the apical disc adjacent to the periproct, a feature which Duncan and Sladen state to be 'very generally present' in the genus (1885, p. 48).



TEXT-FIG. 1. *Coelopleurus melitensis* sp. nov. Adapical, adoral, and side views of holotype MM/E 300, from base of Scutella Bed (transition Aquitanian-Burdigalian) at Qammieh, Malta (scale in millimetres).

Ambulacra. Each ambulacrum is made up of two columns of compound trigeminate plates with two rows of imperforate, non-crenulate, primary tubercles which extend from periproct to peristome. These primary tubercles progressively increase in size adorally reaching a maximum size at the third tubercle, just above ambitus. Below the ambitus, the tubercles abruptly diminish in size, becoming very small and flatter at peristome. All tubercles, except the first four near the apex, have an associated granule in each corner. The ambulacral plates are arbacioid. In each ambulacral column there are 15 above-ambital non-conjugate pore pairs arranged in a sinuous line. The pores are round, equal, and conspicuous. The pores of a pair are arranged oblique to the column, with the adradial pore more oral than the perradial pore. Above the ambitus,

but not below it, the adradial pore is sometimes situated on the boss of the adjacent primary ambulacral tubercle (*ap* Pl. 6). This conflicts with the statement of Duncan and Sladen (1885, p. 293) that the pores situated on the bosses of ambulacral tubercles, both above and below the ambitus, were characteristic of the genus *Coelopleurus*. The interporiferous distance increases till halfway down the aboral surface, and then progressively decreases toward the peristome with the pores progressively diminishing in size, and the pores of a pair becoming arranged more obliquely.

Interambulacra (Pl. 6). Each interambulacrum consists of two columns of alternating plates, each plate being broader than high. The horizontal sutures are very shallow, but the longitudinal ones are deeply grooved. An additional pentagonal plate, higher than broad, is present on the interradius of one of the interambulacra at the level of the third protuberant tubercle from the apex (*aip*). This additional plate lacks tubercles but has a surface decoration similar to that of neighbouring plates on the naked area.

Below the ambitus, there are 14–15 tubercles in each interambulacral area, arranged in 4 longitudinal rows, with a maximum of 5 tubercles per row, and with the largest tubercles at the ambitus. Above the ambitus the outer two rows are continued by a single series of small tubercles (*smt*) that extend to the apical system. The inner two rows do not continue above the ambitus so that each interambulacrum has, adapically, a naked median space, on each side of which are 4–5 prominent protuberant tubercles (*ppt*). Unlike ambulacral tubercles, their height is greater than their width. Each interambulacral plate contains only one such prominent tubercle, to which are generally associated two of the small marginal tubercles (*smt*). The fourth and fifth prominent protuberant tubercles, however, are associated with 3 and 4 small marginal tubercles respectively. The naked areas are ornamented with deep grooves arranged in a zigzag (*zzg*), together with striations, sunken marginal areas or lateral ditches (*ld*), oblique ridges (*or*), and microscopical granulations that are larger and more conspicuous in the central region of each plate. The protuberant tubercles lie interradian to the marginal tubercles (*smt*) of the interambulacral areas and are totally different from them. They (*ppt*) are all very prominent, with the third one from the apex being most so, and the fourth one almost as large as the third. Each protuberant tubercle alternates with its counterparts on the opposite side of the naked area.

The deep grooves arranged in zigzags cross the naked areas obliquely, being directed towards points just aboral to the protuberant tubercles. They do not, however, extend the whole distance across the naked area (*zzg*). Aboral to most of these grooves, and making an angle of about 10° with them, is a weak striation (*zzg*). On the interradian

EXPLANATION OF PLATE 6

Enlarged view ($\times 36$) of the interambulacrum arrowed in text-fig. 1 showing ornamentation and other specific characteristics of *Coelopleurus melitensis* sp. nov. Note additional interambulacral plate (*aip*). *ap* adradial pore perforating boss of a supra-ambital ambulacral tubercle; *ppt* prominent protuberant interambulacral tubercles bordering the naked areas; *zzg* deep zigzag grooves with overlying shallower groove or stria; *ld* lateral ditch or sunken longitudinal area at sides of naked interambulacra; *or* hook-like, oblique ridges limiting lateral ditches aborally and adorally; *smt* small marginal tubercles bordering naked areas; *qd* quadrangular depressions giving promontory (*ahp*) its characteristic shape; *sta* small tubercles in apical disc.

side of each protuberant tubercle, adjacent to the aboral part of the latter, a short, hook-like ridge or process is present. It gaps the sunken areas (lateral ditches) that are found at the sides of the naked interambulacra, decreasing in strength interradially until it finally dies out (*or*). The depressed longitudinal areas on the lateral sides of each naked interambulacrum, bounded adorally by successive 'lateral ridges', are herein referred to as 'lateral ditches' (*ld*).

Comparisons. *Arbacia* (Pliocene to Recent) differs from *Coelopleurus* by being more heavily ornamented, by having only a single sphaeroidal pit in each ambulacrum, by having straight pore zones (widening at peristome), in the absence of a proper naked area in the interambulacra, and by having numerous primary tubercles arranged in several horizontal and vertical series.

Arbia (U. Oligocene to L. Miocene, U.S.A.) can be distinguished from *Coelopleurus* by having simple ambulacral plates, no sphaeroidal pits, smaller peristome, pore zones that are in a straight line above the ambitus and raised with pore pairs forming 'slightly oblique groups of three at and below it' (Cooke 1959, p. 21), and complete absence of lateral ditches which results in the median naked areas being flush with the lateral parts.

Comparison with material in the British Museum (Natural History). *C. forbesi* Archiac and Haime 1853 and *C. sindensis* Duncan and Sladen 1885 are the only two other Miocene species so far known. *C. sloani* Clark 1915 and *C. improcerus* (Conrad) Clark and Twitchell 1915, from the Miocene of the United States and originally regarded as belonging to the genus *Coelopleurus*, have since been transferred to *Arbacia* by Cooke (1941).

C. forbesi, which is the most typical *Coelopleurus* of the Indian Miocene, has been recorded from the Middle Oligocene Lower Nari Series and from the Lower Miocene (Burdigalian) Gaj Series of Sind, West Pakistan (Duncan and Sladen 1885, p. 287). The species was refigured and redescribed by Stockley (1927) from the Lower Miocene Chake Chake Beds of the Pemba Series in East Africa. Compared with *C. melitensis* Stockley's specimen (E 17897) is larger and has flatter (less inflated) and more spread out ambulacral tubercles, but it lacks the distinctive star-shaped area on apical disc, the arrowhead promontories, the wide genital pores, and the protuberant tubercles adjacent to the naked areas.

C. sindensis (E 702), from the Lower Miocene (Burdigalian) Gaj Series, W. Pakistan, though showing marked similarities to *C. melitensis* sp. nov., such as the band-like naked areas with prominent grooves and wide genital pores on conspicuous arrowhead promontories that protrude deeply into the bare areas, lacks the highly characteristic star-shaped raised area on the apical disc. Both specimens in the collection have a larger size. Their diameter is 33 mm. and 20 mm. whilst their height is 16 mm. and 12 mm. respectively. (*C. melitensis* has a diameter of 10.9 mm. and a height of 4.3 mm.) The more highly ornamented, conical apical region, the less prominent protuberant tubercles, and the more developed grooves of the naked area are also distinguishing features.

C. coronalis (Leske) (E 3179), from the Eocene of France, shows considerably more ambital divergence of the naked areas, whose marginal granules are as prominent, but whose marginal tubercles are not as protuberant as *C. melitensis* sp. nov.

C. equis Agassiz, a subjective junior synonym of *C. coronalis* (Leske), (E 10982, E 10983) are from the Eocene of Biarritz, France. The specimen E 10982, which has a broken apical system, lacks supra-ambital swelling, and the primary interambulacral tubercles extend above the ambitus. A broken perforated tubercle has a crenulated base, a feature usually inconsistent with *Arbacioida*. In E 10983, the apical system is crushed, it has naked areas that widen up towards the ambitus, even more so than in E 10982.

C. agassizi Archiac (E 75697), from the Eocene of Biarritz, has similar subpentagonal outline, but wider poriferous zone, more heavily tuberculate apex, and a more continuous (though less spread out) row of tubercles. (The abactinal surface is abraded.)

C. spinosissimus Agassiz (E 38718), from the Calcaire Grossier of the Paris area, though showing close similarity in all features, is not quite identical with *C. melitensis* sp. nov. of which it may well be

an ancestor. Though crushed sideways its shape is more rounded. The ambulacral tubercles are more pointed and spiny looking, but less protuberant above the ambitus. The ambulacral marginal granules are more pronounced.

A Recent dry specimen in the Spirit Room Collection of the Museum 6.19.104, *C. maillardi* (Michelin), collected from 'Station 24', from a depth of 73–200 m., is similar to *C. melitensis* in smallness of size (13 mm. × 8 mm.), subpentagonal shape, outline of periproct, and band-like naked areas on the interambulacra. Major distinctions are the shape of the raised promontories, which are polygonal instead of arrowhead, due to the absence of lateral quadrangular depressions, the presence of radiating lines round the fairly wide genital pores, the absence of the round-topped, higher-than-broad, protuberant tubercles (which are replaced by tubercles that are only slightly more prominent than adjacent ones), and the presence of a row of small tubercles inside and parallel to the interambulacral marginal wall. The oblique ridges are straighter and longer, and, with the exception of one ridge (which covers only three-quarters of the distance), they extend over the whole width of the naked area.

PALAEOECOLOGY

The associated faunule of *C. melitensis* sp. nov. consists of rock-borers, sponges, echinoids of the genera *Clypeaster*, *Echinolampas*, *Echinocyamus*, and *Cidaris* (spines), bryozoa, and nests of the small *Terebratulina minor* Philippi, which, according to Davidson (1864, p. 9), still abounds in the near-shore sediments of Sicily. It is quite likely that *C. melitensis* sp. nov. lived at much smaller depths than modern *Coelopleurus*, which is now confined to the deep waters of the Indo-Pacific region (56–1,323 m.), with a record of *C. floridanus* Ag. from 102–2,419 m. (Cottreau 1913, p. 46). Specimens in the Spirit Room Collection of the British Museum (Nat. Hist.), however, were recovered (1892–1948) from depths ranging from 73–200 m.

Although in the Mediterranean *Echinocyamus* is in modern times found also in the neritic zone (Cottreau 1913, p. 153), a littoral bathymetry is suggested by the associated echinoid fauna and by the animal borings in the Nodule Bed in which *C. melitensis* was found. In addition, the animal borings are also indicative of a stratigraphic break. The entire associated faunule is indicative of a rocky bottom of a relatively clear and shallow warm sea of normal salinity with possibly small sandy or muddy patches, as suggested by the small pockets of *Echinocyamus*.

An abrupt radical change of these environmental conditions, with onset of stronger currents and greater turbidity, is indicated by the sudden disappearance of the associated faunule and its replacement by numerous fragmented Scutellae scattered in a disorderly fashion and embedded in a very coarse matrix.

Acknowledgements. The author is deeply indebted to Dr. R. P. S. Jefferies of the British Museum (Nat. Hist.) for his help with the identification of the specimen and for his encouragement to publish this note, as well as to Dr. Porter Kier of the Smithsonian Institution for his constructive criticism and for providing photographic facilities. The help of Captain C. G. Zammit, Director of the National Museum, Malta, and of Miss Attard and Mr. J. Spiteri is gratefully acknowledged.

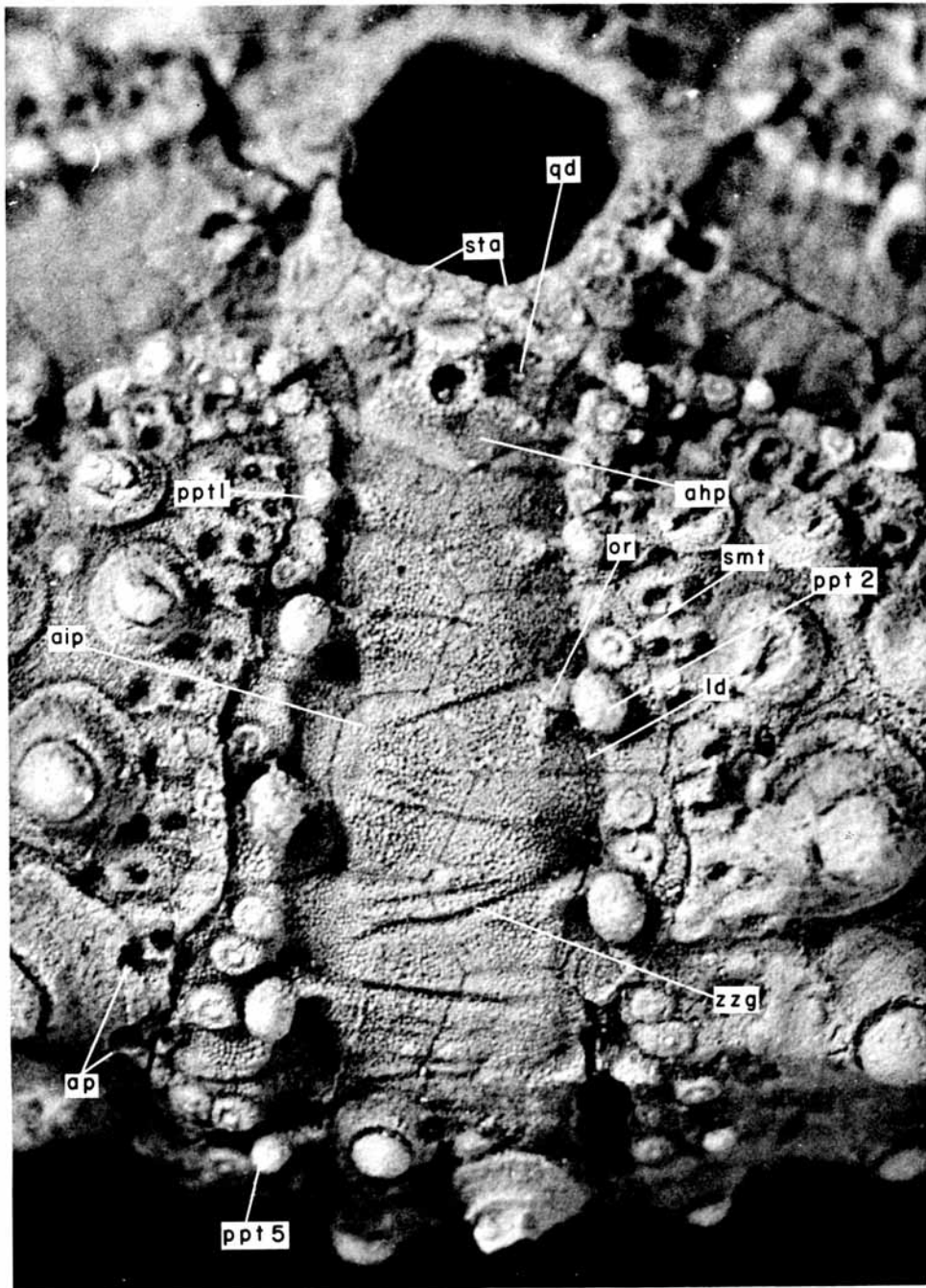
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Typescript received 5 December 1967



ZAMMIT-MAEMPEL, *Coelopleurus*