

4. The Manaccan Series are repeated on the horizons of Probus and Grampound, from which they extend across the county to either coast.

5. The Manaccan Series represent the basement beds of the Lower Devonian, and the Lower Palæozoic groups include Lower Silurian of Caradoc age, but whether the succession is ascending or descending has not been definitely proved, although the evidence suggests a descending sequence.

Before concluding, it may be remarked that the facts, herein presented, involving such a complete change in the colouring and interpretation of the old geological maps that a special investigation of the evidence on which the conclusions are based was undertaken at the request of the Director by Mr. H. B. Woodward and Mr. Clement Reid. As the result of that investigation they were satisfied that the conglomerate was partly derived from the underlying Veryan and Portscatho Beds, and that those groups, together with the associated Falmouth and Mylor Series, are of Pre-Devonian age. The conclusions, therefore, which form the subject of this communication not only embody the opinions of the author, but command the support of his official superiors of the Geological Survey.

#### EXPLANATION OF PLATE XIV.

Sketch-map to illustrate the geology of the Manaccan district.

#### IV.—FOSSIL ECHINOIDEA FROM SINAI AND EGYPT.

By J. W. GREGORY, D.Sc., F.R.S., F.G.S.,  
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(PLATES X AND XI.<sup>1</sup>)

THE collections of Echinoidea described in the following report were made by Messrs. Barron, Beadnell, and Hume during their work for the Egyptian Geological Survey, and were entrusted to me for description by the Director, Captain Lyons, R.E.

The collections belong to three main series—(1) Cretaceous, (2) Eocene and Miocene, and (3) Pleistocene. The Cretaceous Echinoids come from the massif of Abu Roash, and from Sinai. The specimens from Abu Roash were collected by Mr. H. J. L. Beadnell, and mostly came from the eastern end of the massif near the village of Abu Roash. The best known fossil from this horizon is *Coptosoma abbatei* (Gauth.), and the bed from which it comes has been assigned to both the Cenomanian and the Turonian. The sections published by Fourtau<sup>2</sup> show that the beds belong to the older part of the Cretaceous massif of Abu Roash; but he places the *C. abbatei* beds in the Turonian<sup>3</sup> or Lower Senonian.<sup>4</sup> Walther,

<sup>1</sup> [Plate XI will appear with the second part of Professor Gregory's paper in the June Number of the GEOLOGICAL MAGAZINE.—EDITOR.]

<sup>2</sup> Fourtau: Notes E'ch. foss. E'gypte, 1900, p. 17.

<sup>3</sup> Fourtau: *ibid.*, p. 21; and Crét. massif Abu Roash, C.R., vol. cxxxi (1900).

<sup>4</sup> Fourtau, Révision E'ch. foss. E'gypte: Mém. Inst. E'gypt., vol. iii, fasc. 8 (1899), pp. 607, 623.

Schweinfurth, Blanckenhorn,<sup>1</sup> and Beadnell,<sup>2</sup> on the other hand, place these beds in the Cenomanian; so also does Dacqué.<sup>3</sup> But the Echinoids from these beds appear to me to be Turonian rather than Cenomanian. The Echinoids from this massif are few in number, and they are mostly species new to the locality, so that their evidence is by no means decisive. But the affinities of the Abu Roash Echinoids known to me are Turonian. The collections give no evidence of the occurrence of a Cenomanian Echinoid fauna at Abu Roash. Of course, Cenomanian beds may occur, from which Echinoids were not collected.

In Sinai, on the other hand, the bulk of Echinoids are of Cenomanian affinities, as shown in the table of species (*infra*). The Sinai Echinoids include two Turonian species and a new species, of which the nearest ally known to me is Turonian. This fact may represent either that the species lived in both epochs or that the beds of the two series occur at the same localities in Sinai.

The Cainozoic fauna in this collection, excluding the Pleistocene, is very small, and the specimens are not well preserved. The most puzzling form is an *Echinolampas* allied to *E. crameri*, Lor., which is reported as having been found in the raised beaches of Wadi Feiran; it is quite unlike any living *Echinolampas*. Professor Jeffery Bell, the best British authority on recent Echinoids, kindly examined the specimens, and tells me that they are unlike any living species. The affinities of these species are Miocene or earlier; possibly they were derived from blocks of limestone that may have fallen from an old cliff into a recent beach.

The Pleistocene fauna from both shores of the Gulf of Suez has purely Erythrean characters. Most of the specimens are identical with living species. A few specimens, however, which are badly preserved, may be of an earlier age, as they may be either recent or extinct species. All the well-preserved material is identical with the existing Red Sea species. There is nothing to suggest any considerable antiquity for these raised beaches. Seven specimens are somewhat doubtful, and two of them may be Pliocene or Miocene. Nos. K 1660 and J 1624 are both imperfect specimens, and cannot be identified; and K 1660 from the level of 380 feet in the Wadi Abu Shigeli is perhaps *Brissus egyptiacus*, Gauthier, which is assigned by its author<sup>4</sup> to the Miocene.

The three specimens referred doubtfully to *Schizaster gibberulus* are so imperfect that the determination is of no value. They may be crushed casts of that species, but their generic characters are not known.

The *Echinodiscus* is quite unlike any Pleistocene species, and the fragment of the *Clypeaster* (L 4204) described as coming from the

<sup>1</sup> Max Blanckenhorn, Neues zur Geol. & Pal. Aegyptens: Zeit. deut. Geol. Ges., 1900, p. 33.

<sup>2</sup> Beadnell, Cret. Reg. Abu Roash: Rep. Geol. Surv. Egypt, 1900, pt. ii (1902), pp. 18, 19, 20, etc.

<sup>3</sup> Dacqué, Mitth. Kreidecomplex Abu Roash: Palæontogr., vol. xxx (1903), p. 354.

<sup>4</sup> Fourtau, Révision E'ch. foss. E'gypte: Mém. Inst. E'gypt., vol. iii, fasc. 8 (1899), p. 718, pl. iii, figs. 11, 12.

beach deposits of Wadi Feiran may be a fragment of a Miocene species. The only species from that locality which is satisfactorily determinable is an *Echinolampas*, which is a Lower Cainozoic or Miocene species. Hence it may be that the three species of Echinoids from the beach deposits of Wadi Feiran are *remanié* from a Miocene or Lower Cainozoic horizon.

I must express my best thanks to Captain Lyons for having allowed me to keep the collection so long, in spite of the unavoidable delays in the preparation of a report upon it.

## I. CRETACEOUS.

### Subclass *REGULARIA ECTOBRANCHIATA*.

#### Suborder *DIADEMINA*.

#### Family *DIADEMATIDÆ*.

*HETERODIADEMA*, Cotteau, 1864.

*HETERODIADEMA BIGRANULATUM*,<sup>1</sup> n.sp. (Pl. X, Figs. 1a-f.)

*Diagnosis*.—Test small, low; well flattened above and below; the ambitus is tumid.

Apical area large, its length is half the diameter of the test; and the ratio of breadth to length is 7 to 9 (it is 21 : 29 in *H. libycum*). In shape it is nearly pentagonal; the three anterior sides are straight, while the two posterior sides are somewhat convex. Peristome small.

Ambulacra, 13-14 compound plates in each vertical series; the passage from the large tubercles on the ambitus, to the smaller ones near the apex, is less sudden than in *H. libycum*.

Interambulacra, 10 compound plates in each vertical series; the scrobicular areas are not confluent, but occasionally the scrobicular circles become very thin, and the granules somewhat scanty; there are two granules in each of the horizontal rows (instead of the four in *H. libycum*) between the base of the boss and the median suture.

#### *Dimensions* :

Diameter	...	...	...	...	...	21 mm.
Height	...	...	...	...	...	8.5 mm.
Width of apical area	...	...	...	...	...	9 "
Length of apical area	...	...	...	...	...	11 "
Width of ambulacrum at ambitus	...	...	...	...	...	5.5 "
Width of interambulacrum at ambitus	...	...	...	...	...	8 "

*Distribution*.—Cenomanian : southern slope of Jebel Gunneh, Sinai. L 3506. Collected by Dr. W. F. Hume, 1899.

*Figures*.—Pl. X, Fig. 1a, from above, nat. size; Fig. 1b, from the side, nat. size; Fig. 1c, a compound ambulacral plate showing the granulation, by 4 diam.; Fig. 1d, a worn ambulacral plate showing the sutures, by 4 diam.; Fig. 1e, interambulacral plates showing

<sup>1</sup> From its double rows of granules around the bases of the ambital interambulacral tubercles.



the ornamentation, by 4 diam.; Fig. 2, *Heterodiadema libycum* (Desor), two interambulacral plates, after Cotteau.

*Affinities*.—This echinoid is a typical *Heterodiadema*; it differs from *H. libycum* (Desor),<sup>1</sup> the well-known type-species, by its non-confluent scrobicular areas, and by having only two instead of four granules in each row on the interambulacral plates.

### Family DIPLOPODIIDÆ.

#### ACANTHECHINOPSIS,<sup>2</sup> n.gen.

*Diagnosis*.—Diplopodiidæ with the ambulacra diplopodous abactinally, where the plates are long, thin, simple primaries; but with uniserial epipodia on the actinal surface and near the mouth. The ambital plates are of five primaries, one of which may be reduced to a demiplate.

There is a bare depression in the median line of the abactinal part of the interambulacra.

Tubercles crenulate and perforate.

*Type Species*.—*A. humei*, n.sp.

*Distribution*.—Cretaceous: Sinai and Southern Tunis.

*Affinities*.—This species is most nearly allied to *Acanthechinus*, but it differs therefrom by its perforate tubercles.

#### ACANTHECHINOPSIS HUMEI, n.sp. (Pl. X, Figs. 3a-e.)

Test of medium size; subpentagonal; flat below, somewhat turban-shaped when seen from the side.

Ambulacra broad above, where the epipodia occur in long narrow primaries. The ambital plates have five primaries, one of which may be reduced to a demiplate, by being just crushed out from the middle line.

Interambulacra, about 16 plates in a vertical series. The tubercles begin as a single series, separated from the series on the opposite side of the interambulacrum by a bare depressed area. On the seventh plate from the top a second line of tubercles begins, and the ambital plates have three rows of tubercles in a somewhat oblique series.

#### *Dimensions*:

Diameter	...	...	...	...	...	...	36 mm.
Height	...	...	...	...	...	...	15 mm.
Diameter of peristome	...	...	...	...	...	...	12.5 mm.

*Distribution*.—Cenomanian: southern slope of Jebel Gunneh, Sinai. L 3506. Collected by Dr. W. F. Hume.

*Figures*.—Pl. X, Figs. 3a and b, test from above and from the side, nat. size; Fig. 3c, ambulacral plates near the apex, by 4 diam.; Fig. 3d, ambital ambulacral plates, by 4 diam.; Fig. 3e, ambital interambulacral plates, by 4 diam.

<sup>1</sup> *Pseudodiadema libycum*, Desor, 1858: Syn. E'ch. foss., p. 72. *Heterodiadema libycum*, Cotteau, 1864: Pal. franç., Terr. crét., vol. vii, p. 522, pl. 1124. Cotteau, Peron, & Gauthier, 1879: E'ch. foss. Algér., fasc. 5, p. 201, pl. xv, fig. 5. Gauthier, 1889: E'ch. foss. S. Hauts-Plat. Tunisie, p. 68.

<sup>2</sup> Like *Acanthechinus*.

*Affinities.*—This species is most nearly allied to a specimen, described by Gauthier as *Diplopodia semamensis*, Gauth., from the Cenomanian of Jebel Semama in Southern Tunis, to which it is certainly a near relation. Gauthier referred to the abnormal characters of what he truly described as this "remarkable species." He had only one imperfect specimen; its dimensions are diam. 35 mm., height 12 mm., and diam. of peristome 11 mm.

*A. humei* differs from *A. semamensis* (Gauth.), as that has more abundant interambulacral tubercles.

	<i>Acanthechinopsis humei.</i>	<i>A. semamensis.</i>
Ambital plate has	a slightly oblique series of three tubercles.	a zigzag row of four tubercles.
The series of tubercles which begins at the top of interambulacral area	becomes the middle row at the ambitus.	remains the innermost line throughout.
The second vertical series of tubercles begin on the	fifth plate.	third uppermost plate from top of 1a.
On the ambital plates	a large second tubercle appears inside the long row of primary tubercles.	no conspicuous secondary tubercle inside the main series.

### Family PEDINIDÆ.

MICROPEDINA, Cotteau, 1867.

#### MICROPEDINA BIPATELLIS.<sup>1</sup> (Pl. X, Figs. 4, 5a-f.)

Test, the average size for this genus; well rounded, subspheroidal, but with depressed actinal surface, tumid ambitus, and the upper surface much more raised and tapering than the lower.

Circular in section.

Apical area and peristome both small.

Ambulacra: the epipodia appear conspicuously biserial, especially near the mouth, but at the ambitus they may be recognized as triserial.

The ambulacral plates on the ambitus consist of a large primary, with small adoral and aboral demiplates; the aboral and middle epipodia are in the same vertical line, near the interradius; the adoral epipodium occurs at about the middle of the lower edge, giving the biserial aspect to the ambulacrum.

Near the peristome the aboral plates may be a primary, and the adoral is nearly so. The ambital ambulacral plates are ornamented by two small granules. Interambulacra of long narrow plates with an irregular line of very small granules, which may be as many as seven in number. In some plates the line of granules becomes doubled near the ambulacrum.

<sup>1</sup> Having two small plates (or patella) in the compound ambulacral plates.

*Dimensions :*

	L 3482.	L 4323.	<i>M. olisipponensis.</i>	<i>M. cotteaui.</i>
Diameter ...	40 mm.	33 mm.	13-40 mm.	25 mm.
Height...	28 mm.	26 mm.	...	22 mm.
Ratio of height to diam.	70 : 100	78 : 100	64 : 100 to	88 : 100
			88 : 100	

*Distribution.*—Egypt. Cenomanian : Jebel Gunneh (L 4323) ; northern side of Jebel um Raiyig, north-eastern Sinai (L 3482). Both collected by Dr. W. F. Hume.

*Figures.*—Pl. X, Fig. 4, a small specimen from the side, nat. size, from Jebel Gunneh, L 4323 ; Figs. 5*a-f*, plates from L 3482 from Jebel um Raiyig ; Fig. 5*a*, ambulacral plate from near the apical area, by 4 diam. ; Fig. 5*b*, an ambulacral plate from the ambitus, by 4 diam. ; Fig. 5*c*, an ambulacral plate from the actinal surface, by 4 diam. ; Fig. 5*d*, an ambulacral plate from near the peristome ; Figs. 5*e* and 5*f*, ambital interambulacral plates, by 4 diam. Pl. XI, Fig. 15, the ambital ambulacral and interambulacral plates of *M. cotteaui*, Coq., after Cotteau.

*Affinities.*—The nearest ally of this species is *M. olisipponensis*, Lor.,<sup>1</sup> from the Cenomanian of Portugal, which differs by having three regular granules on the ambulacral plates, and somewhat larger granules on the interambulacra. It differs from the type-species, *M. cotteaui*, Coquand,<sup>2</sup> by having an adoral demiplate, instead of both the lower plates in the ambital ambulacral plates being primaries. In this respect it resembles *M. olisipponensis*, which agrees with *M. cotteaui* in the granulation of both the ambulacral and interambulacral plates.

## Family CYPHOSOMATIDÆ.

## CYPHOSOMA, Agassiz.

CYPHOSOMA BEADNELLI, n.sp. (Pl. X, Figs. 6, 7*a-d*, and 8.)

*Diagnosis.*—Test of medium size, subcircular and low.

Ambulacral plates composed of six constituents ; each plate has one large tubercle, and a median row of coarse scanty granules down the middle line of each area. The scrobicular circles are confluent. Interambulacra, 10 plates in a vertical series ; each bears one large tubercle, round the base of which is an incomplete scrobicular circle, a line of about 5 large granules on the inner and outer sides of the scrobicular circle, which is incomplete above and below in the ambital plates, so that the scrobicular areas are confluent.

*Dimensions :*

	Largest.	Another specimen.	Another specimen (Fig. 7 <i>b</i> ).
Diam. max. ...	28 mm.	23.5 mm.	24 mm.
Diam. min. ...	26 mm.	22 mm.	—
Height ...	9.5 mm.	7 mm.	10 mm.

<sup>1</sup> P. de Loriol : Crét. Fauna Portugal, vol. ii (1887), Echinodermes, p. 62, pl. x, figs. 3-6.

<sup>2</sup> Cotteau : Pal. franç., Terr. crét., vol. vii (1867), p. 823, pl. 1197.

**Figures.**—Pl. X, Fig. 6, abactinal view of a specimen, nat. size; Fig. 7a, another specimen from the side, nat. size; Fig. 7b, abactinal end of an ambulacrum of the same, by 4 diam.; Fig. 7c, an ambital ambulacral plate of the same, by 4 diam.; Fig. 7d, interambulacral ambital plates of the same specimen, by 4 diam.; Fig. 8, actinal surface of another specimen, nat. size.

**Distribution.**—Cretaceous (Cenomanian or Turonian): east end of Abu Roash village. L 1376. Collected by H. J. L. Beadnell, Esq.

**Affinities.**—The species is allied to the Turonian *Cyphosoma coquandi*, Cott.<sup>1</sup> of Batna, Algeria, in which the granulation is more abundant, the scrobicular areas are not confluent, and there are only five components in the compound, ambital, ambulacral plates.

THYLECHINUS, Pomel, 1883.

1. THYLECHINUS QUINCUNCIALIS,<sup>2</sup> n.sp. (Pl. XI, Figs. 8a-c.)

**Diagnosis.**—Test above medium size; circular; depressed.

Peristome moderate in size; circular with well-developed buccal slits.

Ambulacra: about 16 compound plates in each vertical series. The scrobicular circles are very incomplete; they may be represented only by a series of granules round the edge of the boss, but there may be a line above and below the boss, along the horizontal edge of the plate.

Interambulacra: about 13 plates in each vertical series. The plates are slightly bent, the abactinal margin being concave. The ambital tubercles are quincuncial in arrangement, and there are three vertical series on each side of an interambulacrum at the ambitus. The three plates nearest the peristome have one tubercle each.

**Dimensions:**

Diameter	...	...	...	...	...	...	30-31 mm.
Height	...	...	...	...	...	...	12-13 mm.

**Distribution.**—Cenomanian: Sinai, marls at the head of Wadi Ethal. L 3872. Collected by the late T. Barron, Esq.

**Figures.**—Pl. XI, Fig. 8a, a specimen from the side, nat. size; Fig. 8b, part of the ambitus, showing the plan of the interambulacral tubercles, by 3 diam.; Fig. 8c, two compound ambulacral plates from the same, by 4 diam.

**Affinities.**—This species resembles by its quincuncial tubercles one of the two echinoids included by Gauthier<sup>3</sup> in *T. sancti-arromani* (Gauth.), from the Dordonian (Upper Senonian) of Bir Maguer, Southern Tunis. It appears to me probable that the specimen illustrated by Gauthier's figs. 9-11 is a distinct species from his figs. 8, 12, and 13, which may be selected as the type of the species. This *Thylechinus quincuncialis* differs from *T. sancti-arromani* by the presence of only one tubercle, instead of a row of smaller ones on the plates next the peristome.

<sup>1</sup> Cotteau: Pal. franç., Terr. créét. (1864), p. 587, pl. 1139, figs. 7-12.

<sup>2</sup> From the plan of the tuberculation.

<sup>3</sup> *Cyphosoma sancti-arromani*, Gauthier, 1889: E'ch. foss. Sud Hauts-Plateaux Tunisie, pp. 81-82, pl. v, figs. 8, 12, 13, non figs. 9-11.



2. *THYLECHINUS TRIGRANULATUS*, n.sp. (Pl. XI, Figs. 9a-d.)

Test low and small; circular; it is flat below, is tumid at the ambitus, and somewhat pointed above. Apical area small. Peristome decagonal, with broad buccal slits.

Ambulacra, about 11 compound and 5 abactinal primary plates, in a vertical series. The uppermost, or the two uppermost, compound plates are smooth, and have only a low granule. Each ambital plate has a single prominent tubercle, but little smaller than those of the interambulacra. The boss occupies nearly the whole of the non-poriferous part of the plate, and is surrounded by a thin single row of small granules on its border.

*Interambulacra*.—There are about 11 plates in each vertical series. The plates are long and low; the abactinal side is slightly concave. The base of the tubercle is surrounded by a circle of low granules, so that the scrobicular areas are non-confluent. Each plate typically has three prominent granules, one in each of the two adambulacral corners and one on the abactinal interradial corner.

*Dimensions :*

Diameter	...	...	...	...	...	...	22 mm.
Height	...	...	...	...	...	...	9 mm.
Diameter of apical area	...	...	...	...	...	...	5-6 mm.
Diameter of peristome	...	...	...	...	...	...	8-9 mm.
Width of ambulacrum at ambitus	...	...	...	...	...	...	5 mm.
Width of interambulacrum at ambitus	...	...	...	...	...	...	8.5 mm.

*Figures*.—Pl. XI, Fig. 9a, test from below, nat. size; Fig. 9b, from the side, nat. size; 9c, upper part of an ambulacrum showing the structure of the plates, by 4 diam.; 9d, part of an interambulacrum at the ambitus, by 4 diam.

*Distribution*.—Cenomanian — Cretaceous Marls: head of Wadi Ethal, Sinai. L 3872. Collected by the late T. Barron, Esq., 1899.

This *Thylechinus* is represented by one specimen; it is somewhat distorted, but the characters are well shown. The ornamentation reminds me most of *Cyphosoma baylei*, Cott. (Pal. franç., Terr. crét., vol. vii (1864), pl. 1138, fig. 12), which, however, is a true *Cyphosoma*.

## COPTOSOMA, Desor, 1858.

1. *COPTOSOMA ABBATEI* (Gauthier), 1899.

*Cyphosoma abbatei*, Gauthier, in Fourtau, 1899: Rév. E'ch. foss. E'gypte, Mém. Inst. E'gypt., vol. iii, fasc. 8, p. 620, pl. i, figs. 2-6.

*Cyphosoma abbatei*, Fourtau, 1900: Notes E'ch. foss. E'gypte, p. 21.

*Cyphosoma abbatei*, Daqué, 1903: Mitth. Kreidecomplex Abu Roash, Palæontogr., vol. xxx, p. 357.

*Pseudodiadema*, sp., Walther, 1887: Apparition craie, Bull. Inst. E'gypt., 1887, p. 7.

This species, well described by Gauthier, is represented by a good series of specimens. They show that the ambulacra are not diplopodous abactinally, so the species is a *Coptosoma*.

*Distribution*.—Cenomanian or Turonian: eastern end of the village of Abu Roash. I 3792. Collected by H. J. L. Beadnell, Esq.

2. COPTOSOMA GUNNEHENSIS,<sup>1</sup> n.sp. (Pl. XI, Figs. 10a-d.)

*Diagnosis.*—Test of medium size; subpentagonal in form. Flat base; somewhat tapering below. The middle area of the interambulacra is depressed near the apical system.

Apical system apparently somewhat small, pentagonal.

Peristome large, subdecagonal, with broad buccal slits.

Ambulacra: 13 compound plates each with one well-developed tubercle. Scrobicular circles confluent; a well-developed double series of granules down the middle line of each area. Four constituents in each ambital ambulacral plate.

Interambulacra: 12-13 plates in each vertical series. At the ambitus each plate bears two well-developed tubercles; the plates are bent into a step-like form, the central tubercles being half the width of the plate nearer the actinal surface.

Granulation scanty; the two scrobicular areas of each plate are confluent, but they are not confluent with those of the plates above and below it; usually two granules on the side of the plate near the ambulacrum.

*Dimensions:*

Diameter	...	...	...	...	...	27 mm.
Height	...	...	...	...	...	8 mm.
Diameter of apical area	...	...	...	...	...	9-13 mm.
Diameter of peristome	...	...	...	...	...	13 mm.
Width of ambulacrum at ambitus	...	...	...	...	...	5.5 mm.
Width of interambulacrum at ambitus	...	...	...	...	...	11 mm.

*Distribution.*—Cenomanian (?): Jebel Gunneh, Sinai. L 3506. Collected by Dr. W. F. Hume.

*Figures.*—Pl. XI, Fig. 10a, type-specimen from above, and Fig. 10b, from the side, nat. size; Fig. 10c, a compound ambital ambulacral plate, by 4 diam.; Fig. 10d, ambital interambulacral plates, by 4 diam.

*Affinities.*—This well-marked form has the doubly-bent, step-shaped, interambulacral plates found in various Cyphosomoid echinoids of the Middle and Upper Cretaceous, as in *Cyphosoma alcantarense*, de Loriol.<sup>2</sup> Its nearest ally is the Turonian *Coptosoma major* (Coquand),<sup>3</sup> which has a more granulate test, the two scrobicular areas on each plate being separated by a line of granules, and according to Cotteau's figures<sup>4</sup> the ambulacral plates consist of five primaries. Gauthier<sup>5</sup> included in his *Cyphosoma sancti-arromani* a specimen shown in his figures 9, 10, and 11, which is another ally of this species; it has the step-shaped interambulacral plates, but the secondary tubercles are on a somewhat different plan. *C. sancti-arromani* is from the Dordonian (i.e. Maastrichtian or uppermost Senonian) of Southern Tunis.

<sup>1</sup> From Jebel Gunneh, the locality of the type-specimen.

<sup>2</sup> P. de Loriol: Faune Crét. Portugal, vol. ii (1887), Echinod., p. 52, pl. ix, fig. 4, from Up. Carentonian.

<sup>3</sup> *Phymosoma major*, Coquand, 1863: Géol. et Pal. Constantine, Mém. Soc. Émul. Provence, vol. ii, p. 256, pl. xxvii, figs. 16, 17.

<sup>4</sup> Cotteau: Pal. franç., Terr. crét., vol. vii (1864), pl. 1143, fig. 5.

<sup>5</sup> Gauthier: Echin. foss. Sud Hauts-Plateaux Tunisie, pl. v, figs. 9-11, non figs. 8, 12, 13.

Subclass *IRREGULARIA*.

## Order 1. GNATHOSTOMATA.

Suborder *HOLECTYPINA*.

## Family PYGASTERIDÆ.

## HOLECTYPUS.

1. *HOLECTYPUS CENOMANENSIS*, Guéranger, 1859.

*Holectypus cenomanensis*, Guéranger, in Cotteau & Triger: E'ch. Dep. Sarthe (1859), p. 173, pl. xxx, figs. 5-10.

*Holectypus cenomanensis*, Duncan, 1865: Ech. Coast Arabia, Quart. Journ. Geol. Soc., vol. xxi, p. 354.

*Holectypus cenomanensis*, Fourtau, 1899: Rév. E'ch. foss. E'gypte, Mém. Inst. Egypt., vol. iii, fasc. 8, p. 625.

*Distribution*.—Cenomanian: Algeria, France, etc.; Jebel um Raiyig, north-eastern Sinai. L 3483. Collected by Dr. W. F. Hume. Cretaceous Marls: Jebel el Araba, Wadi el Araba, Sinai. L 4220. Collected by the late T. Barron, Esq.

*Dimensions*:

	L 3483.	L 4220.	jullieni.	cenomanensis.
Diameter ...	—	—	24 mm.	45 mm.
Length ...	40.5 mm.	22.5 mm.	35 mm.	31 mm.
Width ...	39 mm.	22.25 mm.	11 mm.	31 mm.
Height ...	21 mm.	10 mm.	15 mm.	15 mm.
Length to width...	100 : 96.3	—	—	100 : 48.4
Length to height...	100 : 51.8	—	100 : 45 to 42.8	Diam. in this species is up to 45 mm. <sup>1</sup>

*Affinities*.—The characteristics of this species are its comparatively large size (up to 45 mm. in diam.), the subpentagonal or subcircular form, the very low, conical form, and the great size of the periproct, which is acuminate at both ends, and extends from the peristome to the margin.

It differs from the *Echinoconus egyptiacus*, d'Orb.,<sup>2</sup> by its low height; from *H. excisus*, Cott.,<sup>3</sup> by the fact that the periproct does not notch the posterior margin of the test. *H. serialis*, Deshayes,<sup>4</sup> is much smaller, and has less numerous tubercles on the interambulacral plates; and so also has *H. jullieni*, P. & G.<sup>5</sup> The latter is a Turonian and Senonian species, and in spite of its somewhat lower height is a near ally of *H. cenomanensis*.

2. *HOLECTYPUS TURONENSIS* (Desor), 1847.

In Agassiz & Desor: Cat. rais., Ann. Sci. nat., ser. III, vol. vii, p. 146.

Cotteau: Pal. franç., Terr. crét., vol. vii (1861), p. 56, pl. 1018.

Cotteau, Peron, & Gauthier: E'ch. foss. Algér., fasc. 6 (1879), p. 87.

<sup>1</sup> Cotteau, Peron, & Gauthier: E'ch. foss. Algér., fasc. 5 (1879), p. 172.

<sup>2</sup> D'Orbigny: Pal. franç., Terr. crét., vol. vi, p. 544, pl. 1005, figs. 7-9.

<sup>3</sup> See e.g. the figure in Cotteau & Triger: E'ch. Dep. Sarthe, p. 368, pl. lxii, figs. 1, 3.

<sup>4</sup> See Desor: Syn. E'ch. foss., p. 174, pl. xxiii, figs. 6-9.

<sup>5</sup> Peron & Gauthier: E'ch. foss. Algér., fasc. 6 (1880), p. 86, pl. vi, figs. 3-7; fasc. 7 (1881), p. 91.

*Distribution.* — Turonian : S. France, and Tebessa, Algeria. ? Cenomanian—Cretaceous Marls : Sinai, Wadi Ragga (L 4123); and head of Wadi Ethal (J 3873).

This species is represented by three specimens, of which the two from the Wadi Ragga show all the characters very well. They resemble the Cenomanian *H. crassus*, of which it is possible that they are young specimens.

Their dimensions are :—

	J 4233.	<i>H. crassus</i> , fide Cotteau.
Diameter ... ..	15–23 mm.	51½ mm. by 31 mm.
Height ... ..	7–10 mm.	17 mm.

The ornamentation and shape agree with *H. turonensis* better than with *H. crassus*. The periproct notches the hinder margin, as much as in the French specimens, whereas the Algerian specimens are said by Cotteau, Peron, & Gauthier (op. cit., p. 88) only rarely to do so.

### 3. *HOLECTYPUS LARTETI* (Cotteau), 1867.<sup>1</sup>

Cotteau, Notice E'ch. foss. recueillis par Lartet pendant voyage duc de Luyne :

Bull. Soc. géol. France, ser. II, vol. xxvi (1869), p. 537.

Lartet : Explor. géol. Mer Morte, Paris (1877), p. 155, pl. xiv, figs. 1–5.

*Distribution.*—Cretaceous : Mt. Hor (coll. Lartet). Cretaceous Marls : head of Wadi Ethal, Sinai. L 3873. Coll. T. Barron, Esq.

This species, by its small periproct, has some resemblance to *Discoidea*, but the peristome is typically that of *Holectypus*. The largest of the three specimens is 23 mm. in diam., and 12·25 mm. in height.

According to Lartet's figure the diameter of the type-specimen is 25 mm. and its height 13 mm. The nearest Algerian species is *Holectypus chauveneti*, P. & G.,<sup>2</sup> in which the diameter and height are 18 mm. and 8 mm. respectively.

## Family GALERITIDÆ.

GALERITES, Lamarek.

### GALERITES THOMASI (Peron & Gauthier), 1878.

*Echinoconus thomasi*, Peron & Gauthier, 1878 : E'ch. foss. Algér., fasc. 5, p. 162.

*Distribution.*—Cenomanian : Algeria (Berouaguiah); head of Wadi Ethal, Sinai. ? L 3873. Coll. T. Barron, Esq.

This species was founded on a very imperfect specimen which showed neither periproct nor peristome, so that the identification is doubtful.

L 3873 includes only one imperfect, worn specimen, which has the tumid margin, a slight actinal flattening, a large subpentagonal peristome, which is large for this genus, and a submarginal periproct.

The apical system agrees with that of *Galerites thomasi*.

<sup>1</sup> Compt. Rend., vol. lxxviii (1867), p. 198.

<sup>2</sup> Peron & Gauthier : E'ch. foss. Algér., fasc. 5, p. 172, pl. xii, figs. 3–6.

EXPLANATION OF PLATE X.

- FIG. 1.—*Heterodiadema bigrammatum*, n.sp. Cenomanian: south slope of Jebel Gunneh, Sinai. L 3506. Collected by Dr. W. F. Hume.  
 1a, type-specimen from above. Nat. size.  
 1b, from the side. Nat. size.  
 1c, a compound ambulacral plate showing the granulation.  $\times 4$  diam.  
 1d, part of a worn ambulacral plate, showing the structure of the compound plates.  $\times 4$  diam.  
 1e, two interambulacral plates, showing the ornamentation.  $\times 4$  diam.  
 1f, another interambulacral plate.  $\times 4$  diam.  
 FIG. 2.—*H. libycum* (Desor). Interambulacral plates after Cotteau.  
 FIG. 3.—*Acanthechinopsis barroni*, n.sp. South slope of Jebel Gunneh, Sinai. L 3506. Collected by Dr. W. F. Hume.  
 3a, b, the test from above and from the side. Nat. size.  
 3c, ambulacral plates near the apex.  $\times 4$  diam.  
 3d, ambital ambulacral plates.  $\times 4$  diam.  
 3e, ambital interambulacral plates.  $\times 4$  diam.  
 FIGS. 4-5.—*Micropedina bipatellis*, n.sp. Cenomanian: Sinai. Collected by Dr. W. F. Hume.  
 4, a small specimen from the side. Nat. size. Jebel Gunneh. L 4323.  
 5a-d, ambulacral plates from L 3482.  $\times 4$  diam.  
 5a, a plate near the apical area.  
 5b, a plate from the ambitus.  
 5c, a plate from the actinal surface.  
 5d, a plate near the peristome.  
 5e, f, ambital interambulacral plates from L 3482.  $\times 4$  diam.  
 FIGS. 6-8.—*Cyphosoma beadnelli*, n.sp. Cenomanian or Turonian: east end of Abu Roash. Collected by H. J. Beadnell, Esq.  
 6, abactinal view of a specimen. Nat. size.  
 7a, another specimen from the side. Nat. size.  
 7b, abactinal end of an ambulacrum of the same.  $\times 4$  diam.  
 7c, ambital ambulacral plate of the same.  $\times 4$  diam.  
 7d, interambulacral ambital plates of the same specimen.  $\times 4$  diam.  
 8, actinal surface of another specimen. Nat. size.

(To be concluded in the June Number.)

V. — NOTES ON THE CORRIES OF THE COMERAGH MOUNTAINS,  
CO. WATERFORD.

By F. R. COWPER REED, M.A., F.G.S.

(Concluded from the April Number, p. 161.)

**B**ETWEEN Crotty's Lough and Coumshingaun a long spur of the Comeraghs juts out eastwards for about a mile and a half with an average height of 1400-1500 feet. On the south side this projecting ridge descends rather steeply to a stream at its base, which heads at a height of over 2,400 feet on the lofty plateau between Coumgorra and Coumshingaun; it runs down the mountain-side in a narrow gully over bare rock and reaches the foot in a series of picturesque waterfalls. No glacial débris occurs in this ravine, but on the lower ground the stream flows over the margin of the moraines belonging to Coumshingaun and runs eastward as the River Ire to join ultimately the Clodiagh.

We now come to *Coumshingaun*, the principal and best known corrie in the Comeraghs and containing the largest lake. The corrie has the form of a somewhat elongated horseshoe and faces