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NOTES ON THE SYSTEMATIC POSITION OF CERTAIN GENERA AND HIGHER GROUPS OF STARFISHES.

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THE GONIOPECTINIDÆ.—In "Asteroidea of the North Pacific and adjacent Waters"* the family Goniopectinidæ, proposed by Professor A. E. Verrill, was said to differ from the family Porcellanasteridæ in having double ampullæ connected with the tube-feet (p. 19), and in having an intestine and intestinal cœcum. The component genera of the Goniopectinidæ, *Goniopecten* and *Prionaster*, bear the closest resemblance to *Ctenodiscus*, although the rays of the latter are short while in the Goniopectinidæ they are long and slender. This resemblance results from the similar characteristic biserial arrangement of the skin-covered actinal plates with the intervening fasciolar channels, the similar structure of the marginals, between which are cribriform organs, and the similar form and armature of the adambulacral and mouth plates. Recently Mr. A. H. Clark found, in a specimen of *Prionaster elegans* Verrill, single ampullæ, thus breaking down one of the principal differences between *Ctenodiscus* and the Goniopectinidæ. I have again examined the ampullæ in a very large *Prionaster megaloplax* Fisher, and in *Goniopecten asiaticus* Fisher, and have also verified the structure of these organs, as described, in *Goniopecten demonstrans* Perrier. All of these have single ampullæ, what I formerly regarded as the lower lobe of the ampulla, or as a second ampulla, being a swelling probably due to the extreme contraction of the muscular vesicles. If the swelling has any significance at all, it is the merest rudiment of a ventral lobe,

* Bulletin 76, U. S. National Museum, 1911, part 1.

and the ampullæ are to be regarded as single. This fact seems to make it advisable to unite the three genera in a single family which would be separated from the Porcellanasteridæ proper by the presence of cribriform organs between all the marginals, by the actinal fascioles, and by the presence of superambulacral plates. Although an apical pore may be present in *Ctenodiscus*, I have also dissected specimens in which I could find no trace of an opening, nor of a tubular connection between the stomach and the "epiproctal cone." In the middle of the dorsal side of the stomach there is a roundish lobe of small size which may represent the degenerated rudiment of a cœcum. *Prionaster elegans*, on the other hand, has a fairly large, butterfly-shaped cœcum, connected with the apical pore by a definite tubule. *P. megaloplax* has a conspicuous "anal" aperture. This difference between *Prionaster* and *Ctenodiscus* must be weighed against the important common characters mentioned above. I would suggest that the genera be rearranged as follows:

Family Goniopectinidæ.

Characters.—Specialized fascioles or cribriform organs between all the marginal plates; actinal plates in double transverse series, there being between every pair a specialized fasciolar channel, roofed by webbed spinelets, leading from the marginal fascioles to the furrow; ampullæ single; superambulacral plates present; abactinal skeleton astropectinoid.

Subfamily Ctenodiscinæ.

Characters.—Marginal cribriform organs consisting of superimposed transverse webbed combs of spinlets; intestinal cœcum obsolete; no intestine.

Included Genera.—*Ctenodiscus* Müller and Troschel; *?Pectinidiscus* Ludwig.*

Subfamily Goniopectininæ.

Characters.—Marginal cribriform organs consisting of discrete spinelets covered by a single webbed series on the transverse margin of the plate; well developed intestinal cœcum, intestine, and apical pore.

Included Genera.—*Goniopecten* Perrier and *Prionaster* Verrill.

Craspidaster.—*Craspidaster hesperus* (Müller and Troschel), which resembles the Goniopectinidæ in having a single series of webbed peripheral spinelets on the marginal and actinal plates, differs in lacking the characteristic double serial arrange-

* *Pectinidiscus* has not as yet been fully described.

ment of the actinal plates (these being essentially astropectinoid in disposition), and in having patently double ampullæ. It is best considered as representing a separate subfamily of the Astropectinidæ, the Craspidasterinæ (new name).

Mimaster and Radiaster.—In respect to its systematic position *Mimaster* Sladen has been a rather restless genus. Sladen recognized its curious combination of apparently incompatible characters and made it the type of a subfamily of the Pentagonasteridæ. It has been variously regarded as belonging to the Archasteridæ (Perrier, 1894), Plutonasteridæ (Verrill, 1899), and Goniasteridæ (Fisher, 1911), until recently it was dignified by being raised to family rank (Verrill, 1914). Professor Verrill's disposition seems to be the best way out of the difficulty.

Since the publication of the "Asteroidea of the North Pacific" I have had the opportunity of examining two true Mimasters, *M. tizardi* Sladen, and *M. notabilus* Fisher, as well as the *M. cognatus* of Sladen, which appears to be generically distinct.

The abactinal skeleton of *Mimaster* is strongly astropectinoid, the plates being typical penicillate paxillæ, but the marginals, while perhaps neutral, remind one strongly of the marginals of *Cycethra*, a resemblance heightened by the actinal and adambulacral armature, which is decidedly ganeriid. By having definite sucking disks on the tube feet *Mimaster* is removed from proximity to *Leptychaster*, an association suggested by the dorsal surface, including the marginals, while it can not be placed in the Ganeriidæ because it possesses superambulacral plates and lacks the heavily calcified internal interbrachial pillar, the reticulated, imbricated, abactinal skeleton, and the asterinoid abactinal armature of *Cycethra* and *Ganeria*.

In *Mimaster* the *membranous* interradial septum forms a complete partition from the side wall of the disk to a free margin close against the stomach; but in *Cycethra* and in *Ganeria* (as in *Solaster* and in *Asterina*) there is a rigid pillar running from above the mouth plates to the abactinal surface, the cœlom being undivided between this pillar and the margin (an incomplete calcified septum).

In this connection I would like to call attention to the resemblance between *Ganeria* and the Solasteridæ, recently suggested

in conversation, by Mr. A. H. Clark. The marginal plates of *Ganeria falklandica* are essentially like those of Solaster, and in the adambulacral armature we find a very generalized form of the peculiar pectinate type of the Solasteridæ. The form and armature of the mouth plates, the actinal intermediate plates, and even the adambulacral plates can, however, be more nearly matched in the Asterinidæ. The abactinal skeleton, though of on open reticulate form, especially on the disk, is more nearly like that of the Asterinidæ than like that of the Solasteridæ.

While perhaps in some way related to the Ganeriidæ, I think *Mimaster* is well within the Phanerozonia. *Gephyreaster*, which I formerly associated with it in the Mimasterinæ, is probably more nearly related to *Pseudarchaster*. Unless its resemblance to *Mimaster* is only superficial, it may constitute an annectant group.

The purely nomenclatorial side of the matter is complicated by *Radiaster elegans* Perrier. Through the kindness of Dr. H. L. Clark I recently examined the type (unfortunately dried) in the Museum of Comparative Zoölogy (No. 909, Dominica, West Indies, 982 fathoms). From every outward indication this species is a typical *Mimaster*. *Radiaster** has one year priority. The family and its two genera may be summarized as follows:

Radiasteridæ, new name.

Mimasteridae Verrill, Monograph of the Shallow-Water Starfishes of the North Pacific Coast, 1914, p. 282.

Characters.—Phanerozonia with small, subequal, subpaxilliform marginals, resembling the Astropectinidæ abactinally and the Ganeriidæ actinally, but with sucking disks on the tube feet and complete membraneous interbrachial septa, and superambulacral plates; abactinal skeleton consisting of penicillate, usually independent, paxillae; actinal plates imbricated in transverse series, tabulate, with a coördinated tuft of spinelets; adambulacral armature a coördinated tuft of spinelets increasing in length toward the two or three almost undifferentiated furrow spinelets; first adambulacral somewhat compressed; mouth plates rather astropectinoid, with a straight marginal series of spines and without an unpaired median spine at the inner angle; madreporic body covered with paxillae springing from its surface.

Synopsis of the Component Genera.

1. Gonads confined to the disk and consisting of several tufts springing from a common point close to the interbrachial septum; hepatic

* *Radiaster* Perrier, Bulletin Museum Comparative Zoölogy, Vol. 9, June, 1881 p. 17. *Mimaster* Sladen, Proc. Royal Soc. Edinburgh, Vol. 11, 1882, p. 579.

cœca with long subdivisions, so that each ray appears to have from six to ten separate cœca of unequal length; tube feet with well-developed sucking disks; lateral abactinal plates not cruciform nor regularly imbricated

Radiaster [*Radiaster elegans* Perrier, *R. tizardi* (Sladen) and *R. notabilis* (Fisher)].

2. Gonads consisting of numerous tufts extending in a radial series near the superomarginal plates for over half the length of the ray; hepatic cœca two, not appearing multiple on account of long subdivisions as in the preceding; tube feet with very small sucking disks; lateral abactinal plates distinctly four-lobed, regularly imbricated

Mimastrella gen. nov. [Genotype *Mimastrella cognata* = *Mimaster cognatus* Sladen].*

Solaster and Crossaster.—These two genera have been united by most recent writers,† although in practice it is not very difficult to recognize them. Since new species of the *Crossaster* type are continually being described, it is becoming more and more desirable to keep them separate. A good differential character is the presence in *Crossaster* of a complete membraneous interbrachial septum between the internal interradial calcareous dorsoventral pillar and the margin. The pillar arises from the mouth plates and passes upward, its point of union with the abactinal skeleton being usually marked by a smooth spineless area. In *Crossaster papposus* between this calcified buttress and the margin there is a definite septum separating the gonads of adjacent rays, while in *Solaster endeca*, *S. borealis* and *S. abyssorum* the pillar is present, but not the membraneous septum; as a result the gonads of adjacent rays are not separated, and the cœlom is continuous. My recently described *Solaster scotophilus* has a complete membraneous septum and the outward habit of *Crossaster papposus*. It must therefore be classified as a *Crossaster*.

* *Mimaster* can not be used for this group because when described the genus was monotypic. The genotype, *M. tizardi*, being congeneric with *Radiaster elegans*, the name *Mimaster* becomes strictly a synonym of *Radiaster*.

† For some of the reasons for uniting them see "Asteroidea of the North Pacific," p. 329.