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**HUBERT LYMAN CLARK**

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THE CIDADARIDAE.

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BY HUBERT LYMAN CLARK.

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WITH ELEVEN PLATES.

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No. 7.— *The Cidaridae*. By HUBERT LYMAN CLARK.

Introduction.

THE opening years of the present century have witnessed the publication of an unusual number of quarto volumes dealing with the morphology and classification of the Echini. In each of these the Cidaridae receive considerable attention, and many genera of that family, new either in name or in contents, are proposed. As the different writers reveal wide divergence of opinion as to the relative importance of the characters on which the classification of the Echini is based, the arrangement of the Cidaridae differs to an unusual degree in these several reports. Mortensen (:03)<sup>1</sup> practically rejects previous classifications and the principles on which they are based, and, ignoring the fossil forms, to which his method is not applicable, recognizes thirteen genera and a subgenus, defined wholly in terms of the pedicellariae, the spicules of the pedicels, and occasionally the spines. It is only fair to state, however, that the writer says frankly, these features are not "sufficient for definitive diagnoses." He includes in his classification 42 species, and lists 12 others which he is unable to place satisfactorily because of lack of information about the pedicellariae. Very soon after this volume appeared, de Meijere's (:04)<sup>2</sup> valuable report on the "Siboga" Echini was published. Unwilling to accept Mortensen's genera unreservedly, the writer adopts the clumsy and unsatisfactory method of recognizing only a single genus, *Cidaris*, and using Mortensen's names for subgenera. Later in the same year Agassiz (:04)<sup>3</sup> in his report on the Panamic deep-sea Echini, points out the weaknesses of Mortensen's method and the unsatisfactory nature of his results, and emphasizes anew the great morphological significance of the test (including the abactinal system). Two years

<sup>1</sup> The Danish Ingolf-Expedition, 4, 1. Echinoidea. Part 1. Th. Mortensen. Translated by Torben Lundbeck. 193 pp., 21 pls. Copenhagen, 1903.

<sup>2</sup> Die Echinoidea der Siboga-Expedition. J. C. H. de Meijere. 252 pp., 23 pls. Leiden, 1904.

<sup>3</sup> The Panamic Deep Sea Echini. Alexander Agassiz. Mem. Mus. Comp. Zool., 31, 243 pp., 112 pls. 1904.

later Döderlein (:06),<sup>1</sup> in an effort to avoid some of the difficulties of Mortensen's system, and yet to retain the valuable results of his work, offers a classification of the recent Cidaridae, consisting of ten genera and five subgenera, defined chiefly in terms of the pedicellariae. This classification, however, is quite different from any of its predecessors because, while Döderlein attempts to apply rigidly the recent International Code of zoölogical nomenclature, his interpretation of certain perplexing cases is quite different from either Mortensen's or Agassiz's. Finally Agassiz and Clark (:07)<sup>2</sup> reject the proposed innovations of both Mortensen and Döderlein and offer considerable evidence in support of their view that the pedicellariae of the Cidaridae are as unreliable for generic characters as are the spines.

It is perfectly obvious, therefore, that the classification of the Cidaridae is at the present time in a state of great confusion, and that some effort should be made to reduce it to order and place it on a permanent basis. Thanks to the great kindness of Mr. Agassiz, a very unusual amount of material, both recent and fossil, has been accessible to me during the past two years, and I have endeavored to find and formulate a natural arrangement of the Cidaridae. Needless to say, Mr. Agassiz is not responsible in any way for statements made or opinions expressed in the following pages, but whatever value my results may have are due to his constant sympathy and encouragement, and I wish here, in this inadequate way, to express my thanks to him. I have also to thank Dr. Richard Rathbun for the privilege of examining the collection of Cidaridae in the United States National Museum, and this proved to be of added interest because it has recently been studied by Dr. Mortensen, who, in many cases, left labels in his own hand, showing the views he held as to the identification of the specimens. As my point of view differs fundamentally from his, I desire to do him full justice, and the examination of a collection, a large part of which has been named by him, was therefore of special importance to me. Finally I may add that in the preparation of this report I have personally handled not less than 3,100 specimens, representing 48 of the 60 recent species which appear to me to be valid, and all of the 15 recent genera herein recognized.

<sup>1</sup> Die Echinoiden der deutschen Tiefsee-Expedition. Ludwig Döderlein. 290 pp., 42 pls. Jena, 1906.

<sup>2</sup> Hawaiian and other Pacific Echini. The Cidaridae. Alexander Agassiz and Hubert Lyman Clark. Mem. Mus. Comp. Zool., 34, 42 pp., 44 pls. 1907.

## Historical summary.

The first writer to use the name *Cidaris* for a genus of Echini was Klein (1734), who, however, included all of the regular sea-urchins under that name. Linné (1758) used the same name for a *species* of *Echinus*, but Leske (1776) was the first writer subsequent to Klein who recognized *Cidaris* as a genus. Only one of the 28 species which he includes in the genus belongs in the family Cidaridae as understood to-day, and to that one he gave the name *papillata*. Now it is clear from both text and figures that Leske intended to include under the name "*Cidaris papillata*" all those regular Echini with the conspicuous interambulacral tubercles of the Cidaridae. His "species" is therefore a composite group, including not only the now well-known European *Dorocidaris papillata*, but also *Phyllacanthus imperialis* and several species of the restricted genus *Cidaris*, one of which appears to have been *tribuloides* Lamarck. The next writer to deal with the classification of the Echini was Lamarck (16), and he clearly indicates and defines the group which we now call the Cidaridae. He called them "Turbans," under his genus *Cidarites*. So far as the Cidaridae are concerned the name *Cidarites* is equivalent to Leske's *Cidaris papillata* and is obviously a synonym of *Cidaris*. It cannot be used, therefore, at the present time for any genus of animals. Lamarck listed eleven species of "Turbans," all but one of which were recognized and described by Alexander Agassiz in 1872, in his classic "Revision of the Echini." No attempt to subdivide the genus *Cidaris* was made until 1835, when Brandt established the genus *Phyllacanthus* for a supposedly new species, *dubia*. He divided Lamarck's *Cidarites* into two sections, A (including the species not in B and for which he selected and named *tribuloides* Lam. as the type species) and B, *Phyllacanthus*, with *dubia* for the type, and including also *imperialis*, *hystrix*, *geranioides*, and *pistillaris*. Later investigation made it plain that of these four only *imperialis* and *pistillaris* are congeneric with *dubia*, and the other two were therefore returned to *Cidaris*. In 1872 A. Agassiz showed, however, that Lamarck's *baculosa*, *verticillata*, and *annulifera* had important features in common with *dubia* and *imperialis* and accordingly placed them in *Phyllacanthus*. When Agassiz and Desor (46) considered the Cidaridae, they neglected *Phyllacanthus*, but established *Gonicidaris* with *geranioides* for the type, and with it associated a "new" species *quoyi*, which subsequently proved to be synonymous with Lamarck's *tubaria*. In 1854 Desor suggested as genera of fossil Cidaridae, *Rhabdocidaris*, *Diplocidaris*, *Porocidaris*, and *Leiocidaris*, and in



1858 he described the fossil Eocidaris. The same year (1858) Quenstedt named Polycidaris and Leptocidaris for fossil forms. In 1862 Cotteau described the remarkable fossil Orthocidaris, and the following year the equally interesting fossil Temnocidaris. In 1863, A. Agassiz suggested the name Stephanocidaris for Lamarck's *bispinosa*, and Prionocidaris for *pistillaris*. At the same time he proposed Chondrocidaris as a new genus for a notable species from the Hawaiian Islands, and Gymnocidaris for *metularia* Lam. and a supposedly new species, *minor*. He also proposed Orthocidaris and Temnocidaris as new genera of recent Cidaridae, but later (1869) withdrew them as preoccupied by Cotteau's fossil forms. At this later date he suggested Dorocidaris for a new species, *abyssicola*, associating with it *affinis* Phil. and *papillata* Leske. With the last Lamarck's *hystrix* is synonymous, and consequently, as a result of these various changes, there remained in Lamarck's genus "Cidarites: Turbans" only the well-known West Indian species, *tribuloides*.

In the "Revision of the Echini" (1872) A. Agassiz recognized only six genera of the recent Cidaridae, as follows:—

- Cidaris Klein, with 3 species. (Including Gymnocidaris A. Ag.)
- Dorocidaris A. Agassiz, with 1 species. (Including Orthocidaris A. Ag.)
- Phylacanthus Brandt, with 6 species. (Including Prionocidaris A. Ag., and Chondrocidaris A. Ag.)
- Stephanocidaris A. Agassiz, with 1 species.
- Porocidaris Desor, with 1 species.
- Gonicidaris Desor, with 3 species. (Including Temnocidaris A. Ag.)

This classification has been maintained by Agassiz ever since, without any changes other than the addition of ten more species (1881, 1883, 1898) and the unique genus Centrocidaris (1904).

In 1877 Studer described Schleinitzia as a recent genus allied to Phylacanthus. In 1883 Pomel divided the "Cidaridés" into three subfamilies, the Cidariens, Gonicidariens, and Rhabdocidariens. The first contains four genera, including of Agassiz's six only Cidaris, which is divided into five sections (subgenera?); the second subfamily contains four genera also, including Dorocidaris and Gonicidaris of Agassiz's list; the third contains seven genera, including the remaining three of Agassiz, though Stephanocidaris is considered only a subgenus (?) of Phylacanthus. Although Pomel thus recognizes fifteen genera and six subgenera (?), his classification of the recent forms is essentially identical with that of A. Agassiz. The new genera which he proposes are Tylocidaris, Stereocidaris, Typocidaris, and Pleurocidaris, all for fossil

forms. His proposed subgenera of *Cidaris* are, *Plegiocidaris*, *Paracidaris*, *Procidaris*, *Polycidaris*, and *Eucidaris*. In 1884 Zittel proposed *Anaulocidaris* for a fossil cidaroid, and in 1885 Döderlein used the name *Discocidaris* for some recent Japanese species. In 1887 Döderlein published a classification of the Cidaridæ, including the fossil as well as the recent forms. Of the 22 genera which he recognizes, 15 include only fossil species. He rejects *Stephanocidaris* altogether, and uses Desor's name *Leiocidaris* for *Phyllacanthus*. For some inexplicable reason he considers *Porocidaris sharreri* A. Ag. as a living representative of Pomel's genus *Pleurocidaris*. To another of Pomel's genera, *Stereocidaris*, he assigns three recent Japanese species which he describes. He proposes four new genera of fossil cidaroids, but only gives names to three: *Mikrocidaris*, *Triadocidaris*, and *Miocidaris*. In 1889 Duncan's "Revision of the Genera . . . of the Echinoidea" appeared, with a classification of the Cidaridæ, which at first sight seems unique, but on examination proves to be novel only in the rank assigned to the different groups. The writer divides the family into two sections, of which the first contains four genera and one subgenus, and the second contains two genera. For recent forms only the genus *Cidaris*, with a subgenus *Gonicidaris*, is allowed, but the heterogeneous nature of such a genus is so far acknowledged that it is divided into seven "divisions," of which five contain the recent species. These five "divisions" with the subgenus *Gonicidaris* correspond in name and contents to the genera maintained by A. Agassiz. In 1902 Lambert proposed for certain fossil and recent Cidaridæ previously referred to *Stereocidaris*, the name *Phalacrocidaris*, and in 1903 he suggested for some fossil species allied to *Phyllacanthus*, the name *Aulacocidaris*.

In 1903 Mortensen entirely rearranged the recent species of the family, uniting or separating them according to resemblances or differences in the large globiferous pedicellariæ. In this way he makes thirteen genera and a subgenus, and although he uses the names of the six genera of A. Agassiz, the grouping of the species is wholly different from that writer's. Mortensen's classification is as follows:—

- Dorocidaris* A. Ag. (emend.), 4 species.
- Tretocidaris*, g. n., 3 species.
- Stephanocidaris* A. Ag. (emend.), 3 species.
- Schizocidaris*, g. n., 1 species.
- Cidaris* Klein (emend.), 8 species.
- Chondrocidaris* A. Ag., 1 species.
- Acanthocidaris*, g. n., 1 species.

Stereocidaris Pomel, 10 species.  
 Goniocidaris Desor, 4 species and subgenus *Discocidaris* Döderlein, 3 species.  
 Petaiocidaris, g. n., 1 species.  
 Phylacanthus Brandt (emend.), 3 species.  
 Histocidaris, g. n., 1 species.  
 Porocidaris Desor, 1 species and 1 variety.  
 Genus undetermined, 12 species.  
 Total, 56 species and 1 variety.

Of these 56 species, seven, and the one variety, are described for the first time, but only one of them is figured. Unfortunately Mortensen was handicapped by lack of material and the apparent necessity of not deruding even in part the specimens which were available, and as a consequence his descriptions are, with one exception, incomplete, and in several cases quite inadequate. Good photographs of his types would be a very great help in recognizing these supposedly new species.

In 1906 Döderlein presents his classification of the recent Cidaridae, the result of more than twenty years' study of the family. It is radically different from his earlier (1887) arrangement, not merely because no reference is made to fossil forms, but because he endeavors to make use of Mortensen's principles, which his own observations often contradict<sup>1</sup> and his judgment not infrequently condemns.<sup>2</sup> This latest arrangement of the family is as follows:—

Cidaris Leske (syn. *Dorocidaris* A. Ag.), 4 species.  
*Tretocidaris* Mortensen, 3 species.  
*Cidarites* Lamarck (syn. *Cidaris* emend. Mortensen).  
 Subgenus *Dorocidaris* A. Ag., 4 species.  
     *Gymnocidaris* A. Ag., 3 species and 1 variety.  
     *Stephanocidaris* A. Ag., 5 species and 7 varieties.  
*Chondrocidaris* A. Ag., 1 species.  
*Goniocidaris* L. Agassiz et Desor.  
 Subgenus *Goniocidaris* s. str., 6 species.  
     *Discocidaris* Död., 6 species.  
*Stereocidaris* Pomel, 14 species.  
*Acanthocidaris* Mortensen, 1 species.  
*Phylacanthus* Brandt, 1 species and 3 varieties.  
*Histocidaris* Mortensen, 2 species.  
*Porocidaris* Desor, 1 species and 1 variety.  
 Genus undetermined, 6 species.  
 Total: 10 genera, 5 subgenera, 57 species, and 12 varieties.

<sup>1</sup> Compare page 102, line 24, with page 106, lines 34–36 and page 109, lines 20–21.

<sup>2</sup> See p. 93 et seq.