

Dispute about *Echinodiscus* Leske, 1778 and *Amphiope* L. Agassiz, 1840 (Echinoidea Astriclypeidae)

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ABSTRACT

Between the late 1800s and early 1900s, some European echinologists gave rise to a dispute over belonging to the genus *Amphiope* Agassiz, 1840, rather than *Echinodiscus* Leske 1778, of some lunulate scutelliforms present in the Oligocene-Miocene deposits of France and Italy. The problem has never been resolved, due to the fact that these echinologists considered the similarities or differences in shape, rather than structural ones. One of the nodes of the dispute was the variability in shape and size of the lunules in *Amphiope*. Because of all these problems, and also because of the impossibility to obtain and examine the structures of some type specimens of several species established in the past, the recognition of new species is very complicated and research carried out so far, in many cases is doubtful or controversial.

KEY WORDS

Amphiope; *Echinodiscus*; lunules variability.

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INTRODUCTION

The problems that have constituted the nodes of the dispute which we summarize here, have been the starting point for the studies carried out by different authors (see Stara, 2014). In particular, the frequent lack of references relating to the structural characteristics of *Amphiope* L. Agassiz, 1840 and *Echinodiscus* Leske, 1778, so far established, and the uncertainties due to the impossibility of comparing the type specimens of these species, have greatly complicated these studies.

It should be said, however, that L. Agassiz (1838–41), for example, had already meticulously illustrated the complete plating of the two faces of a specimen of *Lobophora aurita* (*Echinodiscus auritus* Leske, 1778) and that Lovén (1872) published an important work on the structure of echinoids.

With regards to the clypeasteroids, in particular, Durham (1955) systematically had reproduced patterns of the plates (plating) of a large number of species, including those of *Echinodiscus bisperforatus* Leske (1887) and *Amphiope bioculata* (not des Moulins 1837 type). Later, however, except in rare cases (Kroh, 2005; Pereira, 2010) no one, to our knowledge, reported platings of several other nominal species belonging to the family Astriclypeidae Stefanini (1912).

To try to end the dispute which we summarize here, other authors (Stara & Rizzo, 2014; Stara & Fois M., 2014; Stara & Sanciù, 2014) proposed a review of the main characters of some species belonging to this family (Astriclypeidae), using the plate pattern of their tests, considering this the main tool for the specific and generic diagnosis in echinology.

THE DISPUTE

Shape of lunules, uncertainly of the generic attribution and phylogenesis

Cottreau (1914), describing *Amphiope boulei* Cottreau, 1914 from the Aquitanian of Carry (Bouches-du-Rhône, France), stated that the axial lunules are a primitive morphological character in *Amphiope*. This primitive morphological character is already present in some Oligocene species, such as *Amphiope agassizi* des Moulins (1837) from the Asterias-limestone of the Bordeaux Region, *A. pedemontana* Airaghi, 1899, from Piedmont and Liguria (Airaghi, 1899) and *A. duffi* Gregory, 1911, from Cyrenaica. According to this author, the axial arrangement of the lunules persist in present-day species of *Tretodiscus* [currently considered as synonymous to *Echinodiscus* (Kroh, 2012)] bearing elongated lunules or slits notches on the posterior margin. These would be derived from Oligocene species of *Amphiope*, and they were considered the true *Echinodiscus* by Stefanini (1912).

According to Cottreau, also *A. fuchsi* Fourtau (1901), from the Middle Miocene of Siwa (Siouah), Egypt, was an *Amphiope*, as well as *A. boulei*, while "*Amphiope*" bearing elongated lunules was not the typical form. As evidence of the kinship existing between *Amphiope* and *Echinodiscus*, Cottreau observed that juvenile individuals in *Amphiope bioculata* des Moulins, 1837 (the type species of this genus) often bear pear-shaped elongated lunules along the axis of the rear ambulacra. According to this author, *A. cherichirensis* Gauthier, 1957, from Tunisia and *A. truncata* Fuchs (1883) from Middle Miocene of Egypt, can be derived from the Oligocene European "*Amphiope*" bearing axial lunules. These would be derived from Middle Miocene Indian echinoids, such as *A. placenta* Duncan, 1885, *A. desori* Duncan et Sladen 1883, *A. duncani* Lambert, 1907 and from Japanese ones, such as *Echinodiscus formosus* (Yoshiwara, 1901). The latter one would be the true ancestor of *Tretodiscus* (*Echinodiscus*), which has slits and is typical of the Indian Ocean, where it is represented by *Tretodiscus elongatus* Duncan et Sladen, 1883 and *E. bifissus* Agassiz (*Lobophora*) 1840, the latter one corresponding to the living *Echinodiscus auritus* Leske, 1778 with open slits on the back edge. Comparing the internal structure of "*Amphiope*" bearing axial lunules with

that of the typical *Amphiope* (*A. bioculata* des Moulins, 1835), Cottreau discovered that the two structures were identical, but unfortunately, he did not publish detailed descriptions of them.

Lambert (1915) wrote "Cottreau considered *Amphiope agassizi* as a very particular form, that joins very closely *Amphiope* to *Lobophora*, (actually *Echinodiscus*), and he proposed the suppression of the latter genus. (...). The *Amphiope* (morpho) type appeared in the Middle-Early Oligocene with *A. pedemontana*, and it bearing elongated lunules in the direction of the ambulacral axis, and retained this character in a series of successive species: *A. agassizi* in the Stampian (Middle Oligocene), *A. cherichirensis* and *A. baquiei* in the Burdigalian and *A. truncata* in the Early-Middle Miocene. Two branches detached from this main trunk: the first one in Aquitaine (France) during the Aquitanian, with *A. ovalifora* and the series of closely related Burdigalian and Serravallian species extinct in the Tortonian with *A. lorioli*. The second one, developed in the Indo-Pacific region, firstly appeared during the "Helvetian" with *Tretodiscus elongatus*, that clearly represent an ancestral form of the present-day *T. laevis* (A. Agassiz, 1872-74), *T. biforis* (Gmelin, 1778) and *T. rumphi* Lambert et Thiéry, 1914. Thus, the latter one does not descend from the Miocene European *Amphiope*, but it directly descended from the Oligocene *T. elongatum* through a succession of intermediate Indian forms."

On the variability of lunules

Cottreau (1914) examined the variability of the *Amphiope*'s lunules, using a sample from the Burdigalian of Saint-Cristol (Nissan, Hérault, France). He demonstrated their large variability in shape and size, and thus considered these characters not as diagnostic. He asserted that, despite the lunules are rounded or broadly oval in transverse direction in the adult specimens, *A. bioculata* could have elongated lunules in the direction of the posterior ambulacra in the juvenile stages, as well as adults of *A. baquiei* Lambert, 1907. Cottreau justified this apparent anomaly by the replication of ancestral characters in very young individuals.

More recently, Philippe (1998), based on the hypothesis of a wide intraspecific variability of the species of *Amphiope* from the Miocene of the Rhône Basin (France), tried to order the systematics

of this genus, synonymizing a number of species, and maintaining only two valid taxa: *A. bioculata* and *A. boulei*.

DISCUSSION

Unfortunately, Philippe (1998) didn't consider important aspects, such as the internal test structure and the test plating. Those features were partially described by Durham (1955), Kroh (2005) and Pereira (2010). However, the material studied by Philippe did not come from the type locality indicated by des Moulins (1837) (Souze-la-Rousse). The Rhône Basin could even be considered the typical area, but the stratigraphical range of the sediments cropping out in this area is wide and the age of the holotype of *A. bioculata* was not indicated by des Moulins (1837). Additionally, the holotype of *A. bioculata* seems to have been lost [given that the type established by des Moulins (1837) belonged to his own collection (Meo Museum) and being that des Moulins lived in Bordeaux, we asked at the the local Natural History Museum if in their collections there are the Des Moulins collection. But we had no answer] and no description or illustration of its internal structure, or plate structures have ever been provided. Subsequent interpretations are highly controversial (see Agassiz L., 1838-40; Cottreau, 1914; Philippe 1998), thus leading to an uncertainty in the systematics of the genus. This problem and the need to assess the real extent of the intraspecific variability of the species of *Amphiope* comparing it with the living *Echinodiscus* species, are emphasized by Stara & Borghi (2014) during the revision and characterization of the *Amphiope* Sardinian's species, and they're emphasized by Smith & Kroh (2011), who recommended a systematic review of the entire genus. Finally, this problem has been analyzed by Stara & Fois M. (2014) on the bases of an "*Echinodiscus*" cf. *auritus* sample.

On the other hand, with regard to other *Echinodiscus* species, illustrations and descriptions made in the past (except Durham, 1955) concerned only shape and basic test measures. Today, it is demonstrated that the only basic measures, such as Test Length, Test Width and Test Height, are not sufficient to establish the real belonging to a species, rather than another, since different species have

been grouped under a single morphotype who answered to the name of *Echinodiscus*. For example, let's take two cases: the description given by L. Agassiz (in Agassiz & Desor, 1847) in the text where he established the species *Echinodiscus tenuissimus* from Waigiu (Western Papua, Indonesia) and the description of *E. tenuissimus* in Dollfus & Roman (1981), in his publication on Red Sea echinoids. In the first L. Agassiz says only that the species has two small lunules back, but does not contain any illustration concerning the test plating; Dollfus & Roman, however, states only that "*La var. tenuissima (Ag. & Desor, 1847) = E. laevis Al. (Ag. 1873), considérée par Mortensen (1948 d, p. 411-413) comme espèce séparée, n'existe pas en mer Rouge (pl. 33, fig. 5-6). Elle diffère d'auritus typique surtout par la position de l'anus (qui est sur la ligne joignant les milieux des lunules) et ses lunules fermées*".

"*The var. tenuissima (...). Herself differs from typical auritus for the position of the periproct (which is on the line that joins the half of lunules) and by closed lunules.*"

Regarding *Echinodiscus bisperforatus* var. *truncata*, however, they show at least two morphotypes (coming from diverse countries as Papua New Guinea and Zanzibar) and a long synonymy, based on the shape of the test and of the lunules (short or long). This morphotype, in fact, had already been well illustrated by L. Agassiz (1838-40, pl. 11, figs. 11-16) as *Lobophora truncata*, (unknown origin) that differs from *L. bisperforata* by shorter lunules.

It is evident that, in the absence of platings description, regarding the specimens studied by several authors mentioned in the synonymy, it is impossible to understand what the authors refer to, when they talk about *Echinodiscus tenuissimus* and/or about *E. bisperforatus* var. *truncata*.

From Dollfus & Roman (1981): analyzing the beautiful images that illustrate the specimen from New Caledonia, in which the plating is partially visible, it can be observed that the plating is not characteristic of *Echinodiscus*, as will be illustrated best in Stara & Sancier (2014). Other specimens, such as *Echinodiscus bisperforatus* var. *truncata* figured in pl. 34, figs. 3-4, coming from New Britain (Papua New Guinea) or as *E. bisperforatus* var. *truncata* figured in pl. 35 figs. 1-2, coming from Zanzibar, they differ in test shape and lunules length, but it is not clear what is their plating.

CONCLUSIONS

It is evident that, in the absence of careful plating analysis, it is not possible to determine the membership of these specimens to one species/genus rather than to another. We believe that the analysis of the structure and in particular of the plating in echinoids is the primary tool for diagnosing and that is very difficult to confirm old descriptions based only on morphology.

Therefore, to analyze the specimens of the family Astriclypeidae, in this volume will be studied most importantly their plating.

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