

mid-Italy to northern Sweden, strongly militates against the conception that we are dealing here with biotypes (*sensu* JOHANNSEN) which are being called into existence by the influence of human life. There is no reason to regard them as different to any other species in the animal and vegetable kingdom, i.e. we have to admit their existence, but we cannot account for the special mechanism of their origin.

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**Palaeontology.** — *Remarks on Rudists.* By H. J. MAC GILLAVRY. (Communicated by Prof. L. RUTTEN).

(Communicated at the meeting of April 27, 1935).

*A Barrettia from Guatemala.* — After the publication of my paper on Guatemala Rudists (4) some more material was sent to me for identification by Profs. DACQUÉ and BROILI. The material consists of two fragments, one, the greater part of a right valve of *Barrettia monilifera*, below the body-chamber, partly imbedded in limestone, and the other, a small fragment of the same species. They were found by Prof. K. SAPPER on the spot already mentioned by him, i.e. between Chama and Samac, May 1891. SAPPER already referred them to the genus *Barrettia*, but they had not yet been specifically named. The greater piece had been badly battered before fossilization, and the outer shell layer had been worn away entirely in the imbedded parts. The limestone containing the fossil is dark, grey and bituminous. In a slide it is seen to contain Radiolitid fragments, Miliolids and Orbitoids (*Pseudorbitoides israelski* VAUGHAN and COLE, det. M. G. RUTTEN). This species occurs in Cuba also together with *Barrettia*.

If we draw a comparison between the different species of *Barrettia* (cf. 1, figs. 3a—c), we find the ligamental crest about 60° away from S, with the posterior tooth  $P_{II}$  near its top. The inclination ( $\angle \alpha$ ) of the cardinal apparatus then is about 60° in figs. 3a, b, 70° in fig. 3c: *B. monilifera*. In the Guatemala sample the longest moniliform ray lies nearer to S. Near its end there is a dark round spot, which we may consider to be the mark of passage with growth of the posterior alveole. The number of rays is 63. *L* contains 13 pearls. These numbers are minima, owing to the double erosion, one before fossilization and the second in recent times.

The small fragment is from a smaller specimen, with the outer shell layer intact, which is about 2.5 mm. thick. This layer is also distinctly seen in the figures of WOODWARD (1862, fig. 5), TOUCAS (1903, textfig. 73), DOUVILLÉ (1926, Cuba, Pl. VII, fig. 2), SÁNCHEZ Y ROIG (1926, Fauna Cret., Pl. 2). Nevertheless, TOUCAS has come in his monograph to erroneous conclusions, which have been discussed in a previous paper (1). This mistake was caused by his comparing the genus to *Batolites*, where the outer shell layer appears to be differentiated into two layers,

the outer, more compact or "cortex"-like layer shooting out projections into the inner. The real inner shell layer of Hippuritinae, as is well known, forms the tabulae, which curtail the body cavity, or, if more irregular, forms "Kalkmaschen" (cf. KLINGHARDT II, 1922, p. 16). The tabulae of *Barrettia*, much more numerous than those of common Hippuritinae, are intersected by the moniliform rays. The result is the formation of rows of cells, as seen in a section. Comparison of these with the cells in the outer shell layer of Radiolitinae (cf. KLINGHARDT II, 1922, p. 16) is apt to create confusion. They are formed by essentially different units.

*The genus Parastroma* DOUVILLÉ 1926 (3, p. 71; DOUV. 1926, Cuba, pp. 133, 134, Pl. VIII, figs. 1—4). — In the Guatemala *Barrettia* the inner shell layer, centrad of the rays, is seen to consist of many crowded, irregularly concentric tabulae in some parts, which in other places irregularly anastomose. The whole is very reminiscent of PALMER's figure (7, Pl. II, fig. 2) of *Parastroma guitarti* (PALMER). The exterior of this species also resembles that of a *Barrettia*. The Rudist nature of the genus *Parastroma* has been recognized by PALMER, who, however, placed the species wrongly in the genus *Orbignya*, from which it can be readily distinguished by the enormous development of the inner shell layer, which entirely envelops the pillar *E*. The genus is indeed closely allied to *Barrettia*, from which it may be supposed to have originated through the disappearance of the rays and of the stems of *L*, *S* and *E*. As in *Barrettia* these are already atrophying, i.e. dissolving into moniliform rays, this view is not difficult to adopt. At the same time some modifications of the outer parts of the inner shell layer must have occurred.

DOUVILLÉ (1926, Cuba, *B. S. g. F.*) placed two species in this genus: the type species *P. sanchezi* DOUVILLÉ 1926, and *Delheidia haydeni* DOUVILLÉ 1916 (Pal. Ind.). *P. sanchezi* is the type, as in the *Comptes Rendus* (3, p. 71) only this species was brought into the genus. Moreover in the *Bulletin*, where *Delheidia haydeni* was included in the genus, he designated *P. sanchezi* as type through the expression *n. g., n. sp.* (opinion 7, Int. Rules of Zool. Nom.). As the species *haydeni* is no Rudist, it will have to be replaced into the genus *Delheidia*, or in a different or a new genus. Prof. L. RUTTEN pointed out to me its likeness to the Orbitoid *Torreina torrei* PALMER (6, 1934, p. 237). It is interesting to note that other Stromatoporoids are recently thought to be closely allied to foraminifera of the *Gypsina*-group (PARKS, 8, 1935, p. 29). DOUVILLÉ, however, emphasizes the imperforate structure of *Delheidia haydeni*. PALMER (7, 1933, p. 96) described the new species *guitarti*, which already figured in SÁNCHEZ' *Fauna Cretacica* under the name of *Ichthyosarcolites sp.*

The synonymy and bibliography of the genus is:

*Parastroma guitarti* (PALMER) 1933

1926 (*Ichthyosarcolites sp.*) SÁNCHEZ Y ROIG, Mem. Soc. cubana  
Hist. nat. "Felipe Poey", VII, p. 100, Pl. 8.

- 1933 (*Orbignya guitarti*) PALMER, Revista de Agricultura, Habana, XIV, Nos. 15, 16, pp. 96, 97; Pl. I, f. 1; Pl. II, f. 2; Pl. III, f. 1.
- Parastroma haydeni* DOUVILLÉ 1916 (Pal. Ind., n.s., V), no *Parastroma*, no Rudist; either a Stromatopore or a Foraminifer.
- Parastroma sanchezi* DOUVILLÉ 1926
- 1926 (*P. s.*) DOUVILLÉ, C. R. S. g. F., p. 71.
- 1926 (*P. s.*) DOUVILLÉ, B. S. g. F., sér. 4, XXVI, pp. 133, 134; Pl. VIII, figs. 1—4.
- 1926 (*Cyclactinia nov. sp. a*) SÁNCHEZ Y ROIG, l.c., pp. 101, 102; Pl. 9.
- 1926 (*Cyclactinia nov. sp. b*) SÁNCHEZ Y ROIG, l.c., pp. 101, 102.
- 1933 (*Orbignya sanchezi*) PALMER, l.c., p. 97; Pl. I, f. 2; Pl. II, f. 1; Pl. III, f. 2.

If the species *P. sanchezi* really contains two species, the *nov. sp. a* of SÁNCHEZ is the *P. sanchezi* of DOUVILLÉ (cf. SÁNCHEZ, l.c., p. 102). PALMER's *P. sanchezi* is then probably the *nov. sp. b* of SÁNCHEZ.

It may be possible that the genus occurs on Porto Rico too (cf. MEYERHOFF, 5, p. (2), "The specimens do not appear referable to any described species, but have much in common with the genus *Barrettia*..."), but this is a mere guess.

*Classification of Hippuritinae.* — As several features have not received monographical treatment and references are found in many scattered articles, much time is needed in studying Rudists. After the monograph of TOUCAS, moreover, three new genera have been described, and our insight has widened. So I feel justified to give the following key, which contains familiar statements as well as new facts. Care has been taken to stress the genetical relations, at the same time making the sequel of the genera a logical one. *Torreites* is probably more closely allied to *Vaccinites*, but it could not be placed there without disturbing the whole. If a genus is practically cosmopolitan, no geographical range has been indicated.

Heterodont Lamellibranchiata (for the position of this group in different classifications vide MORLEY DAVIES, Proc. Malac. Soc. XX, p. 323, 1933): mantle edges united, two adductor muscles, teeth alternating.

*Megalodontacea (Pachyodonta)*: integripalliate, siphons present, pleurothetic, pachyodont.

*Fam. Gyropleuridae* (cf. DOUVILLÉ 1900, p. 210; PAQUIER 1905, pp. 50—52): posterior adductor muscle attached in the right valve to a myophorous lamina, in the left valve to the internal face of the posterior myophore. "Inverse": right valve with one tooth, left valve with two teeth, valves coiled in the same sense as those of *Exogyra* (cf. DOUVILLÉ 1887, p. 758), or at least with such a predisposition. Animal fixed or resting upon the right valve. Shell consisting of two layers, an outer calcitic and an inner ?aragonitic one (cf. BÖGGILD, 1930, p. 281).

*Subfam. Hippuritinae*: Canals in outer shell layer of left valve, communicating with the outer surface through pores (except in *Torreites*).

Right valve with two infoldings of the outer shell layer towards the interior in the siphonal area: the pillars, and a third at the dorsal side: the ligamental crest or infolding (except in *Arnaudia*). Frequently three longitudinal grooves are seen on the outer surface, corresponding, to *L*, *S* and *E*. Extremely inaequivalve. Valves not connected by a ligament, their opening effected by linear displacement. Outer shell layer of right valve compact, often with holes. Teeth and myophores formed by the inner shell layer. Teeth of left valve highly developed and emancipated away from the shell border towards the interior of the valve. Anterior myophore of left valve emancipated towards the interior, sessile against the base of the anterior tooth. Posterior myophore of left valve likewise emancipated towards the interior and connected with the posterior tooth at the base; highly developed and fitting into an "alveole" in the right valve.

So the posterior adductor muscle is not attached in the right valve to a myophorous lamina proper. The valves are not coiled, but frequently twisted, probably so as to secure a definite orientation of the siphonal area towards influences from outside (cf. MILOVANOVIC, 9, p. 188).

*L* = ligamental crest or infolding; *S* = first pillar, dorsal of the anal, exhalent siphon; *E* = second pillar, dorsal of inhalent siphon;  $\alpha$  = angle between *L* and a line drawn through the centres of the teeth;  $r:u$  = part of circumference occupied by *L—E*; Accessory cavity = cavity dorsal of anterior tooth; Commissure = plane of junction. For the characteristic shape of the pores see figs. 1—14 of TOUCAS' monograph.

- I. Pores linear or polygonal, rarely punctiform, rounded or with a few denticulations (*H. cornucopiae*, cf. DOUVILLÉ, 1910, études, p. 9). *L* short, very rarely a little longer. No accessory cavity in most cases.  $r:u > \frac{1}{4}$ ;  $\alpha > 50^\circ$ .

A. three pillars. Pores unknown.

*Tetracionites* ASTRE 1931.  
Madagascar.  
Upper Campanian-Lower  
Maestrichtian.

B. two pillars.

*Hippurites* LAMARCK 1908.  
(*Orbignya* of TOUCAS).  
Angoumian-Maestrichtian.

- a. pillars rudimental or orimental. *L* likewise. Pores linear, sometimes rounded.

subg. *Arnaudia* BAYLE in FISCHER 1887.  
Charente.  
Upper Santonian-Lower Maestrichtian.

- b. pillars distinct.

subg. *Hippurites* s. str. (*Hippuritella* p. p., *Orbignya*, *Batolites* of Foss. Cat., 54).  
Angoumian-Maestrichtian.

II. Pores mostly denticulate or reticulate, sometimes polygonal, in that case  $r : u < \frac{1}{4}$  and  $\alpha < 50^\circ$ .  $L$  long, very seldom shorter.  $L$  sometimes irrecoznizable. In that case the pores are rectangularly denticulate and  $S$  and  $E$  extraordinarily pedunculate.

C. Accessory cavity distinct.  $L$  always easily recognizable.  $r : u < \frac{1}{4}$  and  $\alpha < 50^\circ$ . Very seldom these values exceed these limits. In that case the pores are distinctly denticulate or reticulate and the inner shell layer of the right valve does not take part in the formation of the commissure, nor does it form a sort of ledge near the border of the valve.

c. If in the right valve open infoldings exist, these are more of the nature of undulations of the outer shell layer. Sometimes only undulations of the inner border of the outer shell layer exist. In most cases no undulations at all.

*Vaccinites* FISCHER 1887. (*Vaccinites* and *Hippuritella* p. p. of Foss. Cat., 54). Angoumian-Maestrichtian.

d. several infoldings of outer shell layer towards the interior, in the right valve. These infoldings vary between such as are long and thin, sometimes almost moniliform, and such as are short and thickened, triangular, some of which may be open exteriorly, but not necessarily so. (This paragraph from a letter by MILOVANOVIĆ). Pores denticulate.

*Pironaea* MENEGHINI 1866.  
Upper Campanian-Maestrichtian.

D. Accessory cavity obsolete, owing to the enormous development of the inner shell layer of the right valve. This layer forms a sort of ledge near the border of the valve, which takes a considerable part in the formation of the commissure, except in *Barrettia sparcilirata*, where there is a little distance between this ledge and the left valve (cf. 1, fig. 2b, p. 1305).  $L$  only recognizable by analogy with its position in *B. sparcilirata*, where it is well recognizable. Or  $L$  is entirely effaced.  $r : u > \frac{1}{4}$ ;  $\alpha > 55^\circ$ .  $S$  and  $E$  extraordinarily pedunculate. Pores rectangular and denticulate.

e. Many infoldings of the outer shell layer into the inner shell layer, in the right valve. Except in *B. sparcilirata*, these infoldings are dissolved into "moniliform rays".  $L$  and the stems of  $S$  and  $E$  are likewise shaped.

*Barrettia* WOODWARD 1862.  
Antilles, Central America.  
Maestrichtian.

f. these infoldings entirely effaced, and likewise the stems of  $L$ ,  $S$  and  $E$  (only rudiments of the rays are traceable near the outer shell layer in *P. guitarti*).

*Parastroma* DOUVILLÉ 1926.  
Cuba, (?? Porto Rico).  
Maestrichtian.

- III. No pores. *L* extraordinarily elongate, longer than the shell radius. Outer shell layer of right valve with short narrow infoldings, that do not reach the inner margin of this layer. Umbo of left valve displaced towards the ventral side, excentral.

*Torreites* PALMER 1933.

Cuba.

Maestrichtian.

The genus *Pseudobarrettia* MUELLERRIED 1931 (Sobre una anomalia) is as yet a nomen nudum, as the author described only an anomaly, after Dec. 31, 1930, thus not complying with the addition to Art. 25a of the International Rules.

The genus *Praebarrettia* TRECHMANN 1924 has been revived by PALMER (7, p. 99) on account of the cells between the rays ("porose structure"). The way these cells come into being has been explained above. They occur in all *Barrettia* and likewise in *Pironaea*. There certainly are differences between *B. sparsilirata* and other *Barrettia* (cf. the key) and the name might be retained as a subgenus of *Barrettia*. Whether this is done or not is a matter of taste at present. The larger gap still exists between *Pironaea* and *Barrettia*, though the almost moniliform rays (MILOVANOVIĆ in litt.) in some samples of *P. polystyla* on the one hand, and the great distance between *L* and *E* in *P. peruviana* on the other, tend to bridge it over.

The differences between *Pironaea* and *Vaccinites* are very subtle and gradual, but it is useful to retain the genus *Pironaea*, as it constitutes a definite, monophyletic branch.

This is not the case with *Batolites*. The previously mentioned feature, which differentiates *Batolites*, occurs also in several other "*Orbignya*", as has already been pointed out by TOUCAS (1904, Observations, p. 734). It even occurs in the specimen of *H. (Hippuritella) variabilis*, figured in TOUCAS' monograph (fig. 82, p. 52). So in order to differentiate the two genera or subgenera, we should have to mention, besides the feature given, the specific characteristics that the two species (*Bat. organisans* and *Bat. tirolicus*) have in common. This would not be a very logical procedure. Otherwise those *Hippurites* mentioned by TOUCAS are to be included in *Batolites* and then the genus would not constitute a natural group. Moreover, we should at once be involved in serious nomenclatural difficulties. They occur all of them, it is true, in the Santonian and Campanian, but so do most Hippuritinae.

As to the group *Hippuritella*, although it may seem more practical to unite the Hippuritinae with polygonal pores under this name, this is not really the case, at least not at present. Many of those are still placed in *Orbignya* and *Vaccinites* in the Foss. Cat. So it will be necessary to revise them thoroughly to see whether DOUVILLÉ or TOUCAS is in the right, i.e. whether there are three or two distinct branches. Before this has been done, the use of the name *Hippuritella* in this key can only result in

confusion. Personally I think TOUCAS' arguments the most convincing, but the question is far from being settled. As to their geographical distribution, several *Orbignya* have already been found in the oriental provinces, whereas both are found together at Corbières (*H. resectus* and *O. roquani*). Only in the New World no *Orbignya* have been found thus far, except the questionable *H. turbinatus* LAM. of URQUIZA and the *Orbignya* spp. of TRECHMANN (1924, pp. 396, 397; Pl. XXIII, fig. 5) from Jamaica, the pores of which are unknown. The papers containing the discussion between TOUCAS and DOUVILLÉ can easily be found in the Foss. Cat., pars 54, bibliography.

The name *Orbignya* WOODWARD 1862 has no status under the rules of nomenclature either as a generic or a subgeneric name, since this section was founded on the type species of *Hippurites* (cf. also TOUCAS 1904, Observations, p. 732). For, although the "Système des animaux sans vertèbres" is not to be accepted as designation of type species ex Opinion 79 (Int. Rules), the only species of the genus *Hippurites* described there was *H. bioculatus*, which thus a fortiori must be the type ex Art. 30 II e a. The same Art. may be applied to the type of *Orbignya*, though other species, not named, were included ("*H. bioculatus* and other hippurites, which....."). Thus, contrary to ZITTEL and in accordance with FISCHER, the *Orbignya* are to be called *Hippurites* s. str. Besides, the original orthography of the name was *Dorbignia*.

More recent *Hippurites* s. str. with polygonal pores show a *Vaccinites*-like tendency in their development, whereas some of the older *Vaccinites* may exceed the values given by TOUCAS. In fact TOUCAS' fig. 100 of *V. rousseli* looks more *Orbignya*-like than *O. carezi*, fig. 93. This is the reason why the restrictions in the key (II and D) have been made.

Whether *Tetracionites* and *Arnaudia* are considered to be genera or subgenera is a matter of taste.

*Torreites* has been included in the subfamily, in spite of the highly aberrant features of the left valve (cf. PALMER, 7, p. 100), because its Hippuritid nature is established beyond doubt by the internal features. The genus is not likely to give any clue as to the origin of the Hippuritinae, as the absence of pores may be expected to be a secondary feature.

There remains one more form to be discussed, the interesting *Vaccinites paronai* KÜHN. This animal does not look like a common Hippurite at all, and KÜHN had his doubts about it. A section, however, convinced him of its being a *Vaccinites*. But it is in this very section, that there is something dubious. The author says (p. 26), that the first pillar *S* is reduced, *L* and *E* powerfully developed. His fig. 2 shows, that this holds true for ridges of the inner shell layer projecting into the body cavity, whereas the pillars of *Vaccinites* are projections of the outer shell layer. There are two possibilities. 1. The animal may yet be a *Vaccinites*. In this case the contours of pillars and ligamental crest must be assumed to have been effaced, for instance through recrystallization. Their true shape is



unknown. The first pillar need not be, and probably is not, reduced.  
 2. The fossil may be something entirely different, with no pillars at all. Personally I think it looks rather like a *Trechmannella* (Cox, 2, 1933). The disposition of the canals ("cells") in the left valve may decide whether it is a Hippuritid or a *Trechmannella*.

References as to the nature of the pores are very scarce, the pores being mostly eroded away. I will, therefore, give them here for the convenience of the reader. Pores of *Parastroma* not described as yet. Their nature has been observed by me on a sample of *P. guitarti* in the Geol. Mus. of Utrecht (cf. the key), as well as other features mentioned. Those of *Barrettia* have not quite sufficiently been described by TRECHMANN (1922, p. 510). That they do not differ from those of *Parastroma* can best be seen on TRECHMANN's Pl. XIX, fig. 1. The pores of *Pironaea* are seen on Pl. XXI, fig. 1a in PETHÖ (1906). They seem to be polygonal, but may have been caused by erosion (cf. TOUCAS' monograph, fig. 12, 8). MILOVANOVIĆ 1932 (Contribution) describes them on p. 60: "The surface layer is easily destroyed, but where it is preserved locally, one sees badly preserved, feebly denticulate pores." (author's translation). Pores of *Tetracionites* unknown.

Desiderata: it may be of interest to know more about the disposition of the canals and canaliculi in the left valve of the genera, and likewise about the existence and nature of siphonal openings in the left valve. References about these are few and difficult to find.

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