THE VALIDITY OF THE MOLLUSCAN GENUS *CAESTOCORBULA* VINCENT.[1]

H. E. VOKES.

ABSTRACT. In 1890 E. Vincent noted the presence of an accessory siphonal plate posterior to the left valve of a specimen of *Corbula henckeliusiana* Nyst from the lower Eocene of Belgium. In 1910 he reported similar plates in two specimens referred to *Corbula regulbiensis* Morris and erected for these two species the genus *Caestocorbula*, with Nyst's form as type. Subsequent authors have generally overlooked this name and his interpretation of his material has been questioned.

Recently, however, similar accessory plates were found in Cretaceous species from Texas and from the Lebanon mountains of western Asia. Further investigation resulted in the discovery of several additional examples showing this feature and, at present, siphonal plates are known from eight species. These fall into two separate groups distinguished not only by differences in the shape and ornamentation of the siphonal plates, but also by differences in the shape and proportions of the shells themselves. The name *Caestocorbula* is retained for one of these groups and a new name *Parmicorbula,* with *Corbula neaeroides* Blanckenhorn as type, is proposed for the other. Both groups, so far as now known, range from the Aptian, lower Cretaceous through middle Eocene time.

THE Cretaceous and early Tertiary faunas contain a number of species of corbulid pelecypods in which the right valve is sharply produced posteriorly into a sort of rostral "snout," while the left valve is more nearly equilateral in shape and lacks all trace of posterior prolongation. The fact that this posterior "snout" served to accommodate the siphons is demonstrated by the presence of a definite median longitudinal ridge on the inner face of the prolongation. This ridge would have separated the two during the periods when they were extended.

In 1890 Vincent described and figured (1890, p. vii) a specimen of "*Corbula henckeliusi*"[2] Nyst from the "sables de Wemmel" in which he had found a small supplementary plate within the posterior prolongation of the right valve. This plate seemed to have served as protection for the left side of the siphons in place of a complementary prolongation of the left valve. He described it as follows:

"Cette plaque, vue de face, a la forme d'un paralléllogramme

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[2] Error *pro Corbula henckeliusiana* Nyst (1836, p. 4, pl. 1, figs. 8a, b); see also Nyst, 1843, pp. 63, 64, pl. 2, figs. 3a, a′, b, b′).

oblique, incliné vers la gauche. Elle est légèrement courbée d'avant en arrière et divisée en deux par une arête obtuse qui la coupe en diagonale, produisant deux surfaces triangulaires; celles-ci sont inclinées de part et d'autre de l'arête, et font entre elles un angle d'une centaine de degrés. Elle est formée de lames plus ou moins imbriquées, et son accroissement s'opérait comme celui des opercules à nucléus apical de certains univalves. Enfin, cette plaque est libre, ce qui fait supposer qu'elle était seulement reliée à l'épiderme.

"Notre espèce, telle quon la connaissait, était très asymétrique; mais l'appareil dont il vient d'être question modifie en grande partie cet état. Cet appariel est évidemment l'homologue du rostre, que nous considerouns lui-même, dans notre espèce, comme une pièce appendiculaire soudée à la valve droite."

Later (1910, pp. 140-142) he reported the discovery of a similar siphonal plate in "*Corbula*" *regulbiensis* Morris and figured two specimens, which he referred to this species, in which such a plate was preserved. One of these specimens from the "Corbula band" of the Thanetian, Eocene, was found between Reculvers and Herne-bay in Kent, England. It seems to be correctly identified. The other, from the "sables de Bracheux" at Chalons-sur-Vesle, is certainly not conspecific with the former. It is difficult to say at the present time just what species is represented, although it may possibly represent a specimen of "*Corbula*" *lamarcki* Deshayes. Concerning the plates of these specimens, Vincent says:

"La plaque de *C. regulbiensis* diffère de celle de la Corbule des sables de Wemmel par sa moindre convexité et par son mode d'accroissement. Chez cette dernière espèce, la croissance de la plaque s'effectuatit à la fois en longeur et en hauteur, comme le montrent dépôts successifs de calcaire en forme de chevrons; chez la première, au contraire, elle avait lieu par la sécrétion régulière des bands verticales seulement, comme en témoignent les stries d'accorissement allant du bord dorsal au bord ventral de la plaque."

The discovery of these specimens led Vincent to propose the generic name *Caestrocorbula*, which he characterized as follows: "Coquille très inéquivalve; valve droit rostrée; valve gauche non rostrée, mais prolongée en arrière par une plaque siphonal libre. Le type du groupe est l' espèce des sables de Wemmel."

So far as the writer is aware this name was not used and remained in obscurity until 1926, when Miss Gardner (1926, p. 44) made the following statement.

"*Caestocorbula* Vincent, type *Corbula henckeliusi* Nyst, is . . . a synonym of *Corbula* s.s. *Caestocorbula* was founded upon the supposed presence of a siphonal plate. The nature of the plate and the mode of attachment are not obvious from the description or the figure, but the plate is either quite foreign

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EXPLANATION OF PLATE 1.

Figs. 1-6, *Caestocorbula* Vincent, 1910.

1. Vincent's original illustration of the siphonal plate in "*Corbula henckeliusi*" Nyst.
2. *Caestocorbula elegans* Sowerby. Reproducton of Woods' figure, pl. 34, fig. 28a. Magnification said to be X5.
3. *Caestocorbula crassiplica* (Gabb). Ripley formation, Coon Creek, Tennessee. X4; U. S. Nat. Mus. Cat. No. 103712.

4-6. *Caestocorbula ficus* (Brander). Eocene, Wemmel, Belgium. This species was said by Vincent to be synonymous with *C. henckeliusiana*. 4. Interior of right valve, X2; U. S. Nat. Mus. Cat. No. 13070. 5. Both valves, viewed from left side, X2. U. S. Nat. Mus. Cat. No. 13070. 6. Exterior of right valve, X2; same specimen as fig. 4.

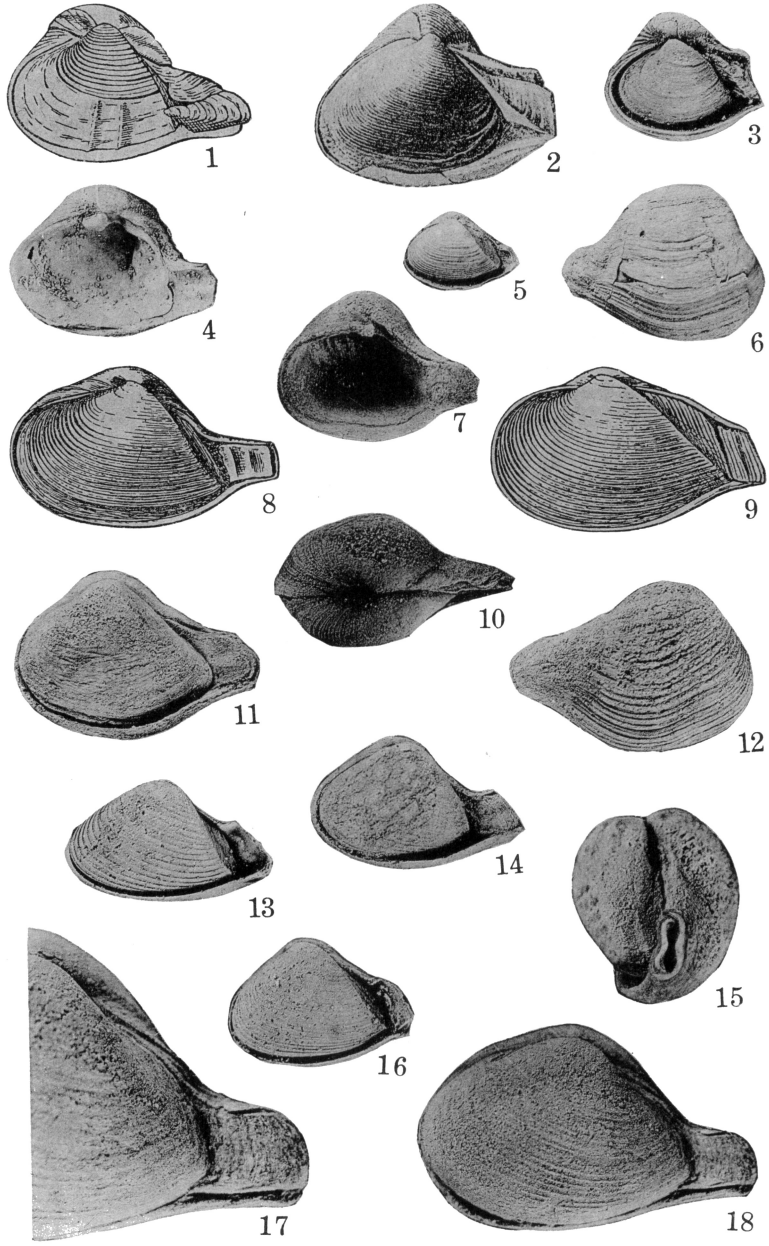
Figs. 7-18, *Parmicorbula* new genus.

7, 10-12, 14, 15. *Parmicorbula neaeroides* (Blanckenhorn). Aptian, Cretaceous, Abeih, Lebanon Mountain, Lebanon. Type of *Parmicorbula*. 7. Interior of right valve, X1.5; Am. Mus. Nat. Hist. Cat. No. 16403/4:2. 10. Dorsal view of paired valves, X1.5; Am. Mus. Nat. Hist. Cat. No. 16403/4:1. 11. Both valves viewed from left side, X1.5, same specimen as fig. 10. 12. Right valve, X1.5; same specimen as figs. 10, 11. 14. Young specimen with siphonal plate in position, X4; Am. Mus. Nat. Hist. Cat. No. 16403/4:3. 15. Posterior view to show siphonal plate in position, X6; same specimen as fig. 14.

8. *Parmicorbula regulbiensis* (Morris) Thanetian, Eocene, Herne Bay, Kent, England. Reproduction of Vincent's figure, said to be X3.
9. *Parmicorbula* sp. Thanetian (?), Eocene, Chalons-sur-Vesle, France. (= ? "*Corbula*" *lamarcki* Deshayes). Figured by Vincent as *Corbula regulbiensis* Morris, said to be X3.5.

13, 16. *Parmicorbula suffalciata* (Wade), Ripley formation, Cretaceous, Coon Creek, Tennessee. 13. Both valves, viewed from left, X4. Note the manner in which the dorsal and ventral margins of the right valve are bent to receive the siphonal plate, which is missing here. U. S. Nat. Mus. Cat. No. 103711. 16. Both valves, viewed from left, with siphonal plate in position, X4; U. S. Nat. Mus. Cat. No. 103710.

17, 18. *Parmicorbula* n. sp. (Stephenson ms.), Lewisville member, Woodbine formation, Cretaceous, Texas. 17. Siphonal plate in position, X6; U. S. Nat. Mus. Cat. No. 103713. 18. Both valves, viewed from left, with siphonal plate in position, X4; same specimen as fig. 17.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to the shell or a fortuitous character resulting possibly from some of the peculiar phenomena of breakage that the Corbulae occasionally show."

The same statement was repeated in 1928 (p. 227), and her conclusions regarding the nature of the siphonal plate were accepted, in manuscript, by the writer during the preparation of a report on the "Superspecific groups of the Family Corbulidae." In that report, however, it was noted that, although the name *Caestocorbula* seemed to be based upon a misconception as to the characteristics of the designated type species it is wholly available for the group of species included within the limits of the characters embraced by Nyst's species.

Just at this time, however, Dr. L. W. Stephenson was engaged in the preparation of a monograph on the fauna of the Lewisville member of the Woodbine formation of the Texas Cretaceous. While examining the corbulid species of this collection Doctor Stephenson and the writer both became aware of the fact that a peculiar structure, which Doctor Stephenson had noted on the posterior portion of one of his specimens, actually represented a siphonal plate similar to those described by Vincent. (See Pl. 1, Figs. 17, 18.)

The discovery of this specimen led to an examination of a series of specimens of "*Corbula*" *neaeroides* Blanckenhorn (1890, p. 96, Pl. 7, Figs. 3a, b, c) from the Aptian of the Lebanon Mountains, Republic of Lebanon, which had already been referred in manuscript to *Caestocorbula.* Seven immature specimens in this collection proved to have the siphonal plates preserved. (Pl. 1, Figs. 14, 15.)

Further examination of specimens in the collections at the United States National Museum led to the discovery of a specimen of "*Corbulamella*" *suffalciata* Wade[3] (1926, p. 97 Pl. 31, Figs. 15, 16, 19, 20) in which a well-preserved plate was present (Pl. 1, Fig. 16) and of more than a dozen specimens of "*Corbula*" *crassiplica* Gabb (1860, p. 394, Pl. 58, Fig. 25) also containing siphonal plates (Pl. 1, Fig. 3). All of these specimens are from the Ripley formation at Coon Creek, Tennessee.

[3] This species differs in nearly all respects from *Corbulamella gregaria* Meek and Hayden, the type of *Corbulamella.* A number of corbuloid species possess a raised platform for the reception of the posterior muscle scar, and that which is found in Wade's species is quite different from the spoon-shaped process which projects from the posterior dorsal portion of the shell in *Corbulamella.* Strictly interpreted *Corbulamella* appears to be still a monotypic genus.

In addition to these four Cretaceous species in which plates have been found, a similar structure is clearly to be observed in the specimen of "*Corbula*" *elegans* Sowerby figured by Woods (1908, Pl. 34, Figs. 28a, b).

Thus the presence of siphonal plates has been demonstrated for the following eight species:

Eocene:
C. henckeluisiana Nyst .....Wemmelian-Thanetian, Belgium.
C. regulbiensis Morris .....Thanetian, England.
"*C.*" sp. (figured by Vincent as *C. regulbiensis* =
? "*C.*" *lamarcki* Desh.) .....Thanetian, France.
Cretaceous:
"*C.*"*neaeroides* Blanckenhorn .....Aptian, Lebanon.
"*C.*" *elegans* Sowerby .....Cenomanian, England.
New species (Stephenson, Ms.)
Woodbine formation (Cenomanian), United States.
"*C.*" *crassiplica* Gabb ....Ripley formation (Maestrichtian) United States.
"*Corbulamella*" *suffalciata* Wade
Ripley formation (Maestrichtian) United States.

As noted by Vincent (see above) there are two types of siphonal plates. In *C. henckeluisiana*, *C. elegans*, and *C. crassiplica* the plates form an oblique trapezium which is inclined toward the left and extends from the rostral portion of the right valve dorsad along the posterior dorsal edge of the left. There is a median ridge extending diagonally across it from the acute dorsal angle to the broader posterior ventral angle. The growth lines form a chevron-shaped pattern and occasionally form raised lamellar ridges. The dorsal margin of the right valve tends to overlap slightly the margin of the plate, aiding in holding it in position. There is no similar structure along the ventral margin of the right valve which tends to flare rather widely below the margin of the left valve. This is the true *Caestocorbula*.

In "*Corbula*" *neaeroides*, "*C.*" *regulbiensis*, "*C.*" sp. (Vincent), "*Corbulamella*" *suffalciata*, and Doctor Stephenson's new species the plate is of a more simple type being essentially rectangular with the dorsal edges sharply angulate and produced laterally to form narrow flanges which are received inside the dorsal and ventral margins of the rostrum of the right valve. These margins also are twisted laterally to form flanges similar to those of the plate itself. Growth took place at the end of the plate, and the growth lines trend transversely across it.

The manner in which these plates fit together clearly shows that they are not foreign to the shells, nor are to be accounted for by any phenomena of breakage. Furthermore, there is a broad, shallow, and inconspicuous longitudinal median groove on the exterior of the plate which, when viewed from the end of the shell (Pl. 1, Fig. 15) is seen to be complementary to a low ridge on the inner side of the plate. This ridge is immediately opposite the median ridge on the rostrum of the right valve. Together they divide the area within the rostrum into two separated tubes for the passage of the siphons and give the outline of the inner margins of the posterior area a distinctive "figure 8" shape.

There are thus two distinctively different types of species bearing siphonal plates of a different character and mode of growth. An examination of the collections shows that they occur in association, both first appearing, so far as present knowledge is concerned, in the Aptian of the Lebanon Mountains[4] and extending up into the upper Eocene. Both groups are represented in the Thanetian by specimens in which the plates are preserved (*Caestocorbula henckeluisiana* and "*Corbula*" *regulbiensis*) and in the middle Eocene by species which, on their shape, seem clearly referable to them. "*Corbula*" *wailesiana* Harris from the Jackson formation of Mississippi, Arkansas, and Texas (probably of Bartonian age) is a *Caestocorbula*, and "*Corbula*" *gibbosa* Lea from the Claiborne sand of Alabama belongs to the *neaeroides* group.

The new generic name *Parmicorbula* is therefore proposed for the latter group of species with "*Corbula*" *neaeroides* Blanckenhorn as the type species. The name is a combination of the Latin "*parma*" (a small shield) and *Corbula* and is in allusion to the protection furnished the siphons by the siphonal plate.

The two genera may be diagnosed as follows:

CAESTOCORBULA Vincent, 1910

Plate 1, Figures 1-6.

Caestocorbula Vincent, 1910, Soc. Roy. Zool. Malac, de Belg., Ann. (for 1909), p. 191.

[4] "*Corbula*" *olivae* Whitfield (1891), p. 413, pl. 7, figs. 19-21) clearly belongs to *Caestocorbula*. This determination is based upon the shape of the valves, for the small collection available contains no specimens in which the plate is preserved.

Type, by original designation, *Corbula henckeluisi* Nyst [error *pro C. henckeluisiana* Nyst].

The shell is relatively small and very inequivalved. The right valve is larger than the left, more inflated and produced posteriorly to form a prominent rostral "snout"; its surface is sculptured by coarse concentric ribs. The left valve is almost equilateral, sub-triangular in outline, not produced posteriorly, but bearing a prominent posterior umbonal ridge. The dorsal margins of the right valve are strongly grooved for the reception of the margins of the left; the posterior dorsal margin of the right valve is sharply bent laterally to meet the dorsal margin of a small, separate siphonal plate which served to protect the siphons in place of a rostrum from the left valve.

The siphonal plate has the form of an oblique trapezium with the more acute angle at the anterior dorsal corner, which lies against the posterior dorsal side of the left valve. The surface bears a distinct oblique median ridge that extends diagonally across the plate from the acute dorsal angle to the broader posterior ventral one. The surface of the plate is ornamented by raised lamellar growth lines that are chevron-shaped and parallel to the posterior and ventral margins of the plate.

The right cardinal tooth is triangular, relatively large, and heavy, and the resilial pit is prominent and elongate, extending dorsad slightly above the posterior side of the cardinal tooth. The left hinge consists of an anterior cardinal socket followed posteriorly by a moderately broad, projecting chondrophore.

The muscle scars are slightly thickened and rugose; the pallial sinus is extremely well developed for the family Corbulidae, broad, and rounded.

Remarks.—There are three species: *Caestocorbula henckeluisiana*, *C. elegans* (Sowerby), and *C. crassiplica* (Gabb) in which plates of the form characteristic of this genus have been found. In addition to these the following species have been noted during a cursory examination of collections and of published illustrations, which, on the basis of the shape of the shell itself, seem most probably to be referable to this genus:

"Corbula" olivae Whitfield: Aptian; Lebanon Mountains, Republic of Lebanon.

"Corbula" angustata Sowerby: Cenomanian; Europe.

"Corbula" parsura Stoliczka; Trichnipoly group, India.

"Corbula" rugosa Lamarck; Cuisian to Bartonian; western Europe.
"Corbula" costata Sowerby; Lutetian and Bartonian; western Europe.
"Corbula" ficus Brander; Lutetian and Bartonian; western Europe.
"Corbula" fossata Aldrich; Lisbon formation, Eocene; Mississippi.
"Corbula" wailesiana Harris; Jackson formation, Eocene; Mississippi, Arkansas, and Texas.
"Corbula" smithvillensis Harris; Mount Selman formation, Eocene; Texas.
"Corbula" texana Gabb; Mount Selman formation, Eocene; Texas.

PARMICORBULA, new genus.

Plate 1, Figures 7-18.

Type species: *Corbula neaeroides* Blanckenhorn [Aptian, Cretaceous, at Abeih, Lebanon Mountains, Republic of Lebanon]; (Pl. 1, Figs. 7, 10-12, 14, 15).

The shell is of moderate size, moderately inflated, and very inequivalved. The right valve is larger than the left, more inflated and produced posteriorly to form a prominent rostral "snout"; its surface is ornamented by coarse concentric ribs that die out before reaching the rostrum, so that the latter is generally relatively smooth. The left valve is almost equilateral, not produced posteriorly, but bearing a moderately prominent posterior umbonal ridge; the surface is marked by concentric ribbing, which is generally finer than that on the right valve. Occasionally there are traces of radial ribbing present. The dorsal margins of the right valve are grooved for the reception of those of the left, and just within the ventral margin there is a linear depression against the inner side of which the left valve rested.

Both the posterior dorsal and posterior ventral margins of the right valve are constricted at the anterior end of the rostrum, and along that structure are sharply bent laterally to receive between them the similarly bent margins of a small, rectangular siphonal plate. The exterior of this plate is marked by a shallow, inconspicuous, median groove, and by growth lines which run transversely across it. Internally there is a low, median ridge, complementary to a similar ridge trending parallel to the length of the rostrum of the right valve.

The hinge, muscle impressions, and pallial sinus are similar to those of *Caestocorbula.*

Remarks.—Siphonal plates of the type characteristic of this

genus have been observed in four species: "*Corbula*" *neaeroides* Blanckenhorn, "*Corbula*" *regulbiensis* Morris, "*Corbula*" sp. (Vincent) [?= *Corbula lamarcki* Deshayes], and *Parmicorbula* n. sp. (Stephenson, ms.). Judging from the shape of the shells, the following species are also expected to prove referable to *Parmicorbula*:

"*Corbula*" *substriatula* D'Orbigny; Senonian of Europe.
"*Corbula*" *striatuloides* Forbes; Trichnipoly group, India.
"*Corbula*" *terramaria* Gardner; Monmouth formation, Cretaceous; Maryland.
"*Corbula*" *longirostris* Deshayes; Lutetian, Eocene; western Europe.
"*Corbula*" *gibbosa* Lea; Claiborne, Eocene; Alabama.
"*Corbula*" *aldrichi* Meyer; Woods Bluff (Wilcox), Eocene; Alabama.

The species included in the lists given above for *Caestocorbula* and for *Parmicorbula* are only those observed in a rapid reconnaissance of the paleontologic literature. The lists are in no sense complete, but they do serve to indicate that species of these genera were widely distributed during the Cretaceous and Eocene times and accentuate the fact that siphonal plates are to be looked for in every collection representing species from these periods.

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U. S. Geological Survey,
Washington, D. C.