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CONTRIBUTIONS TO THE PALEONTOLOGY OF THE LEBANON MOUNTAINS, REPUBLIC OF LEBANON

PART II. NOTES ON "*CARDIUM*" *BISERIATUM* CONRAD

BY H. E. VOKES

The inadequate descriptions and illustrations given by Conrad in 1852 in his "Description of the Fossils of Syria, collected in the Palestine Expedition," an appendix to the "Official Report of the United States Expedition to Explore the Dead Sea and the River Jordan" by Lieut. W. F. Lynch, U.S.N., have resulted in much confusion and uncertainty among subsequent authors as to the identity of the species which he described. Notable among these uncertain species is that described as *Cardium biseriatum.*

The original description of this form is as follows (1852, p. 216):

"Rotundate-cordate; ventricose, subequilateral; posterior side rather longer than the anterior; the margin subtruncated and nearly direct; summits prominent, acutely rounded; basal margin profoundly rounded anteriorly, obliquely truncated posteriorly; surface of the valves marked with concentric lines as far as the umbonal slope; posterior submargin with about 15 slender minutely echinated radii; posterior margin crenulated within.

"Local: Bhamdûn, Mount Lebanon.

"This abundant species resembles *Cardium perigrinorsum* and *Cardium Hillanum,* but is proportionally more elongated and the sulci are much larger. The largest specimen measures $2^1/_2$ inches in length."

Illustrations of three specimens accompanied this description (Plate 6, figs. 38, 39, 40). In an appendix to this report, describing "some interesting fossils" which "have been sent to Dr. Anderson for comparison with those of the Expedition" he notes (p. 234) an additional specimen which he refers to this species "previously described and figured. See Pl. 6, figs. 38, 39, 40. Figure 45 [of Appendix Pl. 5] represents a specimen in which the markings or lines are very distinct. Local: Aleih."

The description is so generalized as to fit the majority of the Cretaceous species of *Protocardia.* The most significant features noted seem to be the fact that the posterior radial ribs are "slender" and "minutely echinated" and that the sulci between the concentric ribs "are much larger" than those of *"Cardium" perigrinorsum* and *"Cardium" hillanum.* But since the original illustrations show that this description was based upon internal casts, considerable doubt is cast upon the significance of even these features. As a result, all subsequent authors have based their evaluation of Conrad's species upon the three original illustrations and that which appeared in the appendix.

The confusion which has resulted is well shown in the table on page 2. This condition was early noted by Hamlin (1884, p. 3) who stated: "The collections of the Lynch Palestine Expedition, and the other material which fell into Conrad's hands, were of very inferior quality . . . . It was his further misfortune that the descriptions published in the Official Report of the Expedition are meagre beyond the habit of their author, and that his figures, through fault of the artist, were poorly executed. From these several causes has resulted uncertainty concerning the identity of some of his species, and respecting the validity of others."

The confusion was further increased by Whitfield's statement (1891, p. 383, footnote): "I have made every reasonable effort to find the originals of Mr. T. A. Conrad's species described in the Official Report

of the United States Expedition to the Dead Sea and River Jordan, under Lieut. W. F. Lynch, for the purpose of identification and comparison, as well as verification; they seem, however, to have been entirely lost sight of, as inquiries of the different societies and persons having charge of collections, where they might have been deposited, have entirely failed to bring any of them to light."

Despite the fact that Beecher, in 1900 (1900, pp. 176–178) announced the discovery in the Yale University collections of a number of Conrad's types and unfigured paratypes, subsequent authors have quoted any of the other possible depositories which have kindly looked for them for me.

Of the two original figured types which have been found, that of figure 38 is so eroded posteriorly that all trace of the radial ribbing in that area has been lost. That of figure 39 shows faint radial ribs which have a suggestion of fine tuberculation. Since, therefore, this latter specimen is the source of the only characters mentioned in the original description which might be significant to the future identification of the species, it is here designated as the lectotype of this species. The original of figure 38 is a somewhat smaller specimen,

	PLATE 6			*Appendix Pl. 5*
	Fig. 38	*Fig. 39*	*Fig. 40*	*Fig. 45*
Conrad. 1852	C. *biseriatum*	C. *biseriatum*	C. *biseriatum*	C. *biseriatum*
Hamlin. 1884	C. (P.) *hillana*	C. (P.) *hillana*	C. (P.) *hillana*	*Not mentioned but* =P. *Judaica nov.*
Noetling. 1886	?-P. *biseriata or P. moabitica*	P. *biseriata* ?	?? P. *biseriata or P. moabitica*	"*Typus der P. biseriata*
Blanckenhorn. 1890	P. *hillana var. typica*	P. *hillana var. typica*	P. *hillana var. grandis nov.*	P. *judaica*
Newton. 1898	P. *biseriata*	P. *biseriata*	*Not* P. *biseriata*	*Not mentioned*
Blanckenhorn 1934	P. *hillana*	P. *picardi nov.*	P. *coquandi*	P. *biseriata*
This Paper.	P. *biseriata*	P. *biseriata*	*indeterminate*	P. *judaica*

C. = *Cardium* P. = *Protocardia* [*Protocardium of some authors*]

Whitfield's statement that the types are lost and have attempted to suggest the probable identity of the species concerned.[1]

Through the courtesy of Professor C. O. Dunbar of Yale University, I have been able to study the specimens found by Professor Beecher. These include the originals of Conrad's figures 38 and 39 on Plate 6, and seven additional unfigured paratype specimens identified by Conrad. The originals of figure 40, Plate 6, and of the specimen illustrated in the appendix, Pl. 5, figure 45, have not been found either at Yale or of identical matrix and nature of preservation. As far as they are observable it agrees with the lectotype in all significant features and is believed to be fully conspecific with it.

Both these specimens are preserved as casts of a somewhat yellowish brown, fine grained, clayey sandstone. They are identical in every way with specimens from the upper Aptian and from the "Cardium" bank, the lowest member of the Albian (see Vokes, 1941b), and differ from the normal type of preservation of specimens found in the lower Aptian or in the higher Albian and Cenomanian.

[1] See esp. Blanckenhorn, 1934, pp. 173–177: "Zur Deutung der Conrad'schen Arten der syrisch-palästinensischen Kreide 1852."

On the basis of an examination of these specimens, together with notes and collections made during the field season of 1940, the following synonymies and notes may be made concerning the species of *Protocardia* which have at one time or another been referred to *P. biseriata* (Conrad).

Protocardia biseriata (Conrad)

Figures 1–7

Cardium biseriatum CONRAD, 1852, p. 216, Pl. 6, figs. 38, 39. *Not* Pl. 6, fig. 40, Appendix, p. 234, App. Pl. 5, fig. 45.

? *Protocardium hillanum* Sow.; FRAAS, 1878, p. 70 (*pars*).

Cardium (*Protocardia*) *Hillanum* Sowerby; HAMLIN, 1884, p. 50.

Protocardia biseriata ?; NOETLING, 1886, p. 867.

? *Protocardia biseriata* or *P. moabitica;* NOETLING, 1886, p. 867.

Protocardia hillana Sow. var. *typica;* BLANCKENHORN, 1890, p. 89.

Cardium (*Protocardium*) *Hillanum* Sow.; WHITFIELD, 1891, p. 385.

Protocardia biseriata (Conrad); WOODS, 1908, p. 201.

Protocardia hillana; ZUMOFFEN, 1926, pp. 98, 100, 107.

Cardium biseriatum; ZUMOFFEN, 1926, pp. 101, 104, 105, 106.

Protocardia hillana Sow.; BLANCKENHORN, 1934, p. 174 (not p. 244).

Protocardia picardi BLANCKENHORN, 1934, pp. 174, 242.

Protocardium hillanum Sow.; DUBERTRET AND VAUTRIN, 1937, p. 47 (after Zumoffen) (? not p. 49).

Protocardium biseriatum (Conrad); VOKES, 1941b, p. 1724.

Lectotype: No. 6888, Peabody Museum, Yale University; length 46.0 mm., height 40.5 mm., diameter (right valve) 23.0 mm.

Lectoparatype: No. 6970, Peabody Museum, Yale University; length 34.8 mm., height 33.3 mm., diameter (both valves) 23.5 mm.

Geological Horizon: Probably Upper Aptian and/or Lower Albian.

As noted in the above synonymy many authors have referred this species to *Protocardia hillana* (Sowerby) (1813, p. 41, Pl. 14, upper figure). This is in a large measure due to the unfortunate and uncritical habit of referring all *Protocardia* of this type to this species. A comparison of the Conrad specimens with the descriptions and illustrations given by Woods (1908, pp. 197–201, Pl. 31, figs. 6a–c; Pl. 32, figs. 1–6) and with topotype specimens from Blackdown in the collections of The American Museum of Natural History shows a number of significant differences separating the two.

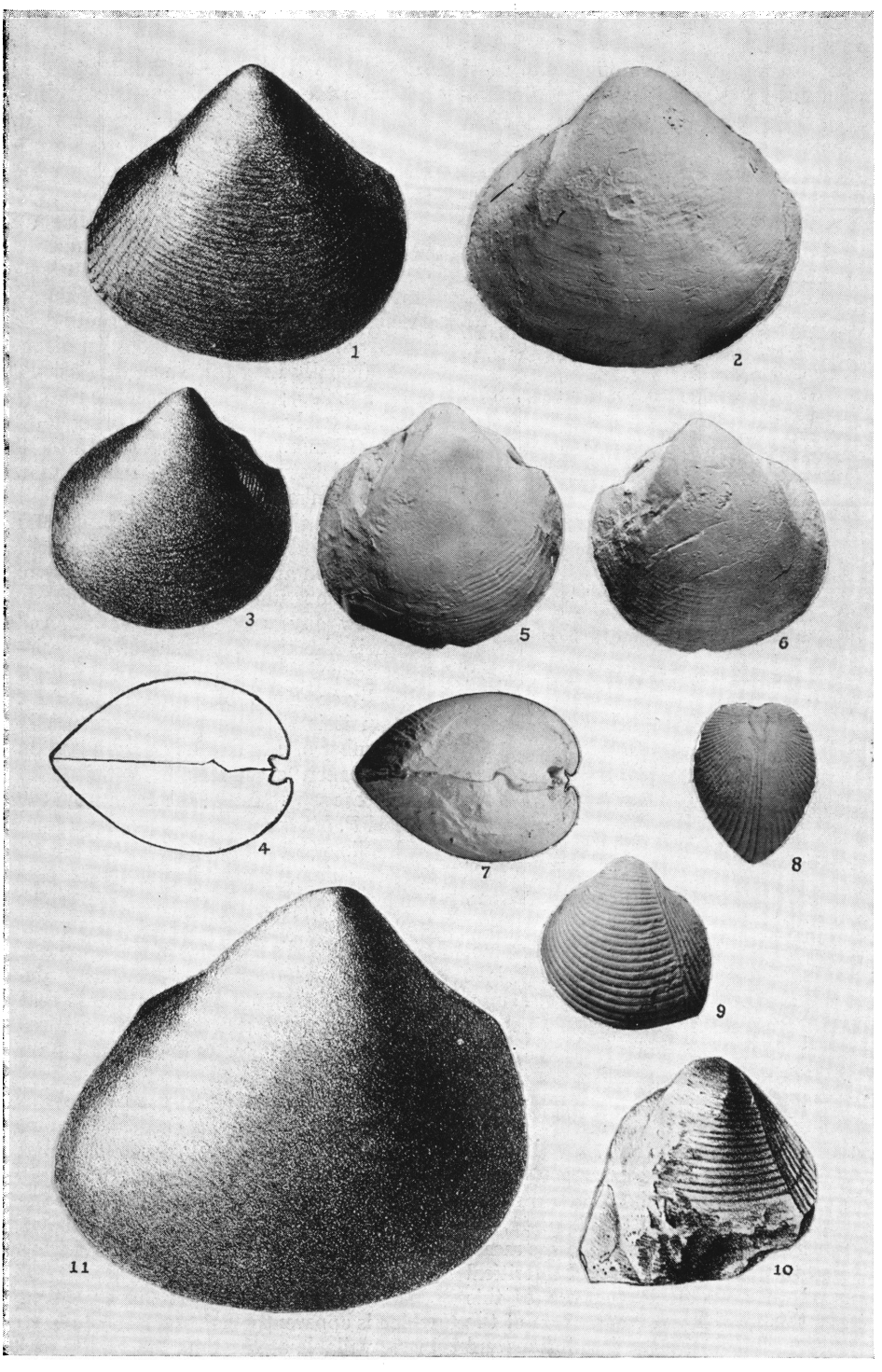
The shell of *P. biseriata* is more elongate in proportion to the height; the number of radial ribs is greater, 13–18 (*fide* Blanckenhorn, 1890, p. 89) to 14–15 in the Conrad specimens where preservation permits their study, while on *P. hillana* there "are from 10–15 (usually 12 or 13)" such ribs (Woods, *op. cit.*, p. 200); and the concentric ribbing is considerably coarser, there being 8–10 ribs in 10 mm., as compared to "15 to 19 (measured between 34 mm. and 44 mm. from the umbo)" in *P. hillana.*

It is true that Woods (*op. cit.*, p. 201) notes that the Blackdown specimens "probably on account of the uniformity of the conditions under which they lived, do not show any very striking variations." But it is also true that some of the variations known as *P. hillana* are probably, if critically examined, of specific importance. Certain it is that the great departure in the number of concentric ribs exhibited on the Lebanon specimens is sufficient to justify the separation of this form from the typical *P. hillana.*

Noetling (1886, pp. 864–867, see esp. p. 867) has designated Conrad's figure, Appendix Pl. 5, fig. 45, as the "Typus der *Protocardia biseriata.*" However, in the light of Conrad's reference of this specimen to "*Cardium*" *biseriata*, "previously described and figured" it seems certain that this specimen was not used in the original description and may well have not been available at that time.

This figure undoubtedly represents a specimen of *Protocardia judaica* Hamlin. In this species there are only 11–13 radial ribs on the posterior area, with 12 present on the majority of the specimens. In the typical *P. biseriata*, as mentioned above, there are 13–18 of these ribs, averaging about 15.

In view of the fact that this specimen, which is apparently lost, seems not to have been available at the time the species was described, and in view of the fact that it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Figs. 1–7. *Protocardia biseriata* (Conrad). 1.—Conrad's original figure, Pl. 6, fig. 39. 2.—The original of Conrad's figure, here designated as the lectotype of this species, Peabody Museum, Yale University, No. 6888. 3.—Conrad's original figure, Pl. 6, fig. 38. 4.—Outline, anterior end, given by Conrad of same specimen as Fig. 3. 5.—The original of Conrad's Fig. 38, here designated as the lectoparatype, Peabody Museum, Yale University, No. 6970; right valve. 6.—Same specimen as Fig. 6, left valve. 7.—Same specimen as Fig. 5; compare with Fig. 4.

Figs. 8–10. *Protocardia judaica* Hamlin. 8.—Anterior view, topotype, A. M. N. H. No. 25376. 9.—Same specimen, left valve. 10.—Conrad's figure, Appendix Pl. 5, fig. 45. Conrad identified this specimen as *Cardium biseriatum*.

Fig. 11. Unidentifiable cardioid cast, Conrad's figure, Pl. 5, fig. 40, identified as *Cardium biseriatum* by Conrad.

All illustrations natural size.

probably does not agree with the characters of the species as originally described, Noetling's designation is here considered to be invalid.

Protocardia judaica Hamlin

Figures 9–11

Cardium biseriatum CONRAD, 1852, Appendix, p. 234, App. Pl. 5, fig. 45 (only).

Protocardium hillanum Sow.; FRAAS, 1878, p. 70 (Abeih record only).

Cardium (*Protocardia*) *Judaicum* HAMLIN, 1884, pp. 50–51, Pl. 4, figs. 5a–d.

Cardium biseriatum Conrad; NOETLING, 1886, pp. 864–867, Pl. 27, figs. 1, a, b.

Protocardia judaica Hamlin; BLANCKENHORN, 1890, p. 89.

Cardium (*Protocardium*) *judiacum* Hamlin; WHITFIELD, 1891, p. 385.

Cardium (*Protocardium*) *bellum* Conrad; WHITFIELD, 1891, p. 385.

Protocardium judaicum Hamlin; ZUMOFFEN, 1926, pp. 76, 77, 78.

Protocardia biseriata Conr. *emend.* Noetl.; BLANCKENHORN, 1934, pp. 177, 242.

Protocardium biseriatum Noetling (*pars* Conr.) (= *P. judaicum* Hamlin); DUBERTRET AND VAUTRIN, 1937, p. 46 (after Zumoffen) (? *non* pp. 47, 48).

Protocardia judaica Hamlin; VOKES, 1941b, p. 1722.

Topotype: A. M. N. H. No. 25376; length 23.8 mm., height 22.8 mm., diameter (both valves) 17.5 mm.

Geological Horizon: Lower Aptian (Vokes, 1941b).

There can be little doubt but that the specimen from Aleih figured by Conrad (Appendix Pl. 5, fig. 45) is referable to this species, which has been well described and figured by Hamlin. Unfortunately, Hamlin did not have any exact locality or stratigraphic information for his specimens, two of which were said to be from the Bird Collection.

The Reverend William Bird was stationed for many years at Abeih, a mountain village southeast of Beirut. He was an enthusiastic amateur geologist and amassed a very large collection which is now housed at the American University of Beirut. Practically ninety per cent (almost 1700) of the specimens representing this species in the Bird Collection are from the famous "Olive Locality" at Abeih. This locality is on the hillside immediately below the house in which Rev. Bird lived. The material from this locality is uniformly well preserved and is among the finest to be collected in the Lebanon. In the light of Dr. Hamlin's statements as to the matrix and the preservation of this species, there can be little doubt that his types are from this locality.

Conrad's "*Cardium*" *bellum* (see below) was described from Deir Mār Sāba, east of Jerusalem, from deposits of probable Senonian age. The specimens from Duccûn referred to this species by Whitfield (1891, p. 385) are from deposits of Aptian age. An examination of the specimens so identified in the Whitfield Collection at The American Museum of Natural History leaves no doubt but that they represent an elongate variant of *P. judaica* in which the concentric ribbing is somewhat finer than is usual in this species.

Protocardia bella (Conrad)

Cardium Bellum CONRAD, 1852, p. 225, Appendix, Pl. 1, fig. 3.

Cardium Hillanum Sow.; FRAAS, 1867, p. 91 (*pars*).

Cardium Hillanum Sowerby var. *moabiticum*, LARTET, 1872, p. 53, Pl. 12, fig. 9.; LARTET, 1877, p. 130, Pl. 11, fig. 5, Pl. 12, fig. 9. (*Mosaïcum* in error, Pl. 11.)

Protocardia moabitica Lartet sp.; NOETLING, 1886, p. 867.

Protocardia moabitica Lart.; BLANCKENHORN, 1890, p. 90.

Cardium bellum Conrad; WHITFIELD, 1891, p. 404. Not *Cardium* (*Protocardium*) *bellum* Conrad; WHITFIELD, 1891, p. 385 (= *Protocardia judaica* Hamlin).

Protocardia biseriata Conrad; NEWTON, 1898, p. 400, Pl. 15, fig. 11, Pl. 27, figs. 2, 2a, 3.

Protocardia hillana Sowerby; QUAAS, 1902, p. 218, Pl. 24, figs. 18, 19.

Cardium (*Protocardia*) *biseriatum* Conrad; PERVINQUIÈRE, p. 264, Pl. 20, figs. 1–3.

Protocardia hillana Sowerby et mut. *prisca* DOUVILLÉ, 1916, p. 158, Pl. 20, figs. 1–3.

Protocardia moabitica Lartet; FOURTAU, 1917, pp. 83–85.

Protocardia moabitica Lartet; ZUMOFFEN, 1926, p. 116.

Protocardia hillana Sow.; BLANCKENHORN, 1934, p. 244 (*pars*).

Cardium (*Protocardium*) *moabiticum* Lartet; DUBERTRET AND VAUTRIN, 1937, p. 49 (after Zumoffen).

Protocardia sp. aff. *hillana* (Sowerby); VOKES, 1941a, p. 10, Figs. 9, 10.

Geological Horizon: (?) Cenomanian—Senonian. The deposits at Deir Mār Sāba

appear to be of Senonian age (Clapp, 1936; Picard, 1938).

There seems to be little reason to doubt the fact that *"Cardium" bellum* and *moabitica* are synonymous. Conrad's type has not been found and is presumed to be lost. His original figure and illustration are so poor that it is probable that only the collection of topotype specimens from Deir Mār Sāba will permit a final solution of this problem. In the event that the two are not conspecific the above synonymy will probably be accurate for *Protocardia moabitica* when Conrad's 1852 reference is removed.

ADDENDA

The original of Conrad's illustration, Pl. 6, fig. 40, has not been found. The figure shows a large, apparently cardioid cast (Fig. 11). There is no evidence of the nature of the external ornamentation, and the species which it represents is wholly unidentifiable.

Blanckenhorn, in 1890, referred this specimen to *Protocardia hillana* var. *grandis* —the varietal name apparently being new—and listed it as "Charakteristisch für die Facies bräunlicher Kalkmergel und Kalke, de sogenannten Cardiumbänke Fraas in 'Aleih, Schumlân, Bhamdûn, Afka" (1890, p. 90). Later (1934, p. 243) he referred it to *Protocardia coquandi* (Seguenza).

There are a number of cardioid casts in the collections from the "Cardium" bank and from the Upper Albian deposits immediately underlying it. These do resemble, somewhat, the figure given by Conrad. They are, however, smooth and devoid of all evidences of surface ornamentation, a factor which indicates that they are not conspecific with *"Cardium" coquandi* Sequenza (1882, p. 86, Pl. 11, figs. 1a–b), a Cenomanian species, which, as figured by Sequenza, and also by Pervinquière (1912, Pl. 19, figs. 22a–c, 23, 24), shows well developed concentric ribbing on the surface of the valve.

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