NEW FOSSIL PEARLY FRESH-WATER MUSSELS FROM DEPOSITS ON THE UPPER AMAZON OF PERU

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The United States National Museum has recently received some fossil Naiads collected by Prof. Joseph T. Singewald, of Johns Hopkins University, in deposits at the headwaters of the Upper Amazon, Peru; also another sending collected by Dr. Harvey Bassler, likewise from Peruvian deposits. The exact geological horizon from which these shells were obtained has not been definitely settled to date. Conrad[1] says, "It is not possible to state without doubt what the relative stratigraphical position of this group may be, but if all the species are extinct it can not be later than the Tertiary. The Pleistocene origin of the group is at least very doubtful." None of the species found in these deposits are living to-day.

Associated with these mussels were large numbers of *Anisothyris*, *Isaea*, *Neritina*, and other fossils, which are brackish-water forms. It is quite possible that the Naiads were swept in to these deposits from higher levels by floods, and thus came to be mingled with the brackish-water faunas. These shells, therefore, argue for the existence of bodies of fresh water at the time they were living at or near the place where they were found.

Until now only one Naiad has been described from the deposit, namely, *Anodon batesii* Woodward. As *Anodon* (=*Anodonta*) does not occur in South America, this shell is probably an *Anodontites* belonging in the family Mutelidae. The new species described herein belong in the subfamily Hyriinae of the family Mutelidae and are the first fossil species of that subfamily described from South America. They are related to two genera, *Diplodon* and *Hyria*, as will be shown in the remarks under the new genus *Prodiplodon*.

PRODIPLODON, new genus

Pearly fresh-water mussels of the family Mutelidae with beak sculpture resembling that of the genus *Diplodon* and also that of

[1] Amer. Journ. Conch., vol. 6, p. 192, 1870.

the genus *Hyria*, and consisting of several V-shaped undulations, "nesting" one within the other, and other undulations on the anterior and posterior umbonal areas, each pair of which if continued would form another V in the series.

Type of the genus.—Prodiplodon singewaldi, new species, described in this paper.

This genus is distinctly related to *Diplodon* and to *Hyria* and seems to stand about midway between them. In *Diplodon* the undulations are more nearly direct radial than V-shaped. In *Hyria* they are composed of "nested" V's but in that genus the shell is alate anteriorly and posteriorly. The fossils at hand give no indication of having been alate posteriorly, but in the type the anterior end is minutely winged. It is possible that this genus was the forerunner of both *Hyria* and *Diplodon*. *Prodiplodon* may have one living representative in "*Castalia*" *pazi* Hidalgo,[2] the type locality of which is Imbabura, Ecuador. Simpson[3] places it in the genus *Diplodon*. From the description and figure it appears to be a *Prodiplodon* and a direct descendent of the new fossil species *Prodiplodon singewaldi*. It appears to be the only Diplodon-like species living in the region near the localities in which the fossils were found. True *Diplodon* is most plentiful in the La Plata system and in southeastern Brazil. It occurs also in Chile and eastern Brazil, a couple of species in Guiana, and a couple in Patagonia. The abundance of *Diplodon*, evidently a descendent of *Prodiplodon*, in the La Plata system is interesting when considered in connection with *Erodona* (apparently descended from *Anisothyris*, the most plentiful fossil in the deposits under consideration) which is found in the brackish waters of the La Plata estuary.

PRODIPLODON SINGEWALDI, new species

Plate 1, figs. 3, 6

Shell rather compressed, somewhat quadrate in form, rounded in front, slopingly truncated at the rear. Ventral margin a little curved in its median portion, sweepingly rounding into the anterior margin and making a broad angle with the posterior margin. Dorsal margin arched, making a very broad, scarcely noticeable, angle with the posterior margin. Beaks well forward, about 19 mm. behind the extreme anterior end and 51 mm. in front of the extreme posterior end. Posterior ridge low, slightly angulated at upper part of shell, anterior ridge almost entirely lacking. Sculpture of very prominent concentric lines marking rest periods, with minor concentric striae between them. Umbonal area sharply and closely sculptured with ra-

[2] Journ. de Conch., vol. 8, p. 353, pl. 13, fig. 6, 1868.
[3] Descriptive Cat. Naiades, p. 1273, 1914.

diating threads or riblets. Those at the anterior portion are narrow, curved, somewhat granulous and do not rapidly increase in thickness. Those at the posterior end are also curved but increase rapidly in size. In the middle portion the threads join into several V's with nearly straight sides. The curved threads of the front and rear portions if continued would form V's with curving sides. Some of the sculpture shows a tendency to continue into the next area after the distinct umbonal period was passed; at the anterior end this tendency shows itself in several direct but rather obscure threads which continue across the next growth area. Pseudocardinal teeth plate-like, nearly parallel to the dorsal margin and close to the tip of the beak. Lateral tooth long and curved.

The type (Cat. No. 370808, U. S. N. M.) measures: Length, 70 mm.; height, 39 mm.; diameter, if both valves were present, would be about 20 mm. A paratype forms Cat. No. 370809, and a paratype was returned to Professor Singewald. They came from Paucarpata, on the Maranon River, and were collected by Dr. Joseph T. Singewald, jr., in whose honor the species has been named. The most striking feature of this species is the neat, clean-cut character of the umbonal sculpture. The species is related to *Prodiplodon paucarpatensis* described in this paper, but is less elongate and somewhat more nasute. It is related also to *Prodiplodon bassleri* Marshall which, however, has an elliptic outline and the beak sculpture pointing differently. The three species form a very natural group.

PRODIPLODON BASSLERI, new species

Plate 1, fig. 1

Shell moderately thin, rather compressed, elliptic, slightly narrower in front. Ventral margin regularly curved, rounding regularly into the posterior margin, and apparently into the anterior margin also. Posterior ridge low and rounded. Anterior ridge not differentiated from the general surface. Beak set well forward, about 10 mm. behind the anterior margin, and 50 mm. in front of the posterior margin. Sculpture of fairly well-marked concentric striae and lines showing rest periods—the earlier ones set obliquely across the general surface of the shell. Sculpture of umbonal area somewhat obscured but evidently similar to that of *Prodiplodon singewaldi* but the points of the V's pointing in the general direction of the postero-ventral margin, while in *Prodiplodon singewaldi* they are directed toward a point anterior to the middle of the ventral margin. Pseudocardinal teeth placed directly under the tip of the beak. Anterior adductor scar very deep, posterior scar nearly superficial. Pallial line at rear end about 10 mm. from the ventral margin.

The type, (Cat. No. 370811, U.S.N.M.) measures: Length, 60 mm.; height, about 38 mm.; diameter, if both valves were present, would be about 16 mm. It was collected at Pebas, Peru, by Dr. Harvey Bassler in whose honor the species is named. Related to *Prodiplodon singewaldi* described in this paper, from which it differs in having the outline elliptic instead of quadrate. It groups also with *Prodiplodon paucarpatensis.*

PRODIPLODON PAUCARPATENSIS, new species

Plate 1, fig. 4

Shell compressed, elongate trapezoidal, slightly narrower in front, slopingly truncated at the rear. Dorsal margin nearly straight, ventral margin nearly straight, rounding into the anterior margin, joining the posterior margin at an angle. Beaks well forward, about 18 mm. from extreme anterior end, 56 mm. from extreme posterior end. Descent from beaks to anterior margin rather abrupt. Posterior ridge low and rounded. Posterior dorsal area long and broad. Sculpture of well-marked concentric lines of growth. Umbonal portion of shell with sculpture evidently similar in general pattern to that of *Diplodon singewaldi* described in this paper, but weathered, so that details can not be pointed out. The whole shell lacks its outer surface and is nearly white.

The type (Cat. No. 370810, U.S.N.M.) measures: Length, 74 mm.; height, 39 mm.; diameter, 18 mm. It comes from Paucarpata, on the Maranon River, and was collected by Dr. Joseph T. Singewald, jr., of Johns Hopkins University. This species has the form common to the well-known *Unio complanatus* of the United States. It is related to *Prodiplodon singewaldi* Marshall, but differs in form, being more elongate and less oblique. It is related also but not so closely to *Prodiplodin bassleri.*

EODIPLODON, new genus

Beaks with very coarse, nearly direct radial undulation, some of which are broken up into nodules. Close to the tip of the beak each pair of undulations unites into a V but the later ones become nearly direct and do not form a V.

Type of the genus, *Eodiplodon gardnerae* Marshall, described below. This genus also is related to the recent genus *Diplodon.*

EODIPLODON GARDNERAE, new species

Plate 1, figs. 2, 8

Shell rather thin, very elongate, beak set very far forward, about 7 mm. behind extreme anterior margin, 57 mm. in front extreme posterior margin. Dorsal margin somewhat broken but evidently

nearly straight posterior to the beak and sloping downward to the posterior margin. Anterior to the beak the very short dorsal descends rapidly to meet the anterior margin. Ventral margin nearly regularly curved, sweeping into the anterior margin in a broad curve and not differentiated from it. Posteriorly the shell becomes narrower, the ventral margin curving sharply to join the posterior margin, the two margins differentiated from each other by the end of the posterior ridge. Posterior ridge well marked, with an indistinct rib running along its summit. Posterior area with two faint radiating grooves forming a low, broad rib between them. General surface of shell rather smooth, concentric growth lines not well marked except on the posterior area and near the anterior margin. At the anterior end of ventral margin are five short radiating flutings. A faint groove just appreciable to touch and made faintly visible by a dark line extends from the beak to the ventral margin just behind its middle point, probably marking the depth to which the animal inserted itself into the material of the bottom. Interior pearly, anterior adductor scar deep, posterior scar well marked but shallow. Pallial line well marked, about 6 mm. from the ventral margin. Umbonal area very prominent because of the strong radial sculpturing. At the anterior end this sculpture consists of five fine, rather granular, curving sharp threads, the middle area shows a crudely V-shaped arrangement, partly broken up into stout nodules. The posterior portion has several direct radiating threads or riblets.

The type (Cat. No. 370812, U.S.N.M.) measures: Length, 64 mm.; height, about 30 mm.; diameter if both valves were present would be about 16 mm. It was collected by Doctor Singewald at Pebas, Peru, and is named in honor of Dr. Julia A. Gardner, of the United States Geological Survey. Cat. No. 370814 includes a cast, a partially preserved umbonal portion, and a number of fragments, all from the type locality. Several partially preserved specimens were returned to Professor Singewald.

The type, owing to a rich chestnut coloring due to a ferruginous stain, has almost the appearance of a recent shell. The species is not closely related to any known recent species. In boldness and extent of umbonal sculpture it is scarcely equaled by any recent species, and in the breaking up of part of the sculpture into nodules it stands unique.

EODIPLODON PEBASENSIS, new species

Plate 1, figs. 5, 7

Shell apparently rather compressed, thick, rounded in front, obliquely truncated behind. Dorsal margin lightly arched, ventral margin slightly curved, meeting the posterior margin in an obtuse angle, and rounding into the anterior margin. Posterior ridge low

and not well pronounced. Beak set well forward, about 5 mm. from anterior edge and 20 mm. from posterior end. Concentric sculpture of faint growth lines. Umbonal region boldly sculptured with radiating ribs and nodules. The anterior portion has five direct, sharp, faintly granulate radiating threads. The middle portion has the riblets arranged in V pattern and somewhat nodulous. The posterior portion has four sharp, direct slender threads. Pseudocardinal tooth stout.

The type (Cat. No. 370813, U.S.N.M.) is a fragment but includes all the shell up to a well-marked rest period. At that period it measured: Length, 25 mm.; height, 13 mm. It came from Pebas, Peru, and was collected by Dr. Joseph T. Singewald.

In beak sculpture this species resembles and might be mistaken for *Eodiplodon gardnerae*, but careful examination shows marked differences. In form the two species are very different, *Eodiplodon gardnerae* being very elongate, narrow, and rather inflated, while *Eodiplodon pebasensis* is subquadrate, broad, especially at the posterior end, and rather compressed.

ANODONTITES?

Included with the collection sent by Doctor Singewald are some fragments of a very large fossil pearly fresh-water mussel, from Tarapoto, Peru. Cat. No. 370815. There is not enough left to determine the genus, but what we know of the microscopic structure of the South American Naiades leads to the belief that they belong to some genus in the subfamily Mutelinae of the family Mutelidae. The shell must have been very large and massive, as one of the fragments from along the ventral margin has a thickness of about 8 mm., and the pallial line is about 27 mm. from the ventral edge. These measurements are not equaled by any known South American Naiad, recent or fossil. They call to mind the size and massiveness of our largest North American Naiades, namely, the genus *Crenodonta*. The numerous layers of nacreous material, each very thin, between the pallial line and ventral margin indicate that the shell was aged, and that growth at this period was very slow. During this time the pallial line appears to have remained nearly stationary. The prismatic layer is very thick (in some places about a millimeter) indicating a member of the Mutelinae and not the Hyriinae, as in the latter the layer is thin and usually flakes off with the periostracum. In spots the component spicules of the prismatic layer have separated from each other and lie scattered about or in a heap.

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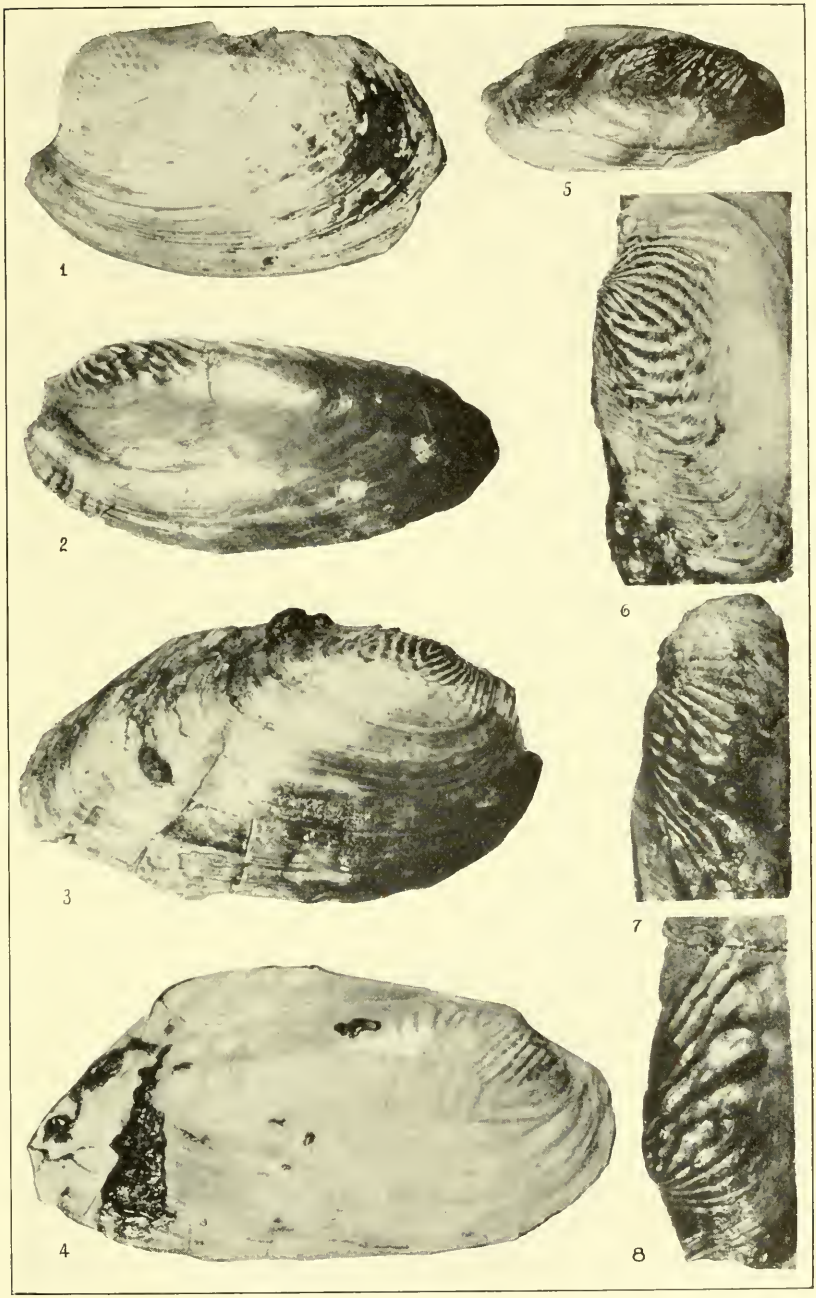
EXPLANATION OF PLATE

Fig. 1. *Prodiplodon bassleri*, new species nat. size.
2. *Eodiplodon gardnerae*, new species nat. size.
3. *Prodiplodon singewaldi*, new species nat. size.
4. *Prodiplodon paucarpatensis*, new species nat. size.
5. *Eodiplodon pebasensis*, new species nat. size.
6. *Prodiplodon singewaldi*, new species. Beak sculpture × 2 diameters.
7. *Eodiplodon pebasensis*, new species. Beak sculpture × 2 diameters.
8. *Eodiplodon gardnerae*, new species. Beak sculpture × 2 diameters.



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