

Mr. Button's collection at Oakland is notable for its fine series of Cypræas, including some of the rarest Pacific coast forms of *Trivia*.

The collection of the University contains a number of Cooper's and Carpenter's types, but awaits a new building for its proper display.

THE ANATOMICAL STRUCTURE OF CERTAIN EXOTIC NAIDES COMPARED WITH THAT OF THE NORTH AMERICAN FORMS.

BY DR. A. E. ORTMAN.

(Concluded from page 120).

In all other cases the diaphragm is complete, and extends to or close to the posterior margin of the mantle, where it separates the anal from the branchial opening. Two types are recognizable, which form as many distinct and fundamentally different groups (families). In the one (*Unionidæ* of North America and Asia) the gills alone form the diaphragm. In the other (South American and African forms, possibly to be called *Mutelidæ*) the diaphragm is formed anteriorly by the gills, but posteriorly by the union of the mantle itself.

(b) The mantle edges are originally free all around. But a tendency develops soon to form two distinct openings, the siphons. In *Margaritana* the most primitive conditions are observed, and the two openings are distinguished only by the development of the papillæ. Closely allied conditions are found in a genus of typical *Unionidæ* (*Rotundaria*). But the general tendency is, among the *Unionidæ*, not only to draw the mantle edges together by the diaphragm, thus separating anal and branchial, but also to limit the anal above by the junction of the mantle edges, which, however, leaves open above the anal a supra-anal opening, which only in rare instances becomes closed (*Lampsilis parva*). The branchial opening in the *Unionidæ* is never defined anteriorly by a growing together of the mantle margins. (In the higher forms of the *Unionidæ*, subfamily *Lampsilinæ*, special structures develop in front of the branchial opening, chiefly in the female, which serve as devices for the aeration of the marsupium during the breeding season.)

In the other family (*Mutelidæ*?) the two openings are always separated from one another by a diaphragm formed by the mantle. In some cases the mantle edges are free from the rest. In other cases

the anal opening is defined above by a growing together of the mantle margins, but here a supra-anal is never formed, the fusion of the mantle edges being complete up to the upper posterior end of the two mantle halves. In addition, we find in certain forms of this group a further step in advance, which consists of the anterior demarcation of the branchial opening by a growing together of the mantle edges.

(c) The formation of the *marsupium* offers the greatest variety. It is hard to say which is to be regarded as the primitive condition, but probably originally all four gills served as receptacula for the ova, and the space between the two laminæ of each gill was not differentiated and divided.

Out of this original condition more advanced structures have developed, which generally exhibit the tendency to localize the marsupium in certain gills or parts of gills, and to divide the interlaminar space into compartments (ovi-sacs and water tubes). In the different groups these purposes have been accomplished in different ways and to different degrees. In *Margaritana* the gills do not possess partitions, and, consequently, are primitive in this respect, and apparently no water-tubes and ovisacs are found. Unfortunately, the gravid female of this form is unknown to the writer.

In the more primitive *Unionidæ* (subfamily *Unioninæ*), either all four gills still serve as marsupium, and have thus preserved the original condition, or only the outer gills serve this purpose, and further, here the interlaminar space is divided by septa into rather regular compartments, running vertically to the edge of the gills, and parallel to the gill filaments. The same fundamental characters, restriction of the marsupium to the outer gills and development of water tubes and ovisacs, are found in the more highly-developed *Unionidæ* (subfamilies *Anodontinæ* and *Lampsilinæ*), but here specializations are met with, which are to be regarded primarily as adaptations to a prolonged breeding season, and to a peculiar way of discharging the glochidia.

In the Afro-South American group of *Najades* (*Mutelidæ*?), all cases so far known show the marsupium restricted to the inner gills. Two main types may be distinguished among them, according to the inner differentiation of the marsupial gill. In one case, the marsupial part of the inner gill is rather restricted (to the middle portion), and here very incomplete and intercommunicating water tubes are formed by rows of interlamellar connections; in the other case,

complete and heavy septa separate completely isolated water tubes. In none of these cases the structure of the marsupial gill is identical with that of the *Unionidæ*, although the septa and water tubes in the latter case show certain analogies to those of the *Unionidæ*. However, the finer structure being different, I consider this a case of convergency of structure.

(7) Of these anatomical differences representing functional differentiation, we may say that the oldest must be the formation of the diaphragm, for the tendency to form siphons necessarily must start with it. Almost as old as this is the differentiation of the marsupium, and thus the location of the latter and its structure must be essential. To these characters we consequently should attribute the greatest systematic value, and thus it is evident that the genus *Margaritana*, which I have placed formerly (NAUTILUS 23, Feb., '09, p. 116) in a subfamily by itself, but within the family *Unionidæ*, should rank higher, and I do not hesitate now to call it a family. Thus we would have the following three families among the *Naiades*:

Family: MARGARITANIDÆ. Diaphragm incomplete, formed only by the gills. Anterior end of inner gills distant from the palpi. Branchial and anal siphons ill defined, and not closed above, and no supra-anal developed. Gills without water tubes and with irregularly scattered interlamellar connections. Marsupium and glochidia unknown.

Family: UNIONIDÆ. Diaphragm complete, formed only by the gills. Anterior end of inner gills distant from the palpi. Branchial and anal siphons sharply separated from one another by the diaphragm. Anal very rarely not closed above, generally closed, but with a supra-anal opening (which very rarely may be obliterated). Gills with water tubes and distinct, continuous, interlamellar septa. Marsupium in all four, or only in the outer gills. Larva a glochidium. (Contains three subfamilies: *Unioninæ*, *Anodontinæ* and *Lampsilinæ*.)

Family: MUTELIDÆ.¹ Diaphragm complete, formed anteriorly by the gills, posteriorly by the mantle. Anterior end of inner gills in contact with the palpi. Branchial and anal siphons sharply separated from one another. Anal open or closed above, but there is never a supra-anal opening. Gills with very indistinct and intercommunicating water tubes or with well-developed water tubes. Marsupium only in the inner gills.

Subfamily: *Hyriinæ*. Anal closed above. Marsupium with interrupted interlamellar connections, standing in rows, and forming incomplete, communicating water tubes. Non-marsupial gill with poorly developed, scattered interlamellar connections. Larva a glochidium. (*Hyria*, *Tetraplodon*, *Diplodon*, *Castalina*.)

Subfamily: *Mutelinæ*.¹ Anal open or closed above. Marsupium with well-developed, continuous septa, forming well-defined water tubes. Non-marsupial gills also with distinct water tubes. Larva a lasidium. (*Spatha*, *Glabaris*, *Fossula*, *Monocondylæa*.)

(8) Our chief attention should now be directed to the study of further genera from Africa and Asia, and also the European forms should be more closely investigated.

EXPLANATION OF PLATES.

Plate VI.

Diagrammatic side views of the soft parts of *Naiades*, with the left half of the mantle removed along the mantle-attachment line, showing the arrangement of palpi, gills, diaphragm, anal, supraanal and branchial openings.

In all figures the letters indicate:

- m. Right half of mantle.
- ml. Mantle-attachment line.
- aml. Ascending part of mantle-attachment line.
- f. Foot.
- p. Palpi.
- i. Inner gill.
- e. Outer gill.
- sa. Supra-anal opening.
- an. Anal opening.
- b. Branchial opening.
- d. Diaphragm.
- x. Mantle connection in front of branchial opening.

Fig. 1. *Margaritana margaritifera* (L.). Specimen from Indian Run, Rene Mont, Schuylkill Co., Pa.

Fig. 2. *Quadrula subrotunda* (Lea). Specimen from Allegheny River, Kelly, Armstrong Co., Pa.

Fig. 3. *Unio gibbosus* Barn. Specimen from Little Beaver Creek, Enon Valley, Lawrence Co., Pa.

Fig. 4. *Parreysia wynegungaensis* (Lea). Specimen from Bombay, India.

Fig. 5. *Spatha kamerunensis* Walk. Specimen from Kamerun, Africa.

¹ The nomenclature depends on the knowledge of the genus *Mutela*.

Fig. 6. *Hyria corrugata* Lam. Specimen from Rio Tapajos, Santarem, Brazil.

Fig. 7. *Tetraplodon undosus* (v. Mart.). Specimen from Rio Tiété, Itapura, Brazil.

Plate VII.

Horizontal cross-sections through the gills of *Naiades*. All sections from sterile females. In all figures, i = inner gill, e = outer gill. Photographs taken with B. & L. 1-in. objective.

Fig. 1. *Quadrula pustulosa* (Lea). Specimen from Lake Erie, Cedar Point, Erie Co., O.

Fig. 2. *Unio gibbosus* Barn.

Fig. 3. *Parreysia wynegungaensis* (Lea).

Fig. 4. *Lamellidens consobrinus* (Lea).

Fig. 5. *Spatha kamerunensis* Walk.

Fig. 6. *Hyria corrugata* Lam.

Fig. 7. *Tetraplodon hasemani* nov.

(Specimens of Figs. 2, 3, 5, 6, 7 from same localities as on Plate VI; specimen of Fig. 4 from India.)

NOTES ON SOME PLIOCENE FOSSILS FROM GEORGIA WITH DESCRIPTIONS OF NEW SPECIES.

BY T. H. ALDRICH.

Some years since Prof. S. W. McCallie, State Geologist of Georgia, called my attention to a small block of soft marl in the State Museum which had a number of shells in it, and at my solicitation the same was kindly forwarded to me for examination. I found the specimens were a mixture of fresh water and marine, and that the fresh water ones seemed to be new besides being more or less distorted. The specimens were very fragile; notwithstanding the greatest care many of the most distorted were badly broken. It is hoped that a future examination will reveal more species and an assortment of forms far greater than those here described. The horizon is probably *Pliocene*, and seems to represent a southern fauna. The exact locality is four miles south of Atkinson, Wayne Co., Ga., on the Saltilla River. The list of species is as follows:

1. *Rangia cuneata* Gray. (Common, rather small.)
2. *Mulina lateralis* Say.
3. *Mulina congesta* Con.
4. *Dosinia* ——— sp? (Young shells.)
5. *Modiolaria* ——— sp?
6. *Gemma purpurea* H. C. Lea.
7. *Neritina* ——— sp? (Too poor for identification.)
8. *Neverita* ——— sp? (Fragments.)



Ortmann, Arnold E. 1911. "The anatomical structure of certain exotic naiades compared with that of the North American forms (concluded)." *The Nautilus* 24, 127–131.

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