

SOME OBSERVATIONS ON THE GENITAL ORGANS OF UNIONIDÆ,
WITH REFERENCE TO CLASSIFICATION.¹

BY DR. V. STERKI.

The classification of the Unionidæ is undergoing considerable changes, owing to a closer study of their anatomy, and we are awaiting Mr. Simpson's publication with considerable interest. In the meantime a few observations made on many of our species, especially from the Ohio river drainage, may be worth communicating.

1. The difference in the *season of maturing ova and sperms*, and discharging the young, in the different groups, has been confirmed by the examination of thousands of specimens from different waters. In *Lampsilis*², the ova and sperms are matured, and the former transferred to the branchiæ, during summer. The young are mature in fall, and a part of them discharged during October and November, but most of them are retained until spring. Some of the branchial sacks, single, or in groups of several, were found empty before winter, *e. g.* in *L. alatus* and *subovatus*, and the same was found early in spring; but in most species, the marsupium was still fully charged at that time. Very probably the time of spawning, as it has been called, depends, to a certain degree, on the weather and the temperature of the water. It would be of value to make such observations in the south, and also on the Great Lakes.

Quite different it is with the other Uniones, with a few exceptions. Their branchiæ are invariably found empty during fall, winter and early spring, while the ovaries are charged with ova and the testes with mature sperms. Their season of charging the branchiæ, bringing the young to maturity and dismissing them, is in the summer, and naturally lasts a considerably shorter time than in *Lampsilis* and the other winter breeders.

This discrepancy in the season of propagating, in connection with the different types of the uterus sacks, and the characters of the shell, I consider very significant and pointing at a different phylogenetic origin of the several groups. They probably originated at different geological ages and under different climatic conditions.

In many species, the ovaries and testes were seen beginning renewed activity while the young were still in the branchiæ, and this is probably so in general.

¹ See the articles of Mr. C. T. Simpson in *Am. Naturalist*, April, 1895 and the *NAUTILUS* XI, p. 19, and by the writer, the *NAUTILUS* IX, p. 91.

² A well characterized and well defined genus.

Sometimes in developed ova and the latter will die for want of imp

2. *Branchial* are differentiate are situated in the the marsupium, often exceeding unchanged and already been so characteristic females of the same sides. In the increasing with same size, and the branchial filam

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The young, in all other species considerably large centric lines of in meters.

* In one specimen exception.

Sometimes mature, or apparently mature glochidia and quite undeveloped ova are found mixed up in the branchial sacks. Whether the latter will develop into embryos later, or remained unchanged for want of impregnation, remains to be studied up.

2. *Branchial sacks, or uteri.* On *Lampsilis*, the branchial sacks are differentiated even when not charged with ova or young. They are situated in the posterior part of the outer branchia, in a group, the marsupium, which, when charged, is very considerably enlarged, often exceeding half the length of the shell, and crowding away the unchanged anterior and posterior parts of the branchiæ. It has already been said that the number of sacks is, to a certain degree, characteristic for each species, yet rather variable even in individuals of the same size, and it is also hardly ever the same on the two sides. In the young, there are only a few, and their number is increasing with the age of the animal. They are also not all of the same size, and each one may occupy a smaller or greater number of branchial filaments.

In younger animals, there are always a number of small, empty sacks adjacent to the gravid ones, preformed to be charged in the following year.

The shape of the uterus sacks in *U. irroratus* Lea is known from the author's description and figure. There is considerable variation in their numbers. Of three specimens from the same place, all medium sized, one had seven sacks on one side, four on the other, the second had eleven and ten, the third, ten and eight. At the proximal ends there were exclusively ova; at some distance, those in the periphery had transformed into glochidia, and at the distal ends the latter were in excess, while a great number of ova had still remained unchanged. In accordance with this, the flesh color was much more intense at the proximal than at the distal ends, as the ova are colored, the young colorless.³ The ova are packed closely together and coherent by some intermediate substance, so that the whole worm-like cylinder can be extracted in toto from the enclosing membrane.

The young, in the uterus, show marked differences from those of all other species seen, as to soft parts and shell. The latter is considerably longer than high and has numerous distinct, crowded, concentric lines of growth. Its length is 0.21, alt. 0.17, diam. 0.14 millimeters.

³ In one specimen, the ova, and so the whole cylinders, were colorless, a rare exception.

In *cornutus* Bar., the sacks are also permanently differentiated, about six or seven on each side, near the middle of the outer branchiæ, and considerably projecting over their edges, much as in *irroratus*. But while the latter were found gravid in fall, the few *cornutus* seen, had the marsupia empty at that time, (late in October); the ovaries were filled with ova and the testes with sperma. More observations are necessary.

U. phaseolus is so different from all other species and groups that Simpson and Wetherby are certainly right in regarding it as the representative of a distinct genus. The outer branchiæ, in their whole extent, are permanently differentiated, much less high than the inner ones, and with a brownish edge. Thin and even while barren, they are much larger when gravid, and heavily, somewhat irregularly plaited, the folds being caused by the considerable increase of the length of the branchiæ. The sacks are very numerous; in a large specimen, 283 were counted on one side. Each one is formed by a thin, translucent, yet rather strong and somewhat rigid membrane, enclosing the ova, or the young, loosely inserted in the substance of the branchiæ, with a projecting, half-globular head. It can easily be extracted, and, when the young are mature, probably is expelled in toto.

The young, although in the shape of the shell not much different from other species, shows marked peculiarities of the soft parts.

The uteri were found charged from July, or August to April, in numerous specimens. More exact data must still be obtained.

Most of the remaining species of the old genus *Unio* show no differentiation of the branchiæ or parts of them which are destined to lodge the ova and the young animals. The outer branchiæ, in adult specimens, are charged in their whole extent, and often* also the inner pair; while gravid, they show only a general bulging, but no differentiated or prominent parts, and after the young are discharged, they are in no way different from "common" gills, except a somewhat ragged margin now and then in old specimens. Of a number of species, those cited by Lea, and some others, we know that also their inner branchiæ were found charged, but we do not know whether this is constantly so or not, and whether in all species it may be found occasionally. This uncertainty is partly

*In the writer's article, l. c., p. 91 there is a sad, unintentional lapsus, and cited by Mr. Simpson (l. c.), about this point; the correction will be found in the above.

due to external cutting has been done early summer the collecting is difficult, is necessary that numbers of muscle their young and th

Helix disparilis Ancey

Testa imperforata, perne et infra subter luteis irregulariter virens, concolor. Anfractus 5, regulari et superficiali disco oblique striati, uterius presertim peraperta acuta mediana in situ impressa.

fauce pallidula, marginibus subincrassato junctura obtusata, basali elliptica carinam expansam

Diam. max. 174

Locality unknown

This is a very new species known to Mr. E. J. submitted by Mr. striking, reminding form is nearly that of the peristome and the facies, I however think are with *Dendrobium*. Mr. Ponsonby should be fortunate, as it we might belong.

due to external causes; probably nine-tenths, or more, of all collecting has been done during late summer and fall, since in spring and early summer the water is usually high, muddy and cold, and collecting is difficult, and in many places almost impossible. Now it is necessary that we overcome those difficulties and secure large numbers of muscles just in the time when the *Lampsilis* discharge their young and those under consideration become gravid.

(To be continued.)

DESCRIPTION OF A NEW HELIX.

BY C. F. ANCEY.

Helix disparilis Ancey. (Pl. I, fig. 13).

Testa imperforata, lenticularis, solidula, subnitida, carinata, superne et infra subtus carinam læte fulva et maculis strigisque virenti luteis irregulariter conspersa, circa regionem umbilicarem luteo-virens, concolor. Spira depresso-fornicata, convexa, valde obtusa. Anfractus 5, regulariter crescentes, perparum convexi, sutura lineari et superficiali discreti; embryonales lævigati, concolores, sequentes oblique striatuli, ultimus lineis impressis spiralibus confertisque, subtus præsertim perspicuis striatus, æqualiter utrinque convexus, carina acuta mediana insignis, antice lenissime vixque deflexus, in umbilici loco impressus. Apertura perobliqua, diagonalis, securiformis, fauce pallidula, marginibus distantibus, callo tenui ad insertionem subincrassato junctis, supero antice rotundatim producto, declivi, obtusato, basali elliptico, subincrassato. Peristoma haud, nisi infra carinam expansiusculum.

Diam. max. $17\frac{1}{2}$, min. $14\frac{1}{2}$, alt. $7\frac{1}{2}$ mill.

Locality unknown.

This is a very ambiguous and highly interesting shell. It is unknown to Mr. E. A. Smith of the British Museum, to whom it was submitted by Mr. John Ponsoy, of London. Its color is very striking, reminding one of that of *Helix parilis* Rang, while the form is nearly that of *Helix Josephineæ*, but it has no teeth on the peristome and the sculpture is peculiar. Notwithstanding its external facies, I however think the true affinities of this remarkable species are with *Dendrotrochus* Pilsbry, such as *D. Cleryi*, *Eva*, etc., and Mr. Ponsoy shares my opinion. The absence of locality is unfortunate, as it would, perhaps, enable us to guess to what group it might belong.

cular aspect, and in the young are much obscured by the polish of the base of the shell; base rounded moderately, about as much as the spire, slightly depressed, with a very thin, brilliantly polished callus near the axis; aperture with the upper lip projecting considerably beyond the lower one, moderately thickened and rounded, overrunning the keel at the inner corner where there is a narrow, sharp sulcus, of which the termination in fully adult shells makes a decided notch in the edge of the lip; lower lip receding, flexuous slightly thickened; throat with three basal, one axial and two parietal, strong, subequal, spiral laminae, much as in *C. salleana*, the pillar very short, rendered flexuous by the end of the keel; the internal walls of the preceding whorls and most of the axis, absorbed. Lat. of base (major) 30, (minor) 26, alt. 11 mm.

Habitat, Pilitla, San Luis Potosi, Mexico, E. W. Nelson.

This is the finest species of the genus, more evenly divided by the keel, more depressed, and larger than *C. salleana* or *C. eolina*, the only species hitherto known.

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(Concluded.)

"*Margaritana*." Considerable changes will be necessary about those species hitherto ranged under this genus, and some evidently related forms, e. g. *Unio pressus* Lea and *Anod. edentula* Say. The latter two species seem to stand near *Marg. truncata*, *rugosa* and *complanata*. In all of them, the soft parts are of rather the same appearance, and especially so are the branchiæ, of which the outer are gravid, in almost their whole extent, from fall to spring. *U. pressus*, *Marg. rugosa* and *A. edentula* were found with the posterior halves of the branchiæ empty—evidently just emptied, the anterior part still filled with young, in spring. Some of them were seen with the branchiæ empty, the gonads charged, in July.

In *edentula*, the young are arranged in a singular way, apparently different from others. There are small, cylindrical, worm-like, whitish masses, of about one mill. diameter, lying transversely in the branchiæ, closely packed together. In them, the young are located, six to ten or more in each one, in single or double file, each one in

an isolated cavity ascendant from an with the "sacks" be called *placenta* rounded by water translucent, and expelled by the s facilitated by its cylinder, held by attached to the s of the ovum cavity as such by the p attached for some

In the other s similar; the young which seem to be the same byssus h at the distal end.

The embryonic the same type, i. different from the The shells of the is of rather the sa. to prove that the nearly related for That the hinge of most of the other also the more dev significance.

3. *Gonad and* It has already been possibly four year at that period the *stilis*. The animal regarded as larvae order, showing it except possibly so the gonads come producing small a tion, however, wh

an isolated cavity, which is evidently corresponding with, and descendant from an ovum. These cylinders seem to be not homologous with the "sacks" in *Lampsilis* and other groups, and may properly be called *placentæ*. When removed from the branchiæ and surrounded by water, they swell up, at the same time becoming more translucent, and each embryo is dislodged from its cavity, evidently expelled by the swelling of the surrounding substance, and the exit facilitated by its softening. But each one is still hanging on the cylinder, held by a short byssus thread, whose proximal end is attached to the soft parts of the young, the distal to the inner lining of the ovum cavity. Very probably these *placentæ* are discharged as such by the parent, with the young first enclosed, and then attached for some time.

In the other species named above, the arrangement is rather similar; the young are attached to and held together by filaments which seem to be homologous with the *placentæ* of *edentula*. And the same byssus has been seen in the young of *marginata*, coiled up at the distal end.

The embryonic young of these species as well known, are all of the same type, *i. e.* pointed below and strongly "hooked," quite different from those of other groups, a very significant character. The shells of the adult show some common features, and their nacre is of rather the same appearance. All these qualities combined seem to prove that the several species under consideration, with some nearly related forms, constitute a rather well characterized genus. That the hinge of *edentula* is still more rudimentary than that of most of the others, can be no valid argument to the contrary, and also the more developed *placentæ* are, in my opinion, of secondary significance.

3. *Gonad and gravid branchiæ in the young and old; Parasite.*— It has already been stated that in young individuals, two, three, or possibly four years old, the gonads are not yet developed at all, and at that period the shells show no distinction of sexes, even in *Lampsilis*. The animals seem to be asexual and, in this respect may be regarded as larvæ. There are very few animals, of higher or lower order, showing this peculiarity in their apparently definite state, except possibly some of their congeners, marine Pelecypods. When the gonads commence growing, there are at first few acini developed, producing small quantities of either ova or sperma. It is a question, however, whether at that juvenile age the future sex of an in-

dividual be already established in some way, or becomes so only with the development of the gonad.

On the other hand, in very old specimens, the ovaries and testes seem to become atrophied, and lose their capacity of producing ova and sperma, respectively. There is a mass of fibrous, connective tissue, while the glandular elements are considerably diminished or entirely lost.

Yet it must be mentioned here that there is another cause of that degeneration. In the ovaries and testes of many species and different genera, from the Ohio and Tuscarawas Rivers, the Ohio canal, and other places, I have found a singular, polymorphous, worm-like parasite, of microscopic size and low organization, sometimes in immense numbers. It is very common, in old and middle-aged specimens, and wherever it occurs, the products of the gonad are considerably diminished or entirely suppressed. Details will be found in another place.

It has been stated that in young *Lampsilis* the number of sacks in the marsupium is considerably smaller than in older ones. In the younger specimens of most other groups only a small area of the outer branchiæ may be charged, and slightly so, usually about the middle. The same is found in *phaseolus*. One specimen, 62 mill. long, had 12 sacks on one side, 38 on the other; all of them were quite small, but of rather unequal sizes.

4. *Hermaphroditism, etc.*—It has been asserted, by different writers, partly long ago, that some, if not all, of the Unionidæ are hermaphroditic, as some other groups of Pelecypods are. From my own observations I can say that it is found occasionally, rather an exception than the rule, in the large majority of our species. In a number of specimens, ova and sperma were found in the same gonad, but usually one product was greatly in excess of the other. Very probably it has been overlooked in many instances, as there may be only a few acini producing sperma in an "ovary," or vice versa. It takes a very keen eye to see that unaided, and to look over every parcel of a large gonad, requires an undue amount of time, when scores and hundreds of specimens are to be examined. And so it would be with microscopic examination, either by looking over samples from all parts of the gonad, or by section series on hardened specimens. Yet the question should be studied carefully, especially as to *Anod. imbecillis* and some other species. That would be a task for persons having a good deal of time at their disposal.

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One specimen of *U. rubiginosus* Lea, (Ohio Canal, May) had a few acini producing ova in the gonad charged with copious sperma. In that instance the distinction was easy, for the bright crimson color of the ova. Among 120 specimens of *U. pyramidatus*, from the Ohio River, collected late in September, two were found containing ova and sperma in the same gonads. Of *U. parvus* Barnes one specimen had a good quantity of sperma beside ova in abundance. This case especially needs revision. Among a limited number of *Anod. imbecillis* four specimens (Ohio Canal, May) were found with ova and sperma in various proportions.

The question whether such individuals are capable of self-impregnation, might be decided by experiment on such species where hermaphroditism is frequent.

It has also been said that a total change of the sexes may take place in an individual, and that question also could be settled only by long continued observation and experiments. Or a large number of specimens might be marked in some way, in a pond or certain place of a river or creek, and as many as can be found again, would be controlled year after year. That, however, would be necessary only for such forms in which the shells show no sexual differences. While such a change is *a priori* improbable in all Uniones, it appears really absurd in regard to those forms in which the sexes are established and manifested by permanent characters of the branchiæ, and also the shells, as in *Lampsilis* and some others.

It may be mentioned here that, as to my knowledge, observations on the question of possible *agamogenesis* and *parthenogenesis*, in *Unionida*, have not been made. Carefully conducted experiments might give interesting results in that direction. They would necessarily be difficult, for the possibility of hermaphroditism and self-impregnation, in every instance.

5. *Sexual differences of the shells.*—In *Lampsilis*, as well known, the posterior inferior part in the female mussel is dilated to make room for the marsupium, yet this dilatation is very various in kind and degree. But the differences sometimes are in a certain measure relative, owing to the nature of the habitat, and to inheritance. *L. luteolus*, e. g., in certain localities, is so short and inflated that the males may closely resemble the females from other places where the mussels are more slender.

In most other "Uniones," the differences are little marked. Yet, in general, the females are more inflated than the males, as in

undulatus, *pustulosus*, etc. In *U. gibbosus* the sexes may be recognized with a fair degree of probability by the more inflated shells of the females.

A decided difference we find in *U. verrucosus* Raf. (*tuberculatus* Barn.), where the older females are considerably elongated at the posterior end, that part of the shell being rather even, without the characteristic undulations and warty prominences. In younger, though fecund specimens, that feature is yet little marked.

U. phascolus shows no constant differences in the sutural shape of the shell, but a decided one on the inner surface, in older specimens. The female has, in each valve, a deep, oblique sulcus corresponding with and leaving room for the gravid outer branchiæ.

In the female *Marg. marginata* the posterior end is directed downward and more inflated (with a stronger umbonal ridge), and the same can be said of "*An.*" *edentula*, although it is less marked.

6. *Numerical proportion of Sexes.*—In most species, the number of males is in excess over that of the females, often considerably. A few examples may be cited. Of 50 specimens of *L. subrostratus* Say, from a lake in Indiana, only about one-third were females, and the same must be said of a lot of *L. nasutus* from Ohio. Here, as in many species, the females were averaging considerably smaller. Of 115 *U. pyramidatus*, from the Ohio River, 71 were males, and of eight *retusus*, seven were males, the eighth was young with the gonad undeveloped. It is a question whether this be the normal condition or due to local causes, or an evidence of beginning degeneration.

In concluding, it may be said that the time has come when new species should be based not only upon the shells, but also the soft parts, if such be obtainable.

New Philadelphia, Ohio, April, 1898.

A NEW UNIO.

BY BERLIN H. WRIGHT.

Unio villosus sp. nov.

Shell ovate-elliptical, somewhat inflated, smooth, very inequilateral, bluntly rounded or subbiangular behind, subtruncate before, umbonal slope uniformly rounded above, disappearing at the lower margin. Substance of the shell moderately thin; very slightly

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thickened before. Ligament long, thin and reddish. Beaks prominent and surrounded by coarse, oblique undulations, about four in number and rather acute at summit. Epidermis fuscous, black and deeply striate; strong transmitted light shows a light-olive texture, densely covered throughout with broad, greenish rays. Cardinal teeth rather solid and deeply serrated. Lateral teeth long, slender, straight, nearly smooth and extending to the posterior cardinal. Posterior cicatrices scarcely visible; anterior ones distinct. Beak cavities slight and rounded. Nacre tinged with salmon under the umbos, milky white anteriorly and of a bright blue and iridescent behind. Width, $2\frac{1}{2}$ in., length $1\frac{1}{2}$ in., diam. $\frac{1}{2}$ in.

Habitat.—Suwannee River, Suwannee County, Florida.

Type in National Museum.

Remarks.—This species seems to be related to both the *amygdalum* and *parvus* groups, is readily distinguishable from any of its associates by its remarkable width, beautiful rays and pointed, compressed posterior. It reminds one most of *U. minor* Lea, with which it is found, having the same dark, fuscous epidermis, and like that species is disposed to be sub-truncate before, but the rays, light teeth, thinner substance and greater size at once distinguish it. Some forms of *U. trossulus* Lea approach it, but the beak sculpture, outline and teeth are radically different, besides that species is never rough, but is smooth, polished and yellowish when taken from the water; the rays of the two species are quite similar, except that those of our species are only visible by the aid of transmitted light.

RECENT PUBLICATIONS.

SYNOPSIS OF THE RECENT AND TERTIARY PSAMMOBIIDÆ OF NORTH AMERICA, by W. H. Dall (Proc. Acad. Nat. Sciences of Philadelphia, pages 57 to 62). The title of this paper gives some idea of the ground covered by it. In the genus *Psammobia* a new section *Grammatomya*, is made by Dr. Dall, and in the group *Sanguinolaria* another one, *Nuttallia* is formed, with *Sanguinolaria Nuttallii* Conrad as the type. *Heterodonax* has been removed from the family *Donacidae* into this family. This will be gladly received by collectors who have been sorely puzzled to find affinities in *Heterodonax binaculata* Lin. with *Donax*. Besides a full synonymy, the geographical distribution of the species are given. By the way,