

Cotype No. 2, width, 14 mm.; height, 11 mm. Univ. Colo. Mus.

Cotype No. 3, width, 12.8 mm.; height, 10.6 mm. Univ. Colo. Mus.

Cotype No. 4, width, 13 mm.; height, 10.8 mm. Univ. Colo. Mus.

Cotype No. 5, width, 13.5 mm.; height, 12 mm. Univ. Colo. Mus.

Cotype No. 6, width, 14 mm.; height, 10.8 mm. A. N. S. Phila.

No. 5 is a melanistic example with no light band.

GLOCHIDIA IN SURFACE TOWINGS.

BY H. W. CLARK AND SAMUEL STEIN.

In their article on "Reproduction and Parasitism in the Unionida," by LeFevre and Curtis (Journ. of Experimental Zoology, Vol. IX, No. 1, p. 98), under the caption, "Behavior and Reactions of Glochidia," occurs the following statement:

"At the time of spawning the glochidia, already free from the egg-membranes and more or less loosely held together in slimy strings, are discharged at irregular intervals through the exhalent siphon. Being heavier than water, they sink rapidly to the bottom, coming to rest with the outer surface of the shell directed downward and the valves gaping widely apart." The belief was formerly general that they "swim" about by rapidly opening and closing the valves, after the manner of Pecten, and in spite of frequent denials by Schierholz ('88), Latter ('91) and others, the same statement is still occasionally encountered. In the recent volume on Mollusca in the Treatise on Zoology, edited by Lankester, this inexcusable error is represented. "The glochidia," we are again informed, "swim actively by clapping together the valves of the shell" (p. 250). They are, on the contrary, as is now well known, entirely incapable of locomotion and remain in the spot where they happen to fall, and that "The

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glochidia remain in this helpless situation until they die, unless they happen to come in contact with the host on which they pass through the post-embryonic development as parasites." The same statement occurs in the "Studies on the Reproduction and Artificial Propagation of Freshwater Mussels" by the same authors in the Bulletin of the U. S. Bureau of Fisheries, Vol. XXX (Document No. 756, page 152).

The occurrence of glochidia in plankton is noted and commented on in some fullness of detail by Kofoid in his report on the Plankton of the Illinois River, Part 2, page 287, where, under the heading "Lamellibranchiata" he remarks: "This group is represented in the plankton by the larval stages or glochidia of the *Unionida*, which form an important part of the bottom fauna of the stream and its tributaries." Among those mentioned as occurring in the plankton are *Anodonta corpulenta* Cooper, glochidia "referred with some uncertainty" to *Lampsilis anodontoides*, and glochidia presumably belonging to *Arcidens confragosus*.

Kofoid's remarks concerning the abundance, numbers and percentage of occurrence, temperature relations and seasonal distribution, as well as his remarks on identification of the glochidia encountered, preceding as it does the strenuous attempts at description and identification of glochidia and ascertainment of breeding seasons of different species of mussels later entered into with such avidity in behalf of mussel propagation, form one of the most fascinating episodes in scientific research. His discussion is unfortunately too long to quote in a brief article like that intended here, but too interestingly precious to be missed by anyone studying the history of mussel propagation.

Peremptorily dismissing the temptation to quote remarks illuminating other but what would anciently be called impertinent phases of the subject here, it only remains to remark that what is really the one pertinent query, that of the relation of the glochidia to the surface, is left in doubt. The wording of the one introductory sentence quoted, doubtless perfectly clear when written, develops an ambiguity which increases with a growing interest in glochidia rather than

mussel. Kofoid took his plankton by means of a pump, and at all depths, from near the bottom to the surface. He may, therefore, have obtained his glochidia anywhere between those extremes of depth.

During the spring and summer of 1920, in an attempt to ascertain the relation, quantitatively and qualitatively, between the river, the reservoir and the various ponds of the Fisheries Biological Station at Fairport, Iowa, occasional surface tows were made with a fine bolting-cloth net in all the places mentioned. On April 12, ten short hauls were made at the surface of the Reservoir near its outlet, in about 12 feet of water. In the portion of the haul examined (in most cases, especially where a considerable amount of material was taken, only a small portion, usually about one-tenth, was examined carefully) a glochidium of the *Anodonta* type, probably that of *Anodonta corpulenta*, was taken. It was at first supposed that it was dead, but four hours after capture it was observed to snap its valves.

On July 3, the river, which was high and muddy, showed a slightly greenish cast, suggesting an abundance of plankton. Accordingly several short draws, almost dips, were taken at 11:15 a. m. from the end of the pier, from the surface in shallow water near shore. One glochidium, provisionally identified as that of *Lampsilis anodontoides*, and 12 shorter, rounder, probably of some species of *Quadrula*, were taken. On July 29 a towing was taken in water a considerable distance from shore, from a boat and in the current. Only a small amount of the material—mostly silt—was examined; but in the part scrutinized was found a glochidium.

On July 30, the townet was held under the edge of the mass of water coming up from the river and falling in an inverted bowl-shaped mass from the vertical inlet pipe, where it enters the Reservoir. The net was held here only about 3 minutes, and naturally strained only a small portion of the water falling from the pipe—hardly a hundredth part. A good deal of material, chiefly detritus, was obtained and only a small amount of this examined; but in this small amount was obtained 8 glochidia of the *Lampsilis* type.

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On August 14, twenty-five liters of water was dipped from
the surface out in the river in fairly deep water and in the
channel. In the part examined one very minute glochidium
was taken.

On August 19, in taking a surface towing by dragging the
towntnet from a boat going down stream from a bar above the
station, and in fairly deep water, three glochidia were cap-
tured.

To sum the matter up, there was not a single collection of
surface plankton taken from the river in which there was not
one or more glochidia, and indeed, until the river became low
and calm, permitting the development of plankton organisms,
the glochidia usually outnumbered any other organism; the
river, except during the conditions above mentioned, being
remarkably plankton-poor. In every instance, too, where ex-
amined repeatedly and at long enough intervals, the glochidia
proved themselves alive by a feeble snapping of their valves.
The flapping of the valves was always too feeble and too
widely separated in time intervals to be effective as a means
of locomotion. It may, of course, have been much more vigor-
ous and frequent for a time after first discharged, but there
is no probability that it could ever have resulted in swim-
ming."

On the assumption that the glochidia lie on the bottom
where discharged, and there die unless they become attached
to a fish, one of the most important advantages served by
parasitism is that of dissemination. In the light of the obser-
vations recorded above, it becomes evident that distribution
down stream is common and that perhaps many, if not most,
natural infections take place some distance from and below
the place of discharge. The importance of parasitism as re-
gards dispersal is therefore confined chiefly to up-stream
migration, although of course dispersal in other directions is
greatly assisted and accelerated by means of the fish.

The surface-floating habit of glochidia explains also the
occurrence of *Anodonta imbecillis*, a species which is capable
of developing without parasitism, in floating crates, the bot-
toms of which are considerably above the level of the bottom

of the river, as has happened in crates moored at Fairport, Iowa, and at New Boston, Ill.

Fisheries Biological Station, Fairport, Iowa.

FLORIDA WEST COAST LIGUUS.

BY CHARLES TORREY SIMPSON.

In the April, 1921, number of the NAUTILUS, Mr. M. G. Miller states that Capt. W. D. Collier, long a resident of Key Marco, brought tree snails from Middle Cape Sable and "planted" them at Caxambas, Goodland Point, and Marco, all on Key Marco. This was done forty-eight years ago and there were no *Liguus* snails on Marco previous to this, but they multiplied and spread rapidly.

As a matter of fact there have been found no less than four subspecies of *Liguus* belonging to two species, and one species of *Oxystyla* in the Marco region and for some forty miles southeast of it. *Liguus fasciatus roseatus* has been found on Marco Key, Horr's Island, near it, at Gomez Old Place, ten miles southeast, at Caxambas, and at Chokoloskee farther down the coast. The form of *Liguus* which I have called *lineolatus* has been found at several places on Marco Key, Horr's Island, Gomez Old Place, Russell's Key, Turner's River, Caxambas and Chokoloskee. *Liguus fasciatus castaneozonatus* has been found at Rabbit Key, just below Chokoloskee, and on the island of the latter name, but nowhere to the northwest of these places, so far as I know. *Liguus crenatus marmoratus*, the "black snail", was obtained by Mr. Clarence B. Moore, who got it from a Mr. C. G. McKinney from land which he cleared somewhere near Chokoloskee, according to Pilsbry in his "Study of the Liguus of Florida," page 453. Some five years ago I visited Chokoloskee and was taken by a resident to the island where he said the black snails which Mr. Moore obtained were found. The hammock had been cleared but diligent search brought to light some fragments and three dead, badly-faded specimens, one of which is *marmoratus*, I believe. *Oxystyla floridensis* has been

found at Chokolos and Seminole Point

Now then, what brought all these Cape Sable and d the west coast I have actually been *Liguus fasciatus marmoratus*, and seems he did not lished. How did far north as Chokol from this locality *moratus* to a key on the trees of th forms and plant

As a matter of Cape Sable which west coast forms marked; the *ma* pattern from th single dead speci during several v certainly be refe have brought to them on or are forms of *Liguus* Upper Florida of Florida over tion was proba that they reach aborigines had they made part northern distri trees they lived

This subject and *Oxystylus* migrate will be