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BIOLOGICAL NOTES ON *LETHOCERUS AMERICANUS* (LEIDY.)[1]

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Although studied since 1847 when described by Leidy, very little has been written about the life history or habits of this "Electric-light Bug" or Giant Waterbug. This is rather surprising in view of the fact that its distribution is quite general and that it has been a favorite with biologists and naturalists for a long time, as evidenced by the many references to it in the literature. Its extreme voraciousness and the relation of this trait to fish culture is another reason for expecting that its life history might have been worked out.

In December of 1921 several specimens of this species were taken from their winter quarters by the writer. They were found near St. Paul in a small stream connecting two lakes. The water in this little stream of a hundred and fifty yards in length and about five yards in breadth, comes out of a long concrete conduit. As the water leaves the conduit it has considerable current but it becomes sluggish before it enters the lake. The current at this point, however, is sufficient to keep the water from freezing over during winter. The bugs were found under somewhat varying conditions. In the center of the stream they were found buried some five or six inches deep in the layer of disintergrated plant material forming the bed of the stream. The water at this point was over two feet deep. At the edge of the stream they were found among Typha roots. Here the water was but a few inches deep and the bugs were buried to a depth of

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two or three inches only. The bugs appeared to be dead when first taken but they soon responded to the warmth of the hands as shown by slight movements. They were placed in collecting cans and by the time we returned to the laboratory they were fairly active. Transferred to water of room temperature, in a short while they were as active as those taken during the warmer part of the year. They were kept in a glass vessel in the laboratory for a period of several months, but died before an aquarium suitable for the deposition of eggs was provided. During this period they received an occasional feed of small sunfish and small catfish.

On July first, 1923, a large Lethocerus nymph was secured from a small pond near University Farm campus. It was taken while dredging at the edge of a pond with a heavy water net. The nymph was feeding on a tadpole larger than itself and did not release its victim while it was being taken from the net and placed in a collecting can. In the laboratory it was placed in a glass vessel which was four inches deep and ten inches in diameter. This container was half filled with water and a little vegetation added. The nymph fed greedily upon beefsteak, grasshoppers, tadpoles, young frogs, young fish, flies and other things that were offered. On July fifth it molted. The cast skin measured dorsally as follows: Length along median line, 33 mm.; width of head across eyes, 6 mm.; width of posterior margin of prothorax, 10 mm.; width of posterior margin of metathorax, 14 mm.; width of abdomen across base of second segment, 16 mm. (widest portion of bug). Immediately upon molting it was of a very delicate yellow and green color and seemed quite frail. It was so translucent that it was easy to see what was going on within the bug. When observed a few hours later it had taken on the color it had previous to molting.

About seven hours after molting food was offered and it ate twelve large flies and two meadow grasshoppers. No doubt it it would have eaten more had they been offered. On the afternoon of the following day while out collecting, two tadpoles considerably larger than the nymph were secured, so one of these was offered. At the end of an hour nothing remained of the tadpole but the shriveled skin and some dark mud-like material

in the digestive tract. The second tadpole was then offered to the bug with the same result. I was curious to know how much more it might eat but refrained from offering more food as I still had a vivid recollection of what happened to a number of Ranatra that were allowed to gorge themselves. These bugs had had no food for several weeks and then one evening offered all the flies they could eat. The next morning eleven of the thirteen water scorpions were dead. It was at first thought there might have been something toxic about the flies and later the experiment was tried again. This resulted in the death of all five bugs used in the test. Still later the same experiment was tried again, this time using cockroaches and damsel-fly nymphs. Again all the bugs died. This food ordinarily is very fine for these bugs so evidently it was the effect of a large amount of food being taken after a fast which caused death. When they have been fed more regularly no evil effect seems to occur, even though they have all they can possibly consume.

On the thirteenth of July a move was made to the State Fish Hatchery at St. Peter, where some lake studies were to be conducted. Some anxiety was felt about successfully transporting the Lethocerus nymph, but it made the trip apparently none the worse for the experience. The trip was made by Ford, and this insect along with nymphs and adults of more than a dozen species of waterbugs, came through without mishap. The distance was only eighty-five miles but the life histories were "packed up" for about fifteen hours. Before packing for the trip the water was drained from the life history jars, leaving the bugs upon the wet sand.

In its new home the Belostomid was fed mostly on young trout. Two $3\frac{1}{2}$ inch trout were given every other day, with an occasional feed of grasshoppers, crickets and flies. It was fed trout principally, because the laboratory was located in a trout hatchery and trout became the most available food source. Every day the vegetation near the hatchery was "swept" for soft-bodied insects which were used as food for Velia, Microvelia, Gerrids, Nepa, Ranatra and other bugs in rearing. Grasshoppers and other large insects were often taken inadvertently and accordingly were given to the Lethocerus. The bug would refuse

to take food the day following a meal of two sizeable trout. This rather surpised me for I had always supposed Lethocerus would kill because of a vicious nature, whether hungry or not.

Adults likewise would not kill food excepting when they were hungry enough to eat what they killed. The adults did not feed as often as did the nymphs. It would be expected that the adults would not require as much food as the growing nymphs but this may not be the only reason for their smaller food requirement. There may exist here a condition found in the family Nepidæ. Nepa adults caught afield consistently eat less than the adults reared in the laboratory. Two factors perhaps are responsible in part or altogether for this condition. The food may not suit them as well as what they secure in nature, and they were probably used to receiving food less frequently in nature.

On the twentieth of July the nymph died. Since there was no indication of any unusual condition in the breeding jar it is believed the bug was ready to undergo another molt. As is true of insects in general the period of ecdysis is a critical one for waterbugs. That this mortality occurs at molting time in nature was evidenced by an examination of dead Microvelia nymphs taken afield. Measurements of dead nymphs of the several instars were made and found to correspond with those of the reared specimens just previous to molting time. In addition to this specimens were often found in which the skin had already split. It would be hard to determine whether the death rate is higher with insects reared in captivity or with those reared in nature. Hungerford (1919) in discussing the biology of the water boatman *Palmacorixa buenoi* Abbot remarked, "Under laboratory conditions, molting appears to be a precarious process." I found that to be the case with Ranatra, and it is especially true of the later instars. A number of specimens of three different species of Ranatra were isolated for rearing purposes, not one of which reached maturity.

At death the Lethocerus measured as follows: (all measurements dorsal): Length along median line 45 mm.; width of head across eyes, 5.5 mm.; width of posterior margin of prothorax, 13.5 mm.; width across extremities of mesothoracic wing pads,

20 mm.; width of abdomen across base of second segment, a fraction more than 20 mm.

That this nymph was of the last instar there can be no doubt as it was practically as large as some of the smaller adult Lethocerus in my collection. A comparison of the size and shape of the wing pads with those of a fifth instar *Belostoma flumineum* Say strengthens the opinion that such is the case. In the following discussion the next to the last and the last nymphal stages will be referred to as the fourth and fifth respectively, but for reasons to be given below, this may not be the proper designation.

The shape of the fourth and fifth instar nymphs is noticeably different. The widest measurement of the thorax in the fourth stage is the width through the hind angles of the metanotum (tips of rudimentary wing pads), which flare out slightly, while the greatest thoracic width of the fifth stage nymph is across the mesothoracic wing pads at a distance of about three millimeters before their tips. In the fourth stage the greatest abdominal width is two millimeters more than the greatest thoracic width. The mesothoracic wing pads lack about 1 mm. extending to the hind angles of the metanotum. These angles are not yet differentiated into wing pads. In the fifth instar nymph the greatest abdominal width is equal to the width across the tips of the mesothoracic wing pads, which now extend slightly beyond the hind angles of the metanotum. In this stage the hind angles of the metanotum are clearly differentiated into wing pads. The greatest width of the bug is now across the thorax instead of the abdomen. Our attention has been called to the disappearance of one of the anterior tarsal claws during the last molt. Another difference between nymph and adult is that the nymph has a dense growth of hair on the ventral side of the abdomen, while the same region in the adult is glabrous and devoid of hair.

Weed (1897) figures the "Last stage of nymph." This undoubtedly is a drawing of a fourth stage nymph. It does not agree with the specimen before the writer, in that the shape of the wing pads is different. However, it could not possibly be a last nymphal stage.

Since Belostoma has five nymphal stages it would be ex-

pected that Lethocerus would likewise have that number. This, however, does not necessarily follow, for in the Nepidæ we have a different number of instars in the different genera, Ranatra and Curicta having five, while Nepa has but four. Roesel (1755) figured five nymphal stages for the European *Nepa cinera* L. If we can accept as authentic these notes on the biology of *N. cinera*, we have this difference in the number of instars occurring within the genus. This is known to be the case in the family Veliidæ, where in the genus Microvelia we have some species with five instars while others have only four.

Since the fifth instar is of fifteen or more days duration it is evident that the growing period, the period of great food consumption, extends over a considerable period. The progeny of one or two pairs of adults could do a great deal of damage in a fish pond during their developmental period. The fish culturists are surely justified in their denunciation of this form as a menace to young fish.

Literature is replete with references pertaining to the ferociousness of this bug. A very remakable account of Lethocerus attacking a fish was recently related to the writer by Professor J. R. Parker of the University of Montana. His statement follows: "some time in September 1923, Mr. C. A. Morton of Bozeman with his family was camped on a small creek near Ovando, Montana. Early in the morning Mr. Morton and another man went out along the creek to get some fish for breakfast. In clear, still water they saw a trout about ten or twelve inches in length and while watching the trout they noticed a giant waterbug lying aimlessly on the surface of the water, except for one leg which it appeared to be waving in a manner to attract the attenton of the fish. It appeared to be successful in this for the trout grabbed the waterbug by the leg that had been moving whereupon the bug raised up and sunk its beak into the top of the fish's head. The trout began to swim excitedly in circles and jumped clear of the water several times. It finally turned over on its back. Mr. Morton waded out into the water and caught the fish to which the bug was still attached by its beak. He carried the fish back to camp and the bug did not release its hold until half way there. Mr. Morton

said there were so many skeletons of fish in this creek that they had hesitated to eat them, but after seeing this performance they no longer hesitated to eat them, thinking the waterbugs were the cause of the death of the fish. The stream was plentifully stocked with eastern brook trout and they had no trouble in getting a good string."

Lethocerus adults are strong fliers, and for this reason their distribution is quite general. Since these bugs are frequently taken at night it is likely they do most of their migrating at night. *Belostoma flumineum* Say, on the other hand is not taken at night. Leidy (1847) says both Lethocerus and Belostoma fly by night. In several years collecting the writer has never taken Belostoma at night although it has been taken on the wing during mid-day, far from any body of water.

Undoubtedly there is but one generation per year, although there is no assurance that the adults may not live over the second winter and lay eggs the second summer. If this were the case the potential damage of a pair of these bugs is indeed great. The writer would not be surprised to learn that many of the waterbugs produce eggs the second season. He now has specimens of *Velia watsoni* Drake which are over eighteen months old. These bugs produced eggs for a period of eight months last year and now after a winter rest of a few months, have again commenced laying eggs. There seems to be no reason why this species should not do the same in nature. It is true that in nature their food problem is not simple and enemies have to be reckoned with, but on the other hand they no doubt become inactive during the winter and perhaps age very little if any at this time. Those kept over winter in the laboratory (at room temperature) do not hibernate, consequently their greater activity probably shortens their lives. Further observations on this form are highly desirable.

The eggs of *Lethocerus americanus* Leidy have been searched for during the last two seasons but have not been found. The eggs of this species were first figured in 1868 (American Entomologist, Vol. I, pp. 61 and 62) as "The eggs of the Hellgrammite Fly." They were described as "oval, about the size of a radish seed, and of a pale color, with some dark markings. They are

usually deposited in a squarish patch upon reeds and other aquatic plants overhanging the water." This was an unsigned article, presumably written by the editors, Benjamin D. Walsh and Charles V. Riley. Very much the same account was published in the Fifth Missouri Report by Dr. Riley. The same figure was used but this time it was turned upside down. Packard in his "Guide to the Study of Insects" also published the account accompanied by the figure. Weed (1889) tells of finding a mass of Lethocerus eggs while collecting on the outskirts of Lansing, Michigan, July 3, 1882. He says, "I found a mass of eggs,..... beneath a board lying at the water's edge. The eggs gave evidence of having been freshly laid, and beside them was a living *Belostoma americanum*." In this connection an observation made by Professor Parker of Montana is of interest. He found giant waterbugs guarding their eggs on the bank of a small slough. His statement follows: "This was on June 11, 1921, at Ronan, Montana. The eggs were stuck to the grassy bank about a foot above the water. The slough was premanent, being one of the hundreds of pot-holes which dot the Flathead Indian Reservation. As I approached the eggs the male started for the water but was captured. The female assumed a fighting attitude with the front pair of legs extended and ready for action. Whenever anything was brought near her she struck viciously at it. Finally she was allowed to grab a stick and hung so tenaciously to this that I was able to shake her off into a cyanide bottle. The eggs were taken to Bozeman and hatched in the laboratory on the 15th of June. The young nymphs lived for about two weeks and then died." The writer has examined one of the adults and determined it as *Lethocerus americanus* Leidy.

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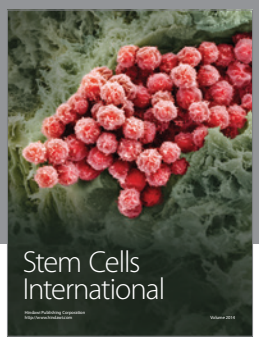

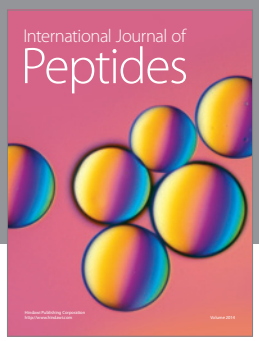

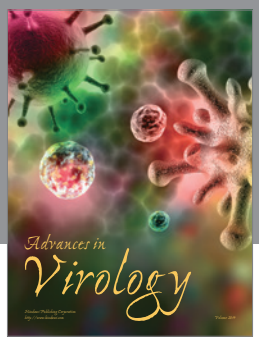

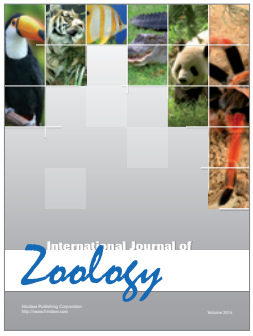

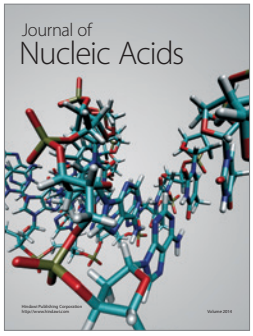

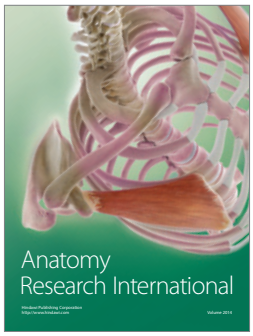

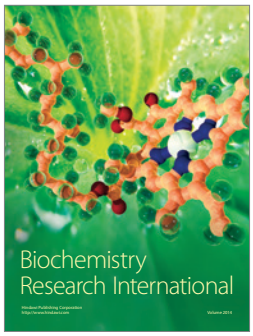

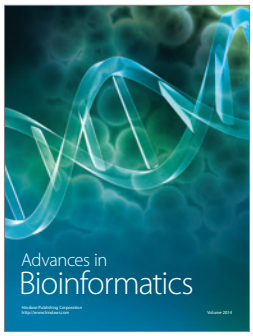

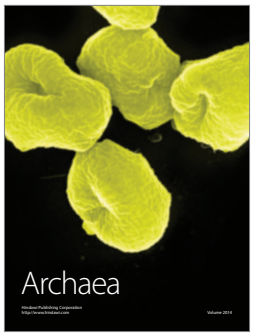

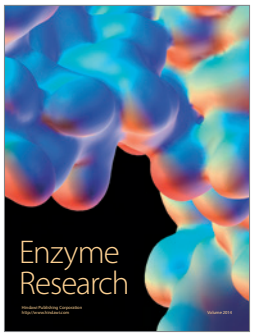

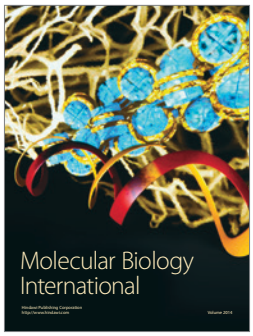

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