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MOLLUSKS OF KEWEENAW COUNTY, MICHIGAN

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THIS paper deals with a small collection of shells that was made by Mr. Norman A. Wood in the spring of 1931 in the course of ornithological studies upon Keweenaw Point, Keweenaw County, Michigan. The material is of special interest because (1) no written records exist concerning the molluscan fauna of the locality; (2) the rocks of the region are mostly of igneous origin and most of the cover is coniferous, both of which are ordinarily inimical to molluscan life; (3) some of the specimens show plainly the contrasting influences of an environment rich in lime and of one wherein lime is scarce. Mr. Wood took eight terrestrial species and subspecies, nine freshwater species and subspecies. An additional species, taken at Eagle Harbor west of where Mr. Wood collected, can be credited to the area. By way of comparison it may be recited that seventy-six forms of mollusks are recorded from Isle Royale (of Keweenaw County) and seventy-six from Ontonagon County. Thirteen land species, probably of quite casual collection, are mentioned by Dr. Bryant Walker as occurring in Houghton County, the first county south of Keweenaw.

In glacial Lake Algonquin time, Keweenaw Point was an elongated, triangular island that was cut off from the main-

land by a sound seven to fifteen miles wide that occupied the present Portage Lake depression. Isle Royale was then two islets of insignificant size. In the Nipissing Great Lakes period, the sound had narrowed to probably less than five miles wide. It was in Lake Algonquin time and that of the prolonged Nipissing Great Lakes that animal and plant life succeeded most in re-establishing itself in the glaciated area, and it is conceivable that the barrier of the present Portage Lake trough had something to do with the paucity today of mollusks on the Point.

On account of the thickness of the shells taken from Lakes Lily and Fanny Hooe and the extreme thinness of those living in adjacent Lake Superior waters, in one instance indicating a plentiful amount of lime and in the other a shortage of lime, it is perhaps of importance to try to trace the source of this essential shell-building material. The rocks of the Point are made up principally of "basic igneous lavas possibly including some basic intrusives" (Van Hise and Leith, 1911). Two series of rocks, one forming the north shore of the open lake at Copper Harbor and the other constituting a narrow bed about one mile back from the open lake, are upper Keweenawan sandstones and conglomerates. Lily Lake is a small body of water at the east end of Copper Harbor. It lies in a depression of the basic rocks. The south "walls" of Lake Fanny Hooe are the inner strip of conglomerates. An analysis of the unaltered diabase of the region, as given by Van Hise and Leith, shows a calcium-magnesia content of only .90 per cent. The same authors speak of the cementing material of the Calumet and Hecla conglomerate as made up largely of calcite and epidote, and it is this same conglomerate that occurs at Copper Harbor. No doubt, it is from these rocks that the lime is derived which permits the thick, healthy growth of *Elliptio complanatus* and *Lampsilis siliquoidea* in the two small lakes, and it seems likely that while Lily Lake is outside of the conglomerate area it derives some drainage from it. An analysis of Lake Superior waters that is given in F. W. Clarke's paper (1924) allows 13 parts of calcium per million parts of water,

the samples being taken at Sault Ste. Marie. The calcium runs to 26 parts in Lake Michigan at St. Ignace, 24 parts in Lake Huron at Port Huron and 33.3 parts in Lake Erie at Erie, Pennsylvania. The effect of a paucity of lime upon mollusks has been strikingly shown by Stephen G. Rich (1915), who found specimens of *Elliptio complanatus* in Maine that were so lacking in mineral matter that they could be cut with small shears. "This feature," he writes, "is quite obviously the result of the nature of the water in which the shells grow. There is no lime to be had save what little weathers out of the feldspar of the country rocks; as these are largely soda feldspars this amount is indeed small."

*Polygyra albolabris maritima* Pilsbry. Copper Harbor. Three specimens, having the average measurements of 14.15 mm. in height and 22.33 mm. in diameter. The shell in all three individuals is thin, and the lip, which in typical specimens is thick and broadly reflected, is thin and narrow. Dr. Bryant Walker made a special study of the races of the species in Michigan according to variations in size. He found the average size of what he called "major" races to be 19.44 by 29.26 mm. in the lower peninsula, 17.59 by 26.79 mm. in the upper peninsula. The "minor" races had an average of 14.04 by 22.18 mm. in the lower and 15.44 by 23.31 mm. in the upper peninsula. The average of the Isle Royale *albolabris* proved to be 17 by 25.86 mm. It will be observed that the Copper Harbor shells fall below all these averages. Dr. Walker's studies were carried on in 1908, and since then many lots of *albolabris* have reached him and the Museum of Zoology from the sandy regions of the state that, for many years, were accessible only with difficulty. It has become apparent from this material that variation in size is less inherent or racial than an environmental effect. The shells of the sandy areas appear to be invariably depauperate. Several factors may play a part in this. Food is unquestionably much scarcer than in the old forests of the loamy regions, and this would seem to include a want of calcium carbonate for shell-making purposes. Moisture-holding material is also scarce.

This would shorten the periods of activity and so influence the shell growth. A depauperate form of *albolabris* which inhabits the sandy coastal plain of southern New Jersey has been named variety *maritima* by Pilsbry. Walker's average for seven specimens of the variety from the type region is 15.6 mm. height by 22.7 mm. diameter. These measurements are nearer to those of the Copper Harbor shells than to Michigan measurements given in Dr. Walker's paper.

*Cochlicopa lubrica* (Müller). Copper Harbor. Twenty specimens from a rotten log. They have the characters and measurements that are given by Walker as typical. The apertures of two were tightly closed with an epiphragm, indicating that as late as May, when the shells were collected, some individuals are in the winter dormant stage. Walker's records suggest that the species is more common to the northern part of Michigan than to the southernmost tiers of counties. Ruthven (1904) reports variety *morseana* Doherty from Ontonagon County. It apparently occurs nowhere else in the state.

*Vitrina limpida* Gould. Copper Harbor. Thirteen specimens. A boreal species that in Michigan is confined to the upper peninsula and the northern part of the lower peninsula. It is reported from Isle Royale and Ontonagon and Chippewa counties, but not from Houghton County.

*Vitrea indentata* (Say). Copper Harbor. Fragment of a single specimen that is recognizable by the indented radiating lines. The species is on Ruthven's Ontonagon County list, but not on the lists for Houghton County and Isle Royale.

*Euconulus chersinus polygyratus* (Pilsbry). Copper Harbor. The four specimens collected have the six whorls and the angled body whorls which are prescribed for the subspecies. The form has been taken in Ontonagon and Houghton counties and upon Isle Royale. Walker speaks of it as "of general distribution in both peninsulas."

*Anguispira alternata* (Say). Copper Harbor. The sixty-six specimens that were taken by Mr. Wood have the typical color markings. No albinos occurred in the lot. The four largest measure:

Height	Diameter
12.75 mm.	19.50 mm.
10.75	18
11	17.25
10	16.50

Along the shores of the Great Lakes, and especially upon the lake islands, a form of this species occurs which has a greater height in proportion to diameter than forms of the interior. I am inclined to think that this is owing to the greater amount of moisture in the air in such situations, which permits a greater amount of living in the open and that, because of this, growth is vertical rather than horizontal as in the case of mollusks in confined quarters under logs. Two of the Copper Harbor specimens are of this supra-littoral form.

*Gonyodiscus cronkhitei catskillensis* (Pilsbry). Copper Harbor. The nine specimens are lighter in color than is usual, but are otherwise typical. The form has been differentiated from the subspecies *anthonyi* (Pilsbry) by reason of its wider umbilicus and angled periphery. *Anthonyi* is common in damp situations throughout the lower peninsula. Walker noted its absence from the upper peninsula with the exception of Isle Royale, the northern Michigan form being *catskillensis*.

*Zonitoides arborea* (Say). Copper Harbor. About two hundred specimens were taken from a decaying log. These shells were more depressed than the typical or common form which itself is ordinarily flattened. The sutures are deep. Only old specimens show the revolving lines that are mentioned as a constant character of the species. The three largest examples measure:

Height	Diameter
2.50 mm.	5.25 mm.
2	5.12
2	5

Walker gives 2.75 by 5 mm. as the average size of Michigan specimens.

*Lymnaea stagnalis sanctamariae* Walker. From trap rocks in the eastern bay of Copper Harbor. Fourteen specimens.

These are thinner and more delicate than the usual examples of this subspecies, and the epidermis is roughened by wave action as is the case with shells of the species which the Museum of Zoology has from Isle Royale. The largest shells have attained only to the fifth whorl, beyond which the peculiarities of this subspecies are developed. One example, however, shows the beginning of the shouldered body whorl and provides a definite determination of the material. The thinness, as mentioned earlier, is undoubtedly correlated with the low content of calcium carbonate in Lake Superior waters.

*Lymnaea emarginata* Say. Associated with *L. stagnalis sanctamariae*. Only three specimens were found. The form corresponds exactly with that of *emarginata* from Tobin Harbor, Isle Royale.

*Lymnaea apicina* Lea. In rock pools worn in the trap at Eagle Harbor. About forty specimens were taken at this place by the writer in 1929. F. C. Baker (1911) figures individuals of the species from Lake Superior and four rivers of the upper peninsula of Michigan. It is noticeable that the lake shells are decidedly thinner than those from the streams.

*Physa sayii* Tappan. Associated with the two species of *Lymnaea* in Copper Harbor. Forty-three specimens were taken by Mr. Wood, the two largest measuring 21 mm. in height and 12 mm. in diameter, 20 mm. height and 12 mm. diameter. Except that even the oldest specimens are extremely thin, there is no appreciable difference between these shells and examples of the species that occur in most of the inland lakes of Michigan which have not passed into the marsh or bog stage. A single specimen, measuring 14.25 by 8 mm., was collected in Lake Fanny Hooe. The last whorl is shouldered more than is usual, but not to the extent it is in *P. ancillaria* Say. The species occurs also in Eagle Harbor.

*Physa gyrina* Say. Lily Lake. One specimen. The shell has the wrinkled microscopic sculpture and the flattened body whorl of the species as it occurs in weedy ponds, warm pools, and small streams of southern Michigan.

*Campeloma rufum* (Haldeman). Twenty-eight specimens from Lake Fanny Hooe and three from Lily Lake. The mate-

rial is alike except that two of the Lily Lake shells are larger than any from Lake Fanny Hooe. Two of the three Lily Lake mollusks have distinct varicoses which are rather remarkable for numbers and their closeness to one another. In one shell there are nine of these dark, vertical lines. The first and second are  $1\frac{1}{2}$  mm. apart. The spacing increases until it is  $11\frac{1}{4}$  mm. between the sixth and seventh varicoses. It decreases to  $9\frac{1}{2}$  mm. between the seventh and eighth line and increases to  $13\frac{1}{2}$  mm. between the eighth and ninth. Such marks are supposed to register checks in growth or periods of rest. In the case of these specimens, drought, food shortage, and high summer heat as well as winter freezing may be the factors that compelled irregularities of growth. The name *rufum* is here used because it is the one which is commonly applied to the thin form of *Campeloma* with reddish aperture that occurs in innumerable inland lakes of the state. It seems likely, however, that most of the species which are credited to Michigan have actually no differences among them that can be termed specific.

*Anodonta grandis footiana* Lea. Three specimens from Lily Lake, two from Lake Fanny Hooe. All these bivalves have been badly parasitized, causing a discoloration of the nacre and the formation in it of irregular pustules and ridges. The largest Lily Lake specimen measures 65 mm. in length, 32 mm. in height, and 21 mm. in breadth. The shells have the fragile character which is usual with *Anodonta* in the upper peninsula. A dark, rough individual from Lake Fanny Hooe has the hinge line and base nearly straight and parallel, besides a distinct posterior ridge. Since it resembles a western form of *Anodonta* the shell might, with some justice, have been considered a subspecies new to the state. But the second specimen is typical. The fact that *footiana* in Saginaw Bay has a tendency to develop a straight base, and even in instances one that is arcuate, may be taken to indicate that the Lake Fanny Hooe specimen is only an unusual mutation.

*Anodonta marginata* Say. One specimen from Mosquito Lake.

*Lampsilis siliquoides* (Barnes). Two male and four female specimens from Lake Fanny Hooe. The largest male is 87 mm. in length, 43 mm. in height, and 23.50 mm. in breadth. One is conspicuously rayed, the other without rays. The largest female is 62 mm. in length, 31.50 in height across the marsupial swelling, and 15.25 in breadth. It is customary to assign the *siliquoides* of the small lakes to subspecies *rosacea* DeKay. But the Fanny Hooe examples are quite like stream forms in shape and size, and have the bluish-white nacre of such shells rather than the reddish nacre on account of which the name *rosacea* was devised.

*Elliptio complanatus* (Dillwyn). Lily Lake. Four of the five specimens are extraordinarily large and heavy for the species as it occurs in Michigan, and are, indeed, more suggestive of the allied *E. hopetonensis* Lea of southeastern Georgia than of any form of *complanatus* of the north. The five measure:

Length	Height	Breadth
110 mm.	54.5 mm.	28 mm.
106	51.5	30
98	47	23
92.5	53	25
75	30	13

The largest have the purple nacre of *E. crassidens* Lamarek and are only a little marked with the liver-colored blotches that are common to the species. The nacre is irregularly indented, the shallow indentations corresponding to "bruises" on the surface of the shell. The youngest specimen is not deformed in this manner. Assuming that the darker rest scars represent the quiescent stage of winter, the largest specimen is six or seven years old. *E. complanatus* occurs in Luce, Chippewa, Alger, Houghton, Keweenaw, and Schoolcraft counties, all of the upper peninsula. Baker (1928) makes mention of a specimen in the Marston collection that is labelled as from Lake Superior. The species is believed by Walker (1913) to have come into the upper Great Lakes region from the east in Lake Algonquin time through the Trent River discharge.



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PLATE I

*Elliptio complanatus* (Dillwyn). Lily Lake, Keweenaw County, Michigan. The lower figure is of the form and size of virtually all the specimens of this species that hitherto have been found in Michigan.







