Other, smaller lots of coastal plain oxylomas show less over-all variation than this one. Unfortunately, insufficient numbers of specimens are available for a thorough study of these phenomena of variation.

Incidentally, a single lot of *Catinella hubrichti* Grimm (1960) from Caroline Co., Md., shows as much variation in shell form as the above discussed *Oxyloma:* the shells ranging in form from that of *Oxyloma decampi gouldi* through that of *O. effusa.*

The following are additional Maryland localities for *Catinella;* see Grimm (1960):

Catinella hubrichti. Mud flats near bridge at Hunting Creek, Caroline Co., near Dorchester Co. line (April 13, 1957). Margin of Big Mill Pond, Swanscut Creek at Welbourne, Worcester Co. (March 27, 1960).

Catinella pinicola. Bald Friar, on the Susquehanna R., Cecil Co. (Nov. 1, 1958). River Road along Susquehanna north of Glen Cove, Harford Co. (Nov. 22, 1958). Near bridge at Mill Branch, 1 mile south of Mardela Springs, Wicomico Co. (March 26, 1960). Dump near valley of Wagram Swamp Branch, 3 miles southsoutheast of Pocomoke City, Worcester Co. (March 27, 1960). Approx. 1 mile west of George Isl. Landing and 2 miles east of Stockton, Worcester Co. (March 27, 1960). Boxiron Creek at bridge, Boxiron, Worcester Co. (March 27, 1960).

Catinella vermeta. Baltimore, Harford, and Caroline Counties.

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THE UNIONIDAE OF OTTAWA COUNTY, MICHIGAN

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Ottawa County, Michigan, is located along the shore of Lake Michigan on the western edge of the lower peninsula. It contains the lower reaches and mouth of the present Grand River which formerly played a major role in the drainage of glacial waters. Several studies of Michigan unionids have dealt with those species of this stream and its tributaries. Coker, et.al.

(1921), listed 22 naiades between Grand Rapids, just east of the Ottawa-Kent County boundary, and Grand Haven at the mouth of the Grand River. Van der Schalie (1941) reported 16 unionids in the Grand River and its tributaries in Ottawa County, while recording 29 species for the entire drainage. In a later study (1948), designed to determine the degree of depletion in the Grand River, he again discussed the naiades of the stream, reporting 17 species.

All specimens on which this report is based are in the collections of the Mollusk Division of the University of Michigan Museum of Zoology. This study was undertaken (1) to compile a list of the highly varied mussel fauna of Ottawa County, and (2) to investigate the present mussel resources of the area in the light of factors which tend to deplete or destroy them, such as clamming for button factories, dredging of the stream channel, and pollution. The assistance of Dr. Henry van der Schalie in making taxonomic determinations and in reviewing the manuscript is gratefully acknowledged.

A list of the extensive naiad fauna of Ottawa County follows. Subspecific designations were used sparingly because most of them represent ecological forms rather than true varieties. For example, *Anodonta grandis footiana* and *A. g. gigantea* were lumped with *A. grandis*. In the following list, it is interesting to note that the fauna is well represented in all three subfamilies of the Unionidae.

UNIONINAE
Amblema costata
Amblema peruviana
Cyclonaias tuberculata
Elliptio dilatatus
Fusconaia flava
Fusconaia undata
Pleurobema cordatum coccineum
Quadrula pustulosa
Quadrula quadrula

ANODONTINAE
Alasmidonta calceolus
Alasmidonta marginata
Anodonta grandis
Anodonta marginata
Anodontoides ferussacianus
Lasmigona complanata
Lasmigona compressa
Lasmigona costata
Strophitus rugosus

LAMPSILINAE
Actinonaias carinata
Actinonaias ellipsiformis
Carunculina parva
Lampsilis siliquoidea
Lampsilis ventricosa
Leptodea fragilis
Leptodea laevissima
Ligumia recta latissima
Micromya iris
Obliquaria reflexa
Obovaria olivaria
Proptera alata
Truncilla donaciformis
Truncilla truncata

Several reports have stressed that there is an increasing number of mollusk species as one proceeds from the headwaters of a stream toward its mouth. The collections considered here are in accordance with this view. Consequently, the streams are arranged according to their size, and the species of mussels are given according to their ecological distribution.

Crockery Creek, Rush Creek, and Sand Creek are tributaries of the Grand River and may be considered to be small streams. Since they are tributary to the Grand River in its lower reaches rather than in the headwaters, a few species such as *Quadrula pustulosa* and *Actinonaias carinata* enter these small streams. Ordinarily these species are associated with larger rivers. These tributaries were found to harbor the following species:

Amblema costata
Elliptio dilatatus
Fusconaia flava
Quadrula pustulosa
Alasmidonta calceolus
Anodonta grandis
Anodontoides ferussacianus
Lasmigona complanata
Lasmigona compressa
Strophitus rugosus
Actinonaias carinata
Actinonaias ellipsiformis
Lampsilis siliquoidea
Lampsilis ventricosa
Leptodea fragilis
Micromya iris
Proptera alata

In the Black River, a medium-sized stream, are found:

Amblema costata
Elliptio dilatatus
Fusconaia flava
Quadrula quadrula
Anodonta grandis
Anodontoides ferussacianus
Strophitus rugosus
Carunculina parva
Lampsilis siliquoidea
Lampsilis ventricosa
Leptodea fragilis
Proptera alata
Truncilla truncata

Present in the Grand River, the only large-sized stream in the county, are 24 species:

Amblema costata
Amblema peruviana
Strophitus rugosus
Actinonaias carinata
Cyclonaias tuberculata
Elliptio dilatatus
Fusconaia undata
Pleurobema cordatum coccineum
Quadrula pustulosa
Quadrula quadrula*
Alasmidonta marginata
Anodonta grandis
Lasmigona complanata*
Lasmigona costata
Lampsilis siliquoidea
Lampsilis ventricosa
Leptodea fragilis*
Leptodea laevissima
Ligumia recta latissima
Obliquaria reflexa*
Obovaria olivaria*

Proptera alata*
Truncilla donaciformis*
Truncilla truncata*

Lentic, or standing water, habitats in Ottawa County support 10 species:

Amblema costata
Amblema peruviana
Fusconaia undata
Anodonta grandis
Anodonta marginata
Lasmigona complanata
Lampsilis siliquoidea
Lampsilis ventricosa
Leptodea fragilis
Proptera alata

This Ottawa County faunal list contains 21 genera and 32 species. Specimens of these different species are not all equally common; and even the more common species must be considered less abundant than they formerly were. The serious depletion of the mussel fauna can be traced to three major factors: clamming for the pearl button industries, dredging, and pollution.

The Grand River was one of the major sites of Michigan button industries (van der Schalie, 1948), and a button factory formerly existed in Ottawa County at the village of Lamont.

Eleven species of naiades have been listed by van der Schalie (1938, 1948) as commercially valuable in the manufacture of buttons:

Amblema costata
Elliptio dilatatus (if white)
Fusconaia flava
Pleurobema cordatum coccineum
Quadrula pustulosa
Quadrula quadrula
Strophitus rugosus
Actinonaias carinata
Lampsilis siliquoidea
Lampsilis ventricosa
Ligumia recta latissima

Two species groups show intergradation between their ecologically upstream and downstream counterparts within the same genus. *Amblema costata* and *Fusconaia flava*, normally associated with upstream areas or small tributaries, have counterparts in larger streams in *A. peruviana* and *F. undata* respectively. Further investigations must be undertaken to define clearly the taxonomic status of these nominal species. *A. peruviana* may be added, for the present, to the preceding list of commercially valuable naiades, which all occur or have occured in Ottawa County in the Grand River. The most abundant mussels are *Amblema peruviana, Quadrula pustulosa* and *Actinonaias*

*Gained entry into the lower portions of the Grand River from Lake Michigan (van der Schalie, 1941).

carinata, which all have heavy shells and provide excellent button material. Published reports of large mounds of discarded valves made by the button factories act as testimony to the significance of these clamming operations in the depletion of the mussel resources and the subsequent abandonment of this industry.

The basin of the Grand River in Ottawa County has been dredged frequently in recent years to facilitate the passage of gravel ships and pleasure craft. The dredged materials are deposited on the banks. This operation destroys all the unionids captured with the substrate, and it severely damages the mussel beds.

Pollution has increased greatly in recent years. The lower portions of the Grand River carry much of the industrial waste of Grand Rapids. More recently, sodium arsenite has been used commonly to destroy aquatic algae, and this chemical is proving very harmful to the bottom fauna.

The combined effects of clamming, dredging, and pollution have greatly depleted the mussel populations of Ottawa County. If one examines the dredged materials on the banks of the Grand River, there is found a conspicuous scarcity of juvenile naiades. Moreover, most of the shells are extensively eroded. Evidently the mussel populations are not being replaced. Shells of adults of only the following three species consistently had an intact periostracum and showed no algal or mineral encrustations: *Anodonta grandis*, *Lasmigona complanata*, and *Leptodea fragilis*. The shells in the collections of the three most abundant species, however, were so badly weathered and eroded as to indicate that they no longer live in this portion of the drainage system.

In addition to its tributaries, the Grand River in Ottawa County contains several long, narrow bayous at right angles to the stream. More intensive collecting may well reveal living naiades which are essentially limited to these relatively unadulterated areas.

This report emphasizes a widespread trend, indicating that the native American mussel fauna is changing rapidly under the influence of human activities. With the cessation of the button industry, there has been little active interest in this mollusk group, and in the face of the alterations of natural conditions,

information bearing on the biology of naiades will become increasingly more difficult to obtain.

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A NEW RECORD FOR THE ASIATIC CLAM IN THE UNITED STATES, THE TENNESSEE RIVER

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Examination of Petersen dredge samples, made by Messrs. Harold N. Mullican, Billy G. Isom, and the senior author on October 21, 1959, below Pickwick Dam, on a preliminary study to gather baseline data on Kentucky Lake, revealed large numbers of the Asiatic clam, *Corbicula fluminea* (Plate 7). Indentification was confirmed by comparison with specimens from Bonneville Dam, Oregon, which are housed in the United States National Museum. The Pickwick collections represent a remarkable extension of the range for this mollusk which was heretofore known in the United States only from collections made in western states, i.e., Arizona, California, Idaho, Nevada, Oregon, and Washington, Ingram (1948), (1959), Dundee and Dundee (1958). Ingram (1959) discussed this clam as a potential and actual pest in potable and in irrigation water supplies. One can only speculate as to the mode of transportation of this native of Asia; however, a likely theory would first incriminate the dumping of aquaria and fish bowls that contained introduced "aquaria rarities."

Station Locations. Clams were taken at three stations below Pickwick dam (mile 206.7) on the Tennessee River in Hardin

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