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THE FRESH-WATER MUSSELS OF ILLINOIS

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Paul W. Parmalee

ILLINOIS STATE MUSEUM

**Popular Science Series
Vol. VIII**

Cyprogenia irrorata
(Fan-Shell)

Quadrula cylindrica
(Rabbit's Foot)

Lampsilis anodontoides
(Yellow Sand-Shell)

Obliquaria reflexa
(Three-Horned Warty-Back)

Truncilla truncata
(Deer-Toe)

Leptodea fragilis
(Fragile Paper Shell)

Dysnomia triquetra
(Snuffbox)

Dysnomia perplexa

Lampsilis fasciola

Plagiola lineolata
(Butterfly)

Quadrula metanevra
(Monkey-Face)

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POPULAR SCIENCE SERIES, VOL. VIII

THE FRESH-WATER MUSSELS OF ILLINOIS

by
Paul W. Parmalee

Printed by Authority of the State of Illinois

Springfield, Illinois
1967

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July 1967

PAUL W. PARMALEE

THE FRESH-WATER MUSSELS OF ILLINOIS

INTRODUCTION

Historic and Economic Background

A variety of species of fresh-water mussels, or naiads, have inhabited the major rivers of Illinois since the end of the last glaciation, for at least 8,000 to 10,000 years. These relatively primitive, soft-bodied animals were used as food by prehistoric Indians, and the discarded shells or valves may be found in the midden debris at most aboriginal camps and village sites. These shell heaps are often indicative of the abundance of mussels that formerly lived in a particular river, lake or stream, and the varieties present reflect the type of aquatic habitat from which they had been collected.

The valves, themselves, were occasionally used by the Indians for the purpose of making utensils (spoons), ornaments (gorgets and beads) and tools (hoes). Pearls, which may be produced by nearly all the various species that inhabit the rivers of North America, were apparently prized by the Indian. Quantities of pearls have been found with aboriginal burials uncovered in the Midwest; they were drilled, strung and usually worn as necklaces. Judging from their position in relation to the skeleton, some pearls were apparently sewn to clothing. Bear canine teeth—highly prized as trophies or ornaments—have been found with pearls imbedded in holes, drilled for that purpose, in the tooth root. Many of the earliest explorers to reach this continent—Vespucci, Cabot, de Narvaez, Ponce de Leon, Cortez—found the natives using pearls (most, apparently, from salt-water oysters) for ornamentation. Father Louis Hennepin stated that Indians along the Mississippi River wore bracelets and earrings of fine pearls, and one of the earliest and most famous explorers, Christopher Columbus, found the Indians wearing numbers of fresh-water pearls.

If the early European explorers who settled in Illinois made use of the bountiful quantities of fresh-water mussels, there is apparently no written record of it. Illinois achieved statehood in 1818 and by 1900 had become one of the most important industrial as well as agricultural states in the nation. It was just prior to the turn of the century when a new river industry evolved in America which was destined to become highly important in Illinois. In 1887, a German pearl-button maker by the name of J. F. Boepple immigrated to the United States and started a multi-million dollar industry, utilizing the almost valueless creature, the fresh-water mussel.

Mr. Boepple eventually settled in Muscatine, Iowa, the city that became, and remained, the center of the pearl button industry in the United States until about 1955. From the beginning, it was realized that the seemingly endless supply of shells, whose beautiful luster and durability will withstand even the severest laundering, would provide the raw material for a new and significant industry in America. In 1912 there were nearly 200 plants in the United States utilizing valves of fresh-water mussels for the manufacture of buttons, the sale of which amounted to almost \$6,200,000. The annual sale of pearls and barques ("slugs" of irregular shape but of high luster and prized for costume jewelry) averaged \$300,000. Within the next fifteen years, the industry grew tremendously; between 40,000 and 60,000 tons of raw shell were being taken yearly, selling for an estimated value of nearly a million dollars. The rivers of Illinois—the Fox, Rock, Illinois, Sangamon, Ohio, Wabash and the Mississippi—supplied a significant portion of the fresh-water mussels used in the pearl button industry.

Methods of collecting and handling mussels have changed little since the industry's beginning in the early 1890's. Probably 75 per cent of the mussels collected in most large rivers are taken with an apparatus known as the crow-foot dredge (Plate 1). A typical dredge consists of a 10- to 18-foot-long piece of one-inch pipe with a large number of four-pronged hooks (Plate 3) suspended from it by heavy cord. Most mussel fishermen use a flat-bottomed "John" boat, and as the boat drifts with the current across the mussel beds, the dredge is dragged along the bottom. When a prong of a hook touches or lodges in the soft parts of the mussel, which is partially imbedded in the bottom with the shell open slightly, the valves instantly clamp shut on the prong. Since the hooks—sometimes as many as 100-200 making up a single dredge—serve to anchor the boat, a "mule" is often employed as an underwater sail. Most of these "mules" are simply a piece of canvas stretched loosely on a wooden frame and submerged beneath the boat; current pushing against the mule serves to propel the boat.

Mussels are also taken with various types of many-pronged forks, shoulder rakes, dredges and rake-like tongs. One style of dredge consists of a dip net bag attached to a stout rake which collects and holds the mussels as they are raked loose from the bottom. In smaller streams and in shallow riffles of the larger rivers (or in low water stages), mussels are simply picked up by hand. Recently the use of scuba gear has been employed for hand picking at greater depths.

Camp sites operated by mussel fishermen normally have one to several "cookers" for killing and relaxing the clams. These are usually about five feet long, two feet wide, 12 to 18 inches deep, with wooden sides and a metal bottom (Plate 2). The unit is built over a shallow pit or elevated on blocks, where a fire is maintained under it to heat the bottom of the cooker. A small quantity of water is placed in the cooker with the mussels and the top is covered with burlap or a wooden lid; the clams are steamed open, a process which takes only 20 or 30 minutes. The soft parts of the animal are then removed, usually by hand (and searched for pearls), and the shells are stacked in piles according to species. Shells of medium thickness and with a white,

PLATE 1. Several "John" boats with crowfoot dredges on the Illinois River at Pearl, Illinois.

PLATE 2. "Cooker" (left) for steaming mussels, and sorting table (right) where the mussel is removed from the shell.

pearly nacre (the pimple-backs, yellow sand-shell or banana-shell, pig-toe, blue-point and mucket) brought the best price per ton. Shells were sold either to traveling buyers or direct to the factories and shipped by rail or river barge.

After the shells arrived at the factory, they were sorted first according to species, then to size. They were then sent to the cutting machines where the disks or "blanks" (Plate 3) were cut out by a hollow cylinder-type bit or hole saw. Waste and scrap shell was sometimes crushed and sold for poultry grit and lime, or the drilled valves were used for road fill. The blanks were placed in slowly revolving tumblers—oval, cast-iron drums—and the friction of the blanks rubbing on each other made the rough edges smooth. The blanks were then ground (on special grinding machines) to a uniform thickness; this process was followed by several days of soaking in water to prepare them for shaping, patterning, and drilling the eyes. The final process included polishing in wooden bucket-tumblers, in which the buttons were placed first with pumice, then with a weak acid, and finally with a dry hardwood sawdust.

Development and refinement of plastics following World War II spelled the beginning of the end for this unique and profitable industry. By the mid 1960's, the last pearl button factory at Muscatine closed, thus representing the finish to a multi-million dollar industry that flourished in Illinois and the Midwest for almost 75 years. The pearl button industry could no longer compete with the quality and the low cost of production of plastic buttons.

An unexpected and rather unusual need for the shells of the fresh-water mussel came into being about 1960. In contrast to making pearl buttons at local factories, the shells are being shipped to Japan for use in the cultured pearl industry, where there now (1966-67) exist over 300 sea farms devoted to the production of cultured pearls in oysters. In Japan, the fresh-water mussel shells are cut up and ground into small, round pellets (about 7 mm. in diameter) that are inserted along the inner shell margin of the oyster. Objects introduced naturally, or in this artificial manner, produce an irritation to the oyster. In order to lessen this condition, the oyster responds by secreting nacre (the mother-of-pearl material forming the normal shell) around an introduced object, thus producing a pearl. Pellets cut from mussel shell are especially preferred because of their hardness and because the resulting pearl is composed entirely of nacre.

The quantity of mussels found in the rivers from Wisconsin to Alabama, and the degree of hardness of their shells, is equaled almost nowhere else in the world. The new use of mussel shells—this time the bigger, thick-shelled species such as the washboard, large pimple-backs and blue-points being especially preferred—has revived the mussel fishing industry. The once-familiar flat-bottomed "John" boats with their crowfoot dredges are rapidly reappearing along the major rivers—especially along the lower Wabash River where mussels attain greatest size, purest color, and maximum degree of hardness. How long this new market will last and how long the mussel beds can survive the intensive fishing which they are now experiencing are questions that will only be answered in the future. Although this revival of the mussel fishing industry is a boon to many, careful management and conservation of the beds must be maintained in order to provide a continuing source of shell.

PLATE 3. Upper left: types of mussel hooks attached to crowfoot dredges. Upper right: drilled valves. Right center: on black background, pearls and baroque (left) and blanks (right); drill bits. Bottom: Salesman's sample board of pearl buttons.

Structure, Development and Growth

Fresh-water mussels belong to a large and diversified group of animals that are placed by biologists, because they all possess certain similar structures or characteristics, into the group or Phylum Mollusca, the mollusks. Included in this major phylum are the chitons, tusk shells, snails, slugs, conchs, nautili, squids, octopuses, clams, oysters and mussels. The last three types are included in the separate Class Pelecypoda (within the Phylum Mollusca) because they all possess a soft body that is enclosed by a shell of two parts. Because of these two separate shells or valves, the animals are commonly referred to as "bivalves."

A detailed description of the structure and function of the "soft parts" or body, although often of significance in determining relationships among the different species, will not be presented here. This aspect of the mussel's structure is of special interest to the anatomist and taxonomist, but most individuals who collect and study the shells are concerned only with its structure and appearance. Usually similarities observed in the structure of shells of closely related species are present in their soft parts as well. However, two closely related species—classified on the basis of similar internal structure—may produce shells altogether different in appearance.

The body of a fresh-water mussel consists of a thickened, central mass that is attached to the dorsal or "top" of the paired valves and contains various organs. The forward, ventral or "bottom" part of the body forms the muscular "foot." On each side of these hang a thin double gill and, outside of these, thin sheets of tissue (the mantle) that adhere to the inner surfaces of the shells (Figure 1). Compared with some of the more advanced groups of animals such as fish and amphibians, the digestive, circulatory, reproductive and nervous systems found in the mussel are fairly simple. At the posterior or back end of the body, two tubes or siphons are present through which water is brought in (incurrent siphon) and expelled (excurrent siphon). Oxygen is removed from the water, mainly in the gills; food, which consists of microorganisms (protozoans or single-celled animals, bacteria, diatoms) and organic particles suspended in the water, is gradually transferred from the incurrent siphon to the gills, then to the "mouth" and finally to the stomach.

The adult fresh-water mussel lives its entire life partly embedded in the bottom of some body of permanent (standing) water; in Illinois, they are active mostly during the warm months. Moving about is slowly accomplished by extending the foot between the valves or shells; extension of the foot causes it to wedge into bottom materials and then the body is pulled along by contraction of these foot muscles. During periods of rest or inactivity, the mussel remains partially embedded—the depth often depends on the particular species, water temperature, current and the like—with the valves slightly spread and the posterior or back end of the shell (and siphons) exposed. Scars on the inner surface of each valve (Figure 2) indicate points of muscle attachment. The largest are the anterior (front) and posterior (rear) adductor muscles which draw the valves together. Anterior and posterior retractor muscles draw the foot into the shell, while the anterior protractor muscle helps to extend the foot.

FIGURE 1. A diagrammatic illustration of a fresh-water mussel: (A) Internal structure as seen with shell, mantle, gill of left side removed. (B) Cross section through the heart region. From *General Zoology* by Storer and Usinger, 3rd edition, 1957; used by permission of McGraw-Hill Book Company.

FIGURE 2. A diagrammatic illustration of a left valve of a fresh-water mussel, showing names and locations of the basic, diagnostic structures.

In the fresh-water mussels, the sexes are usually separate; not only are the reproductive systems distinct, but in many species the shells of females vary in shape from those of males. The posterior section of the valves of females are often more swollen and rounded. This is a compensation, at least in part, for the gills which become enlarged and distended when filled with developing eggs and young. Sperm, the male sex cells, are released into the water; these are taken into the female's body through the incurrent siphon, and then carried to tubes in the gills where the eggs, having been previously discharged from the ovaries, are fertilized. The gills now serve as brood pouches as well as respiratory organs.

Development of a fresh-water mussel from the fertilized egg is unique, since one stage of growth of the young—called glochidia—must usually take place on the skin, gills or fins of a fish (or in one species, on an aquatic salamander). Four distinct stages (Figure 3) can be recognized in the growth of a mussel: (1) the fertilized egg; (2) the young or glochidium in the brood pouch (gill) of the female mussel; (3) the parasitic stage on a fish or salamander; and (4) the free-living stage with a completely formed shell.

Within the brood pouch or gill, the fertilized eggs develop into small larvae or young, the glochidia, which are typically rounded or oval. They possess only the embryonic stages of a mouth, intestines, heart and foot when they are discharged through the excurrent siphon into the water. If these young are not taken in through the mouth of a passing fish and attached to its gills, they fall to the bottom where they lie with their two shell valves open. Many may be scattered considerable distances by the current, but all must attach themselves to a host or they will die in a short time. Glochidia of some species of mussels possess a hook on the margin of each valve, and it is with these that the young assure attachment to the fish with which they come in contact.

FIGURE 3. A diagrammatic illustration of the life cycle (A) of a fresh-water mussel. (B) Female with outer gill modified as a brood sac. (C) A glochidium. (D) Enclosure of glochidia on the gill of a fish. (E) Glochidia on a gill filament. C-E greatly enlarged. From *General Zoology* by Storer and Usinger, 3rd edition, 1957; used by permission of McGraw-Hill Book Company.

During the parasitic stage, each glochidium remains embedded in the tissues of the host fish, changing little in size but developing many of the adult organs and structures. The length of time the glochidia remain embedded depends on the species of host fish, place of attachment, and temperature of the water; this stage may last slightly over one week, or as long as six weeks. Although each female mussel bears a very large number of glochidia, thus insuring continuation of the species, a large proportion fail to pass through the parasitic stage and, consequently, die. Studies have shown that glochidia from a particular species of mussel react to, or will parasitize, only one species of fish, while certain kinds of fish may serve as host for several species of mussels. Normally, most infestations of glochidia are light and apparently do not harm or cause injury to the host fish.

Upon completion of its parasitic stage, the young mussel breaks through the tissue of the fish and falls to the bottom where it begins an independent life. With adult structures being formed, including a small shell, the animal begins its growth to adulthood.

The shape, size, thickness and color of the shell varies enormously among species of fresh-water mussels found in Illinois, but basic structure and method of shell formation is the same for all. The shell has two parts, a right and left valve, held together by a dorsal ligament. Each valve is made up of three layers. (1) The external, or outside, horny covering is a thin epidermis or periostracum that protects the limey parts beneath it from injurious leaching action of carbonic acid in the water. Should this periostracum layer wear thin or completely away in spots, which often happens in the inflated dorsal area (umbo) of old individuals, the shell in these exposed areas becomes pitted or corroded. Variations in the color of this outer covering range from light yellow, through green to brown or black; shells of many species are patterned with irregular-shaped markings or rays. The color and pattern are important characteristics used in identifying many species. (2) Occurring beneath the epidermis or periostracum is a thin, calcareous layer composed of vertical prisms of calcium carbonate. (3) The third layer, constituting the major portion of the shell, is referred to as the nacreous or mother-of-pearl layer. It consists of a large series of thin, calcium carbonate plates that lie one upon another and parallel to the surface of the shell.

Some workers recognize a fourth inner layer called the hypostracum; in many species this inner layer is often iridescent. The nacre or mother-of-pearl varies from a pure silvery-white, through shades of pink to dark purple; in a few species, it is a light salmon. The two outer shell layers are secreted by glands in the edge of the mantle, while the nacre, the inner layer, is produced by the entire surface of the mantle. Growth of the shell *in area* is effected by the addition of material around the margin and *in thickness* by successive deposits of nacre over the shell's entire inner surface.

The outer surface of the shell of many kinds of mussels is completely smooth; shells of some groups or species, on the other hand, possess knobs, pustules, wrinkles, folds, or other configurations. Often the size, combination, or arrangement of these structures is diagnostic of a particular species as are

the ridges or loops on the beaks (see Plates 33, 34, 35). The prominent, often raised, and/or darker concentric lines or rings on the surface of a valve indicate rest periods or stages when little or no growth took place. These lines or rings often result during the resting stage in winter, in periods of low water, or from some physical disturbance or other adverse condition. Occasionally deformed or pathologic (diseased) valves are encountered, most of which are largely the result of mechanical injuries. Mud frequently gets in between the shell and mantle; the mantle then secretes a thin film of shell material over the mud, thus forming a blister on the inner surface of the valve. More rarely, a shell may be so severely injured that the parts of the valve, or both valves, will continue to grow but produce a distortion in the typical shape of the mussel.

Generally, species characteristics of medium-sized and large rivers, or those living in swift current in small streams, develop thick shells, a heavier type of hinge teeth, and have the muscle scar areas deeply impressed. On the other hand, typical pond, lake or quiet water species are thin-shelled, muscle scars are shallow, and often the valves "gape" or do not completely close at one or both ends (for example, in species of Paper Shells, *Leptodea*).

Ecology of Fresh-water Mussels

The ecology of the mussels in Illinois, the relationship of these mollusks to their environment, is particularly interesting because, for one reason, Illinois possesses a great variety of large and small rivers, ponds, sloughs, and lakes, both natural and artificial. This variety of local habitats and environments is reflected in the abundance and in the many different kinds of mussels found in permanent bodies of water in the state (Figure 4).

Mussels generally attain their greatest development in rivers and streams with good current. Rivers were probably their original habitat, since the center of dispersal was in the south where natural lakes are relatively few in number. The strictly lake-dwelling mussels evidently evolved or became established during or after the last glacial periods, since it was then that the lakes were produced in the north. River species are usually larger and heavier than those characteristic of lake environments; some scientists believe this condition may be the result of a more abundant and continuing food supply which is made constantly available by river current. It has also been suggested that river mussels develop a heavier, stronger type of hinge teeth in order to withstand pressure and to facilitate movement in the current.

Mussels spend their entire juvenile and adult life partially or completely buried in the bottom of some permanent body of water. Usually each mussel will position itself so that the posterior portion of the valves protrudes from the bottom and is directed upstream. In this way, materials brought in through the incurrent siphon are partially forced into the mantle cavity by the current, and the waste products that are expelled through the excurrent siphon are quickly swept away. Although the mussel is able to change its position and location to some extent, an individual will rarely move more than

FIGURE 4. The major rivers in and bordering Illinois. Map courtesy Illinois State Water Survey, Urbana; Circular 73, 1958.

a radial distance of a few hundreds yards during a lifetime unless it is dislodged and carried elsewhere by current or some animal. The lives of these mussels are, therefore, directly subjected to effects exerted by the local bottom area which they inhabit and the water passing over them.

In prehistoric times, as evidenced by the quantity and variety of shells found at Indian village and camp sites, the rivers of Illinois were clear with sand and gravel beds ideally suited to these mollusks. Intensive agricultural practices have involved the clearing and plowing of more and more land; during spring run-off or at flood periods, tremendous quantities of top soil are washed into streams and rivers, causing layers of silt and mud to settle and cover the former sand and gravel bottoms. Species adapted to a sand and gravel bottom environment cannot long survive in one composed of mud and they are quickly destroyed by the smothering effects of silting. Industrial and organic pollution has been the other major factor in reducing or completely destroying mussel populations in many sections of the rivers of Illinois. As a classic example, wastes from the cities of St. Louis and East St. Louis have so polluted the Mississippi River downstream that, from these cities to the extreme southern tip of Illinois at Cairo, mussels are no longer able to exist.

The influence of the changing structure of lake and river beds due to silting, or shifting caused by currents, and the detrimental effects of industrial and organic (garbage and sewage) wastes present in a body of water, cannot be over emphasized in their relation to the size and extent of mussel populations. In 1922, Dr. Frank C. Baker found that the mussel fauna in the Big Vermilion River had been completely destroyed 14 miles below the sewage outlet at Urbana, Illinois, and that a normal population of mussels was not encountered until a location of 20 miles downstream from this city had been reached. In spite of more stringent laws prohibiting the dumping of raw or incompletely treated sewage, garbage and industrial wastes into our rivers and lakes, the problem of pollution continues to exist and is even intensifying as our human population increases.

Compared with pollution and silting, the two major kinds of natural enemies, parasites and predators, generally have little over-all effect on any given population of mussels. Probably the most common mammal predator is the muskrat; piles of shells around muskrat houses and entrances to their burrows in mud banks attest to the gathering activities of these rodents. Raccoons, mink and otters, as well as some species of birds (especially waterfowl), also utilize mussels for food. The fresh-water drum or sheepshead feeds almost exclusively on them. Modern man's extensive use of the fresh-water mussel has centered around the shells as a source of raw material for the manufacture of pearl buttons and pellets in connection with the cultured pearl industry. In this capacity, however, man has proved to be a major "predator" and, by over-fishing, has depleted the mussel beds in many localities. The cooked mussels removed during the processing of shells were sometimes used as hog feed and, although fishermen occasionally use the soft parts for bait, these mollusks have provoked little enthusiasm as a gourmet's delight!

Fresh-water mussels are infested with a variety of parasites and commensals; this latter term refers to any animal living in or on another, but one that usually does not harm or injure its host. The most common of these are the water mites (*Unionicola* spp.) which infest the gills and, occasionally, the whole mantle cavity. The eggs and larvae are generally imbedded in the gills, foot and mantle of the mussel, while the adult mites are active and move about over the gills and body. Occasionally mite larvae migrate into the area between the mantle and shell, become covered with pearly matter, and appear as small blisters or pimples on the inside of the shell. These animals apparently cause little, if any, damage to the mussel.

Occasionally leeches attach themselves to the mantle or more rarely to parts within the body cavity, but generally they are uncommon and do not remain attached very long.

There are several types of true parasites (an animal living in or on another at whose expense it obtains food and shelter) known to infest fresh-water mussels. One of these is the fluke, a parasitic flatworm, several species of which have been reported parasitizing the body cavities of mussels. Several kinds of distomids, another type of trematode or parasitic flatworm, are known to occur in the muscular parts and in some organs of mussels. The majority of these parasites are apparently harmless.

Distribution of mussels in a river is rarely uniform since the depth of water, rapidity of current, composition of the bottom and other physical factors may be quite unsuited for mussel development and maintenance in certain areas. A constantly changing or shifting bottom will limit or often prevent the establishment of mussel beds. Dams or high falls may restrict their distribution by preventing the host fish infested with glochidia from ascending the stream or river. In fast flowing rivers like the Mississippi (Plate 4), mussels can be found at depths of 15 feet or more; however, the depth at which they occur is usually directly dependent upon temperature (as affected by the seasons; night and day), amounts of dissolved oxygen, and quantity of suspended food materials. Each species has evolved its own combination of optimum habitat requirements and these differ considerably among the various kinds.

Lakes without current usually have a different and more limited mussel fauna than that found in rivers and streams. Studies have shown that dams constructed across rivers, which reduce or eliminate the current, will produce an environment no longer suitable for river-dwelling mussels. Specific bottom conditions are important for establishment and survival of certain kinds of mussels, but the large majority found in Illinois are tolerant of a bottom composed of various combinations of sand, gravel and mud. Floaters (*Anodonta* spp.) and paper-shells (*Leptodea* spp.) often occur in a bottom composed almost entirely of mud, but most mussels attain their greatest abundance and optimum development in bottom areas composed of a mixture of stable gravel, sand and mud deposits; for example, that of the Embarrass River (Plate 5).

PLATE 4. Mississippi River, Pike Co., Illinois; main channel in background, habitat for deep water species. Foreground, a quiet water shoot.

PLATE 5. Embarrass River, Jasper Co., Illinois. A medium-sized, fairly shallow river environment supporting an abundant mussel population.

Names and Classification

The problem of assigning names, either the common or the scientific, to any particular animal has often proved difficult. In the case of many species, innumerable changes have resulted since the original names were designated. To most individuals, a generally accepted common or vernacular name is sufficient to identify the animal in question. To the scientist, however, a more uniform and stable system of names is necessary in order for specialists from all parts of the world to recognize the animal being described. Such a system was proposed about 1735 by a Swedish naturalist, Karl von Linne (Linnaeus); this system of "binomial nomenclature" means, basically, that each species receives two names (normally of Latin derivation), the first, the GENUS to which it belongs and the second, the SPECIES. For example, the names "pimple-back" and "warty-back" are applied to several species of naiads by mussel fishermen, but use of the scientific name *Quadrula pustulosa* denotes one specific animal.

Early classification of fresh-water mussels was based almost entirely on the shell, but with later detailed studies of the soft parts, this system was found to be inadequate. Because two species have shells with pustules, or have valves with similar shapes, or possess a dorsal wing does not necessarily mean that they are closely related. Presently the nearly 500 recognized species of North American mussels are classified on the basis of a combination of the characteristics of the shell, internal organs and the types of glochidia. In spite of this generally accepted method of classification, there are other factors which complicate the problem.

Widely distributed species often show structural or other variations in groups of individuals occurring at the extremes of the range. Scientists studying fresh-water mussels have noted that in most rivers there is a succession of types, or variations within a particular species, from the source of the river to its mouth. Often, as one descends a river from the headwaters toward the mouth, the general form of the shell of a species may change and become heavier and of greater diameter. Superficially the form or type at the headwaters may appear quite different or distinct from that type found at the river's mouth. The question arises: Are these two distinct species, or are they simply variations within the same species?

As an example, in the case of the three-ridge or blue-point mussel (*Amblema* spp.) that occurs throughout the Illinois River, three separate or distinct species have been recognized by some authorities. The shell of the headwaters species, *Amblema costata*, is compressed and the beaks or umbones are depressed. At the lower reaches of the river near the mouth, the species *Amblema peruviana* occurs, and it is characterized by a heavier, wider shell, and swollen umbones which are located nearer the anterior end. Intermediate between these two—both in structure and location in the river—is the species *Amblema variplicata*. One authority considers only the headwaters and the lower river types as possibly valid species, while still another recognizes only one species and all the variations as simply forms or types. Clines or gradients

have been observed in *Amblema* in an upstream-downstream direction, thus suggesting that only one species is involved.

Identification of the shells or valves of the species of fresh-water mussels occurring in the state is made easier by using a combination of clear illustrations or photographs, descriptive text, and a key based on obvious structural characteristics. Special terms used to describe the varied colors, epidermal patterns, shapes and structures encountered in the shell of the approximately 65 species now found in Illinois waters, may be unfamiliar to the individual not well acquainted with these mollusks. For this reason, a glossary of terms that pertain specifically to the mussels and to the shell characters precedes the key and text; these definitions should aid in clarifying the descriptions and improve the usefulness of the key. Figure 2, a labeled diagrammatic illustration of a typical valve, should also be consulted.

About 12 species of mussels that once formed a part of the naiad fauna of Illinois have now apparently disappeared, or are extremely rare. Valves of these species found in the debris of Indian middens, and the fresh specimens present in museum collections that were obtained many years ago, attest to their former occurrence. These few species which probably disappeared due to silting, dam construction, and/or pollution, have not been incorporated in the key; they are, however, illustrated and described in the text.

A group of small clams commonly referred to as fingernail and pea clams—most less than one-half inch in diameter—which are wide-spread and locally abundant in Illinois, are not included in this publication. An understanding of their relationships has proved difficult because of the great structural variations within the species and the many names applied to these variants. Because of this existing confusion and their small size, representatives of the fingernail clams (Family Sphaeriidae, the genera *Pisidium* and *Sphaerium*) are often difficult or impossible to identify. The most recent and detailed treatment of these small clams is presented by H. B. Herrington (see Suggested References).

Glossary

Alate—	Having a wing-like projection of the two valves of the shell, extending dorsally beyond the hinge line.
Angulate—	Having either the anterior or posterior margins forming a relatively acute (sharp) angle.
Attenuate—	Long and slender.
Anterior—	Front or forward.
Arcuate—	Bent in a bow or arched.
Beak sculpture—	Raised ridges or undulations on the umbones.
Compressed—	Flattened out or pressed together.
Concentric—	Having a common center, such as ridges or loops radiating from the beak.
Distal—	The farthest part or point of an object or area.
Depressed—	Low or flattened.
Dorsal—	The back; in mussels, the hinge portion.
Edentulous—	Shells without teeth.
Elliptical—	Elongated, rounded.
Epidermis—	External or outside layer of the shell.
Flutings—	A series of undulations or ridges.
Globose—	Nearly spherical or globular in shape.
Interdentum—	A flattened area of the hinge plate between the pseudocardinal and lateral teeth.
Inflated—	Moderately to greatly swollen.
Lateral teeth—	The elongated, raised and interlocking structures along the hinge line of the valve.
Lunule—	Depressed area immediately anterior to the umbo.
Nacre—	The iridescent, thin inner layer of a mussel shell.
Oblique—	Slanting; angled, but not horizontal or vertical.
Oblong—	Longer than high.
Obtuse—	Dull or blunt.
Ovate—	Egg-shaped.
Plications—	Parallel ridges on the surface of the shell.
Posterior—	Hind or rear.
Proximal—	The nearest part or point of an object or area.
Pseudocardinal teeth—	Triangular-shaped hinge teeth near the dorsal margin of the shell.
Pustule—	Small, raised structure on the external or outside part of the shell.
Pyramidal—	Having the form or shape of a pyramid.
Quadrato—	Square, or nearly square in outline.
Rhomboid—	Having generally four distinct sides, two sides being longer than the others.
Serrated—	Notched or grooved.
Striated—	Marked or patterned with lines or grooves.
Sulcus—	A longitudinal furrow or depression.
Truncate—	Having the end squared off.
Tuberculate—	Covered with tubercles or rounded knobs.
Umbo—	The dorsally raised, inflated area of the shell.
Undulated—	Patterned with undulations or waves.
Valve—	The right or left half of a mussel (or unionid) shell.
Ventral—	The underside or bottom.

Key for the Identification of the Species of Mussels in Illinois

At best, most keys to particular groups of plants or animals are artificial; they are based on obvious characters and can be used successfully only when a typical adult specimen is at hand. For example, the valves of an adult pimple-back (*Quadrula pustulosa*) are covered with pustules or tubercles and would fit the characters used in the key, but shells of a young or juvenile pimple-back, which are often void of pustules, would not key out correctly. Within the same species, the epidermis of young shells may be yellow, while in mature or old individuals it is dark brown or black. Also, beak sculpture that is diagnostic of many species is often worn away on old individuals. In some species such as *Pleurobema cordatum*, one must also keep in mind differences in the progressive increase in thickness of the valves and the degree of inflation or swelling of the shells from a headwaters form to those found in the lower reaches of a river. However, such variants can usually be identified by using the key in connection with the descriptions and illustrations.

The key is arranged in paired statements (sometimes three combinations), one being in opposition to the other(s) or at least distinctly different. If any part of one of the paired statements seems incorrect or not applicable, the other statement should be true. The selected choice will refer the reader to another pair of statements, or to the name of the species.

The basic descriptions of the shells—their structure and coloration—presented by Simpson (1914), Baker (1922), and Murray and Leonard (1962) have been followed closely but supplemented or altered when necessary to incorporate variations found in Illinois specimens. The General Distribution information was also taken primarily from these references although changed when additional records were obtained during more recent studies.

1. A. Surface covered with pustules, knobs, or ridges.....	2
B. Surface smooth, without pustules or ridges.....	21
2. A. Surface with pustules or knobs; only 1 or a few extending on to
or over the beaks	3
B. Surface with pustules or knobs; a few to many extending on to
or over the beaks	12
C. Surface with ridges or flutings.....	19
3. A. Curve of side of valve evenly rounded, without a sulcus or
median depression	4
B. Curve of side of valve interrupted by a median sulcus or depression	11
4. A. Nacre white	5
B. Nacre purple	8
5. A. Surface with a few large knobs or tubercles.....	6
B. Surface with several to many tubercles or pustules covering half
to nearly all the valve	7

6. A. Posterior dorsal margin somewhat alate, usually pustulose, surface with 2 longitudinal rows of large, elongated tubercles *Quadrula nodulata* (p. 39)
B. Posterior dorsal margin not alate or pustulose; surface with 2 or 3, elongated knobs arranged in a single vertical row on the center of the valve *Obliquaria reflexa* (p. 77)
7. A. Shell rounded, nearly covered with pustules, uniform brownish 9
B. Shell rounded, nearly covered with pustules, yellowish with dark green rays 10
8. Nacre purple *Cyclonaias tuberculata* (p. 27)
9. Beak cavity deep, shell moderately inflated, posterior ridge rounded *Quadrula pustulosa* (p. 40)
10. Beak cavity shallow, shell strongly inflated, posterior ridge high, prominent *Cyprogenia irrorata* (p. 61)
11. Curve of side of valve interrupted by a median sulcus or depression; many small tubercles or pustules mostly anterior of the sulcus *Quadrula quadrula* (p. 43)
12. A. Pustules, tubercles or undulations numerous and scattered over the surface of the shell 13
B. Pustules or knobs not scattered but arranged mostly in a diagonal row 16
13. A. Lateral teeth typical and well developed 14
B. Lateral teeth atypical, represented by a thickening of the hinge line. 15
14. A. Surface with pustules extending well over the anterior end; shell rhomboid, elongated and compressed laterally; dorsal margin with small flutings *Tritogonia verrucosa* (p. 43)
B. Surface of umbonal region densely covered with small zigzag undulations; posterior and lateral or lower sides with pronounced parallel ridges *Megalonaias gigantea* (p. 33)
15. Lateral teeth represented by a thickening of the hinge line, plications on umbonal slope raised to form two nodulous ridges *Arcidens confragosus* (p. 51)
16. A. Tubercles few in number, forming pronounced knobs on the angular posterior ridge 17
B. Tubercles or pustules numerous, broad, low and arranged in a diagonal row from umbo to posterior ventral margin 18
17. A. Tubercles few, forming a row of large knobs on the angular posterior ridge with a few smaller pustules anterior to the ridge, shell squarish *Quadrula metanevra* (p. 39)
B. Tubercles few, low, appearing as rounded knobs along posterior ridge; shell elongated, thick, rhomboid *Quadrula cylindrica* (p. 36)
18. A. Shell elongate-ovate, posterior end sharply pointed; umbones inflated, epidermis a uniform dull yellow *Plethobasus cyphus* (p. 35)
B. Shell rounded, posterior end blunt, epidermis dull yellow or green *Dysnomia perplexa* (p. 62)

19. A. Surface with large diagonal ridges or flutings; lateral teeth
typical and well developed 20
- B. Surface of posterior margin only with ridges or flutings; shell
compressed laterally, lateral teeth represented by a thicken-
ing of the hinge line *Lasmigona costata* (p. 53)
20. A. Shell very wide, thick; umbones elevated, swollen, turned forward,
placed near anterior end *Amblema peruviana* (p. 27)
- B. Shells compressed, umbones not swollen and not, or only slightly,
extending beyond linule *Amblema costata* (p. 26)
21. A. Hinge with well-developed pseudocardinal and lateral teeth;
surface without pustules or ridges 30
- B. Hinge with either lateral or pseudocardinal teeth, or both,
missing or poorly developed 22
22. A. Hinge edentulous and without thickening; shell often thin
and fragile 23
- B. Hinge line thickened, pseudocardinals represented by small tuber-
cular thickenings; beak sculpture 3-4 heavy bars 26
- C. Hinge with well-developed but slight lateral teeth; pseudocardinal
teeth compressed, elevated *Lasmigona compressa* (p. 52)
- D. Hinge without distinct lateral teeth, but with pseudocardinal
teeth well developed 27
23. A. Beak sculpture consisting of distinct double-looped ridges 24
- B. Beak sculpture consisting of subconcentric bars diagonal to the
hinge line 29
24. A. Shell nearly ovate with umbones usually swollen or inflated 25
- B. Shell nearly circular or round, compressed
..... *Anodonta suborbiculata* (p. 48)
25. A. Shell slightly thickened, umbones prominent, often inflated;
epidermis greenish, yellowish or brownish; nacre white, often
washed with salmon or pink *Anodonta grandis* (p. 47)
- B. Shell slightly thickened; umbones greatly swollen, extending well
down toward center of valves; nacre white, washed with
purplish or salmon *Anodonta corbulenta* (p. 47)
- C. Shell very thin; no umbonal swelling; hinge line perfectly
straight; very minute beak sculpture; epidermis bright
green with rays *Anodonta imbecillis* (p. 48)
26. A. Shell very thick (in old adults), compressed, elongated; shallow
sulcus along a low diagonal ridge at posterior third of the
shell; nacre pearly white *Cumberlandia monodonta* (p. 25)
- B. Shell moderately thick, inflated and somewhat rhomboid; some-
times with a low posterior ridge; nacre usually salmon or
pinkish in the center *Strophitus rugosus* (p. 56)
27. A. Shell more than 2 inches in length 28
- B. Shell less than 2 inches in length, solid; posterior end sharply
truncated, high; epidermis greenish or yellowish with many
green rays *Alasmidonta calceolus* (p. 44)

28. A. Pseudocardinal teeth irregular tubercular swellings; lateral teeth represented by elevated ridges; shell greatly compressed, alate *Lasmigona complanata* (p. 52)
- B. Pseudocardinal teeth compressed (right valve) or as tubercular swellings (left valve), lateral teeth by thickenings of the hinge line; epidermis greenish or yellowish with many green rays; many fine radial ridges on the elevated posterior slope *Alasmidonta marginata* (p. 45)
29. Shell thin, long-elliptical, somewhat inflated; posterior end pointed *Anodontoides ferussacianus* (p. 51)
30. A. Shell alate, compressed, usually thin 31
- B. Shell not alate, usually solid, flattened to moderately inflated 33
31. A. Pseudocardinal teeth thin, usually sharp but weak, not ragged 32
- B. Pseudocardinal teeth thick, strong; slightly ragged; epidermis greenish or blackish; nacre usually salmon to deep purple *Proptera alata* (p. 81)
32. A. Alate wing extending well above umbones; epidermis normally glossy, usually yellowish-green *Leptodea laevisissima* (p. 74)
- B. Alate wing forming a straight line with the umbones; epidermis dull, yellowish to yellowish-brown *Leptodea fragilis* (p. 72)
33. A. Epidermis light brown to black, adults without, or with obscure rays; faintly rayed when young 34
- B. Epidermis yellowish, greenish or rarely brown; smooth or polished; rays, if present, usually distinct 42
34. A. Teeth usually distinct, massive; interdentum narrow or absent, shell solid; adult shell more than 2 inches 38
- B. Teeth and hinge line usually slight although distinct; interdentum absent; adult shell not over 2 inches in length 35
- C. Teeth and hinge line distinct; interdentum absent; adult shell elongate, more than 2 inches in length 36
35. A. Beak sculpture consisting of 5-6 distinct subconcentric loops; epidermis thick, usually dark gray or brown; lines of growth pronounced; shell elliptical, nacre white *Carunculina parva* (p. 59)
- B. Beak sculpture consisting of 5-6 distinct sub-concentric loops; epidermis smooth, usually faintly rayed; shell oval, globose, nacre purplish *Carunculina glans* (p. 59)
36. A. Beak sculpture consisting of distinct parallel loops or ridges 37
- B. Beak sculpture consisting of 3-4 indistinct bars; posterior end pointed; epidermis dark green to black with faint, lighter green rays; nacre white suffused with pink in young, purple or salmon in adults *Ligumia recta* (p. 74)
37. A. Beak sculpture consisting of 6-7 concentric ridges rounded up sharply behind; epidermis somewhat smooth, shiny, yellowish-brown; nacre white *Unio merus tetralasmus* (p. 44)
- B. Beak sculpture consisting of 5-6 delicate ridges drawn up in the middle; epidermis dull, dark brown to black; nacre white *Ligumia subrostrata* (p. 75)

38. A. Shell elongate or rhomboid, thick, massive; beak cavity shallow; nacre purple 39
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Accounts of Species

Phylum: MOLLUSCA

Class: Pelecypoda

Order: Eulamellibranchia

Family: Margaritanidae

Cumberlandia monodonta (Say).

Spectacle-Case

Plate 6: A

Description of Shell: Shell elongated, arcuate, compressed, thin in young individuals, extremely thick and solid in old animals; beak sculpture, evident only in young shells, consists of 3-4 heavy ridges parallel with the growth lines. Both anterior and posterior ends rounded; a shallow depression at center of the shell with a broadly rounded, curved posterior ridge; pronounced growth-rest lines often prominent on surface. Epidermis a uniform, rayless dark-green, brown or black.

In young individuals there is a distinct but small, tubercular pseudocardinal tooth in each valve, and two lateral teeth in the left valve and one in the right valve. In old individuals, pseudocardinal teeth become greatly reduced with a single tubercular tooth in the right valve which fits into a depression in the left valve; lateral teeth become indistinct and merge into the hinge line. Nacre white, mostly iridescent in young shells, iridescent posteriorly only in old valves.

General Distribution: Ohio, Mississippi, Cumberland and Tennessee river systems.

Distribution and Ecology in Illinois: F. C. Baker (1906) recorded this species from the Kankakee, Illinois and Mississippi rivers, while Goodrich and van de Schalie (1944) listed it in Indiana as occurring only from the region of the Grand Chains of the Wabash River. Apparently the Spectacle-Case is no longer found in the Kankakee and Illinois rivers, and it is rare and of local occurrence in the others.

This mussel has been found in a gravel or sand bottom, usually buried deeply, and only in medium-sized to large rivers with a fairly good current. Because the Spectacle-Case does characteristically embed itself deeply, it may often be overlooked by collectors and missed by the hooks on crowfoot dredges. It is rarely taken by mussel fishermen. Old individuals may attain a shell length of $7\frac{1}{2}$ to 8 inches.

Family: Unionidae

Amblema costata Rafinesque

Three-Ridge

Plate 6: B

Description of Shell: Shell elongated, solid, somewhat quadrate, compressed to moderately inflated; beaks depressed or only slightly elevated, with the sculpture consisting of a few distinct ridges evident only in young specimens; anterior end rounded, posterior end truncated. Surface with 4-6 pronounced, rounded folds or ridges parallel with the posterior ridge; occasionally a few elongated pustules occur on the posterior half of the shell. In the young, the shell is green or yellowish-green, sometimes with faint or indistinct rays; old shells are dark brown to black.

Left valve with two large, roughened, elevated, divergent triangular pseudocardinal teeth; the two lateral teeth long and nearly straight. Right valve with a single, thick, serrated, triangular, large, pseudocardinal tooth which is preceded by a small lamellar ridge or "tooth"; one well-developed lateral tooth. Beak cavity deep. Nacre white, usually iridescent posteriorly and occasionally tinged with pinkish or purple, especially in streams providing a poor mussel environment.

Some authors (for example F. C. Baker, 1928) have recognized three distinct species of *Amblema*: *A. costata* which is associated with a headwaters or small stream environment; *A. variplicata*, a species of medium-sized rivers, or of down-stream sections of large rivers such as the Illinois and differing from the former in the shell being somewhat more elongated and inflated; and *A. peruviana*, the large river species showing an even greater degree of inflation of the shell and umbones. On the other hand, some authorities recognize only one species, and the others are considered simply as forms or variants resulting from differences in size and depth of rivers in which they occur. Again, depending upon the author consulted, the names *Crenodonta peruviana* or *Amblema plicata* are used.

General Distribution: Entire Mississippi River drainage from western New York west to eastern Kansas, south to eastern Texas and Louisiana, north to Minnesota; the Alabama and St. Lawrence river drainages; Red River of the North, Saskatchewan River and Lake Winnipeg.

Distribution and Ecology in Illinois: The Three-Ridge is one of the most common and wide-spread mussels found in Illinois waters, occurring in the majority of small streams and creeks and in the headwaters and shallow sections of larger rivers. It reaches its greatest abundance on bottoms composed of sand and gravel, usually in 1 to 3 feet of water, although it is one species that can adjust well to a bottom containing a high per cent of mud. Occasionally *A. costata* will adapt to a lake environment that lacks currents.

Plate 6: C

Description of Shell: Similar in general appearance and structure to the preceding species (and possibly only a large river form or variant of it). The shell is more inflated, thicker; beaks considerably elevated, swollen, turned forward. Pseudocardinal teeth proportionately more massive, rough. Epidermis and nacre color similar to *A. costata*.

General Distribution: Upper Mississippi drainage south to the Tennessee and Arkansas rivers. According to F. C. Baker (1928), true *peruviana* occurs only in the Mississippi River and its larger tributaries.

Distribution and Ecology in Illinois: This species, or form, inhabits the entire Mississippi River. In the lower reaches of the Rock, Illinois, Wabash and Ohio rivers, specimens of *Amblema* have been referred to *peruviana* or the form *raviplicata*. The Blue-Point typically occurs in deep water, from 3 to 20 feet in depth, in good current and generally on a mud or mud/sand bottom.

Cyclonaias tuberculata Raf.

Purple Warty-Back

Plate 7: C

Description of Shell: Shell compressed (streams) to inflated (large rivers), squarish or somewhat circular, solid, heavy. Beaks depressed (stream forms) to moderately swollen, rather prominent (large river forms); sculpture consists of numerous fine, irregular, broken ridges, each made up of alternating zigzag bars and loops which continue down the valve until the nodules appear; often a shallow, narrow furrow or depression centrally on the umbone area. A wing-like depression above the dorsal ridge, more extensive in stream forms. Center and posterior surfaces covered with rounded or elongated tubercles parallel with the growth lines; more numerous in stream forms. Epidermis a dull, yellowish-brown to dark brown; young shells occasionally with traces of greenish rays.

Left valve with two narrow but heavy, divergent pseudocardinal teeth, deeply serrated between, sometimes almost meeting anteriorly; the two lateral teeth short, heavy, slightly curved. Right valve with a single, massive, ragged, slightly triangular-shaped pseudocardinal tooth, usually with a small tubercular tooth on either side. Beak cavity compressed, deep; interdentum wide, flat. Nacre varies from a uniform deep purple, often with a coppery tinge along the margin, to light purple with the center (within the pallial line) nearly white; posterior margin iridescent.

General Distribution: Mississippi River drainage, including the Ohio, Cumberland and Tennessee river systems.

Distribution and Ecology in Illinois: Two rather distinct forms of the Purple Warty-Back occur in Illinois; the shell of one, such as is found in the Salt Fork River (Champaign Co.) and other small streams, is characterized by its massive size, squarish outline, compressed valves and numerous tubercles. The other, typical of the upper Rock, Mississippi and lower Wabash and Ohio rivers, is usually smaller, more rounded or oval, inflated and possesses

PLATE 6. A: *Cumberlandia monodonta* (Spectacle-Case). B: *Amblema costata* (Three-Ridge). C: *Amblema peruviana* (Blue-Point).

fewer tubercles. Both forms may inhabit a gravel/mud bottom, usually in areas of current; the former can be found in water 1 to 2 feet in depth, while the latter occurs in 6-10 feet of water.

Elliptio dilatatus (Raf.)

Spike; Lady-Finger

Plate 7: A

Description of Shell: Shell compressed to slightly inflated, attenuate, solid, thick. Beaks depressed, flattened; sculpture consists of 4-5 pronounced loops, running parallel with the growth lines. Anterior end broadly rounded, posterior end sharply pointed and often compressed behind the strongly developed ridge. Concentric growth lines often prominent. Epidermis of young shells greenish or yellowish-green, often faintly rayed; old valves dark greenish-brown to black.

Left valve with two triangular, divergent, compressed pseudocardinal teeth, usually roughened or finely serrated; the two lateral teeth heavy, rough, widely separated, the inner surface usually rough. Right valve with a heavy, triangular pseudocardinal tooth; lateral tooth low, thick, roughened. Interdium moderately wide; beak cavity usually very shallow or absent. Nacre varies from white, through salmon to deep purple; Illinois specimens typically purple.

General Distribution: Entire Mississippi River drainage; from the St. Lawrence River and its tributaries southeast into Florida and west to the Guadalupe River in Texas.

Distribution and Ecology in Illinois: The purple nacre and elongated shape easily distinguish this common Illinois mussel. It occurs in most of the small streams in suitable habitat, and it is common locally in large rivers such as the Wabash, Ohio, Mississippi and Rock. Shells of these large river specimens are generally more inflated, larger and thicker; old individuals from the lower Wabash attain a shell length of 5 1/2 inches. Although the Spike was once locally abundant in the Illinois River, it has now nearly or completely disappeared due to pollution and silting. Generally this mussel thrives best in a sand/gravel bottom, in riffles or in rivers with strong current. Individuals may occur in shallow water or at depths exceeding 6 to 8 feet.

Elliptio crassidens (Lamarck)

Elephant's Ear

Plate 7: B

Description of Shell: Shell thick, heavy, solid; older valves nearly rhomboid, elongated; anterior end rather sharply rounded, posterior end obliquely truncated with the posterior ridge prominent and typically sharply angled; the dorsal margin and posterior ridge usually ending in a point. Beaks large, flattened, slightly elevated; sculpture consists of 2-3 coarse loops parallel to the growth lines, but usually evident only in very young shells. Surface marked with prominent growth lines, often giving it a rough appearance in old valves. Epidermis thick, reddish-brown to black; young shells marked with numerous dark green rays.

A

B

C

PLATE 7. A: *Elliptio dilatatus* (Spike). B: *Elliptio crassidens* (Elephant's Ear). C: *Cyclonaias tuberculata* (Purple Warty-back).

Left valve with two heavy roughened, triangular, divergent pseudocardinal teeth; the lateral teeth short, heavy, wide, nearly straight. Right valve with a heavy, triangular, serrated pseudocardinal tooth; lateral tooth short, finely serrated. Interdentum narrow; beak cavity shallow to nearly absent in old shells. Nacre varies from light salmon to a uniform deep purple.

General Distribution: Mississippi River drainage; south and east in the Alabama, Tombigbee and Chattahoochee rivers.

Distribution and Ecology in Illinois: The Elephant's Ear is restricted to the large rivers in and bordering the state; it is now found primarily in the lower Wabash and Ohio rivers and locally in the Mississippi above St. Louis. Ten years ago it was of rare local occurrence in the Illinois River, but like several other species that once inhabited this river, it has disappeared. Individuals normally inhabit a bottom matrix composed of stones and coarse gravel, in swift current, and at a depth of at least 6 feet. Like other species possessing a purple or colored nacre, its shells were of no value in the pearl button industry. Large, mature shells attain a length of six inches.

Fusconaia ebenus (Lea).

Plate 8: A

Description of Shell: Shell somewhat oblong to nearly round, heavy, solid, inflated; anterior and posterior ends broadly rounded. Beaks greatly elevated, full, directed forward and inward; sculpture consists of a few weak, indistinct ridges which are noticeable only in very young shells. Rest periods evident by the prominent concentric ridges which give the surface a rough appearance. Epidermis without rays, reddish-brown to black.

Left valve with two massive, triangular pseudocardinal teeth that are usually joined anteriorly and appear as one, the depression between roughly serrated; the two lateral teeth wide, nearly straight. Right valve with a large, ragged, triangular pseudocardinal tooth that appears to stem from a deep depression or pit; lateral tooth high, finely serrated. Interdentum wide; beak cavity deep. Nacre pearly white, posterior end iridescent.

General Distribution: Mississippi River drainage; south in the Alabama and Tombigbee rivers.

Distribution and Ecology in Illinois: This mussel, once common throughout the larger rivers of the state, is now restricted to portions of the Mississippi, lower Wabash and Ohio rivers. In areas where it does occur, *Fusconaia ebenus* is often abundant, but its former range in Illinois has been greatly reduced due to pollution and silting. Sections of large rivers with swift current and a sand/gravel bottom provide the best habitat; it is normally found at depths of 3 to 10 feet, although it may occur in much deeper water.

Fusconaia flava (Rafinesque).

Wabash Pig-Toe

Plate 8: B

Description of Shell: Shell slightly elongated, quadrate, thin to moderately solid, compressed to slightly inflated. Beaks depressed, turned forward, not much elevated; sculpture consists of 3-5 nearly concentric bars that form an

angle on the posterior ridge. Anterior end rounded, dorsal margin squared, posterior end obliquely truncated; dorsal ridge evident but with a sloping angle; a wide, shallow depression usually anterior to the posterior ridge. Surface often marked with growth lines, occasionally raised and forming slight ridges. Epidermis yellowish-brown, becoming darker in old shells and having a satin-like gloss.

Left valve with two elevated, triangular, serrated, divergent pseudocardinal teeth; the two lateral teeth thin, high, nearly straight. Right valve with a triangular, elevated, serrated pseudocardinal tooth; lateral tooth high, thin—occasionally a second smaller lateral tooth develops. Interdentum narrow or absent; beak cavity wide, moderately deep. Nacre whitish, often tinged with light pink or salmon; iridescent posteriorly.

General Distribution: Entire Mississippi River drainage; from western New York to eastern Kansas, Nebraska and South Dakota, south to Texas; St. Lawrence River; Red River of the North; southern Ontario.

Distribution and Ecology in Illinois: *Fusconaia flava* is one of the more common and widely distributed mussels in the small to medium-sized streams throughout the state. Because of continued silting and the resulting mud-covered bottoms, the Wabash Pig-toe has been reduced in numbers or entirely exterminated in many streams. A hard gravel and sand mixture forms the most suitable bottom habitat for this species; it is usually found at a depth of a few inches to two feet, in quiet water often just below riffles. The shell varies somewhat, being more compressed in the smaller streams, but the distinct squarish outline remains characteristic.

Fusconaia undata (Barnes).

Pig-Toe

Plate 8: C

Description of Shell: Shell triangular in outline, solid, heavy, inflated. Beaks elevated, swollen, directed forward; sculpture consists of several fine ridges, usually evident only in young shells. Anterior end rounded below, truncated dorsally and posteriorly; dorsal ridge sharply angled, with a depression immediately ventral to it. The widest and highest part of the shell is just in front of this depression. Surface marked with prominent growth lines. Epidermis yellowish-brown or greenish in young shells, which are often rayed, to dark brown or black in old individuals.

Left valve with two wide, heavy, divergent, roughened pseudocardinal teeth which are often joined anteriorly and appear as a single tooth; the two lateral teeth short, wide, thick, slightly curved. Right valve with a single, massive, serrated triangular pseudocardinal tooth, stemming from a deep, roughened pit; laterals partly doubled, the anterior one the largest, being high, wide, and serrated. Nacre whitish, often tinged with salmon; iridescent posteriorly.

General Distribution: Mississippi River drainage; from Minnesota east to western New York and Pennsylvania, south to Arkansas, Louisiana and Alabama.

Distribution and Ecology in Illinois: The Pig-Toe is the large river counterpart—or variant—of *Fusconaia flava*, and only appears to differ from it primarily by the more massive inflated shell and umbones. It is locally abundant in the large rivers in or bordering Illinois and occasionally in medium-sized rivers such as the Embarrass, Sangamon, and Big Muddy. Young and juvenals more commonly occur on sand bars in gravel or coarse sand; adults can adapt themselves to a mud bottom habitat and may be found at a depth of 3 to 10 feet or more, usually in current.

Megalonaias gigantea (Barnes).

Washboard

Plate 9: A

Description of Shell: Shell slightly elongated, quadrate to rhomboid, thick, heavy, moderately inflated; anterior end rounded, posterior end and dorsal margin nearly straight, the dorsal area appearing alate in young shells; the posterior ridge rounded and appears to merge with the folds of the surface. Beaks depressed; sculpture consists of heavy, double-looped ridges which become nodulous on the posterior ridge. Below the beaks and well down the sides, the surface is densely covered with chevron-shaped (in young shells) or irregular-shaped tubercles or nodules. The dorsal "wing" on posterior end possesses several rounded folds; in mature and old shells, these folds or ridges, and tubercles, become indistinct and the surface is marked mostly with growth lines. Epidermis a yellowish-brown in young shells, becoming dark reddish-brown to black with age.

Left valve with two heavy, roughened, broadly triangular, divergent pseudocardinal teeth; the two lateral teeth heavy, straight. Right valve with a thick, triangular, deeply serrated pseudocardinal tooth, occasionally with a small, tubercular tooth on either side; single lateral tooth heavy, high and straight. Lateral teeth often become slightly curved in old shells. Inter-dentum usually narrow; beak cavity slightly compressed, deep. Nacre whitish, occasionally tinted with salmon and often blotched with dark brown spots (from parasite infection); posterior end and margins iridescent.

General Distribution: Mississippi River drainage; west to eastern Texas, north to Wisconsin; Red River of the North; Manitoba, Canada. South to Alabama (Tombigbee River) and northeastern Mexico.

Distribution and Ecology in Illinois: The specific name *gigantea* is truly descriptive, as the shell of a single individual of this largest species of mussel occurring in Illinois waters may weigh up to 3 pounds and reach a length of 10 inches. Although more characteristic of larger rivers such as the lower Wabash, Ohio and Mississippi, the Washboard may become well established in small streams (for example, South Fork, Sangamon River). In Illinois, this species attains its greatest size in the lower Wabash River where it is found in areas of slow current with a coarse gravel and mud bottom. Shells of the Washboard were used in great numbers by the pearl button industry, and presently (1967) it is one of the preferred shells—because of its size and thickness—for use in the cultured pearl industry.

PLATE 8. A: *Fusconaia ebenus*. B: *Fusconaia flava* (Wabash Pig-Toe). C: *Fusconaia undata* (Pig-Toe).

Plate 9: B

Description of Shell: Shell elongated, ovate, inflated, thick; forward ventral margin rounded, posterior end bluntly pointed. Usually a row of large, broad tubercular swellings on the center of the valve, extending down from near the umbones to the ventral margin; a shallow, furrow-like depression between the row of tubercles and the rounded dorsal ridge. Beaks elevated, high, placed near the anterior margin; sculpture consists of a few concentric ridges at the tip of the umbones, evident in only very young shells. Epidermis rayless, light yellow to dull, yellowish-brown; concentric ridges resulting from rest periods usually darker.

Left valve with two heavy, erect, roughened, somewhat triangular, divergent pseudocardinal teeth; two lateral teeth low, heavy, finely serrated, slightly curved. Right valve with a large, triangular roughened pseudocardinal tooth, usually with a smaller tubercular tooth on either side; lateral tooth heavy, serrated. Usually a second smaller lateral tooth is present on the inner side. Interdentum varies from moderately wide to narrow, or absent; beak cavity shallow. Nacre pearly white; iridescent posteriorly.

General Distribution: Ohio, Cumberland and Tennessee river systems; Mississippi River system west to Iowa and Kansas, north to Minnesota.

Distribution and Ecology in Illinois. In Illinois the Bullhead is restricted primarily to the Mississippi River above St. Louis and in the lower Wabash and Ohio rivers; even where it occurs, however, it is generally uncommon to rare. It is usually found in current on a mud bottom at depths of 3 to 6 feet, although this large river species may live at much greater depths. Goodrich and van der Schalie (1944) list two other species of *Plethobasus*, *P. cicatricosus* and *P. cooperianus*, from the lower Wabash and Ohio rivers, but examination of shells taken by mussel fishermen and systematic collecting in recent years has failed to reveal shells of either species.

Pleurobema cordatum (Rafinesque).

Plate 10: A, B, C

Description of Shell: (1) Small stream form, *Pleurobema cordatum coccineum*: Shell compressed, flattened, solid, somewhat quadrangular. Beaks only slightly elevated, compressed, turned forward; sculpture consisting of a few coarse, irregular ridges, curving upward behind. Anterior end rounded, posterior end squarely truncated; posterior ridge rounded, ending in a blunt point. (2) Large river form, *Pleurobema cordatum pyramidatum*: Shell roundly oblique or squarish, heavy, inflated. Anterior end rounded; posterior end squarely truncated, usually a pronounced furrow or depression in front of the rounded posterior ridge. Beaks high, elevated. There is still a third, intermediate form or gradient, *Pleurobema cordatum catillus*, which more closely resembles *coccineum* but with a more inflated shell and a posterior end more rounded in outline. Growth periods often represented as prominent concentric ridges. Epidermis yellowish to dark reddish-brown; young shells faintly rayed.

Left valve with two heavy, triangular, divergent, coarsely roughened pseudocardinal teeth; the two lateral teeth wide, short, thick, slightly curved. Right valve with a large, triangular, serrated pseudocardinal tooth, deeply set, with a small, tubercular tooth on either side. Interdentum moderately wide, flat; beak cavity shallow to fairly deep in the large river form. Lateral and pseudocardinal teeth become progressively more massive, and the shell thicker and more inflated as, for example, from small (Mackinaw) to medium-sized (Embarrass) to large (Ohio) rivers. Nacre varies from a nearly uniform pink (typical of *coccineum*) to white; iridescent posteriorly.

General Distribution: Upper Mississippi River drainage; from southwestern New York, west to Kansas and Iowa, north to upper Wisconsin. The form *coccineum* also occurs in the St. Lawrence drainage, and south into Alabama.

Distribution and Ecology in Illinois: Nearly all the streams and rivers in Illinois providing suitable habitat for mussels contain one of the forms of *Pleurobema*, and it often becomes locally very abundant. In smaller creeks and streams this mussel is found buried deeply, often in riffles, on a gravel or sand bottom. The large river form appears more tolerant of a sand or gravel bottom mixed with mud, and it lives at depths of 3-10 feet or more.

Quadrula cylindrica (Say).

Rabbit's Foot

Plate 11: A; Frontispiece.

Description of Shell: Shell rhomboid, rectangular, elongated, thick, solid, compressed to moderately inflated. Beaks moderately elevated; sculpture consists of several coarse folds or wrinkles ending or continuing on the umbonal area as small tubercles. Anterior end rounded; posterior end squared or truncate. Posterior ridge elevated, rounded, extending diagonally from the umbone to posterior ventral margin; characterized by several rounded, inflated tubercular swellings. Dorsal area behind umbones compressed with several to many, broadly rounded ridges curving up towards the dorsal margin. Epidermis light yellowish or greenish, becoming darker and yellowish-brown in old shells; numerous dark green streaks or triangular spots—the point directed ventrally—over most of the surface.

Left valve with two low, triangular, divergent, roughly serrated pseudocardinal teeth; the two lateral teeth prominent, long, nearly straight. Right valve with a low, heavy, deeply striated pseudocardinal tooth, often with a smaller elongated tubercular tooth on either side; lateral tooth long, thin, occasionally with a suggestion of a partial, smaller inner lateral present. Interdentum narrow to absent; beak cavity moderately deep. Nacre white, often blotched with dark brown spots in and behind the beak cavity; posterior third iridescent.

General Distribution: Ohio, Cumberland and Tennessee river systems; now north into the St. Lawrence drainage; south into Arkansas, west to Kansas and Oklahoma.

PLATE 9. A: *Megalonaias gigantea* (Washboard). B: *Plethobasus cyphus* (Bullhead).

PLATE 10. A: *Pleurobema cordatum coccineum*. B: *Pleurobema cordatum catillus*. C: *Pleurobema cordatum pyramidatum*.

Distribution and Ecology in Illinois: Baker (1922) reported this uniquely-shaped mussel as rare in Middle Fork, Big Vermilion River (Vermilion Co.); it has now apparently disappeared entirely from this river, and in Illinois it can be found only in the lower Wabash and Ohio rivers. The Rabbit's Foot is the least common of the five species of *Quadrula* occurring in the state, possibly because it is less tolerant of pollution and silting than the others. Mussel fishermen report encountering this mussel most often in 6-10 feet of water on a gravel and sand bottom in current.

Quadrula metanevra (Rafinesque).

Monkey-Face

Plate 11: B; Frontispiece.

Description of Shell: Shell solid, inflated, squared or rhomboid. Beaks slightly to moderately elevated; sculpture consists of a few short, pronounced ridges, becoming nodulous on the posterior part. Anterior end of shell broadly rounded; posterior end squared or sharply truncated, with a sinus (cavity) above the prominent posterior ridge. Dorsal area behind the umbones flattened and appearing alate. The wide, elevated ridge extends diagonally from the umbones towards the posterior ventral margin; characterized by several large, high, elongated knobs. Remaining surface, except the lower anterior third, covered with numerous, rounded tubercles. Epidermis yellowish-green or brown, with numerous streaks, triangular or chevron-shaped markings of dark green, more common on the umbone area.

Left valve with two heavy, triangular, divergent pseudocardinal teeth, often so deeply serrated or sulcated as to give the appearance of three pseudocardinals; the two lateral teeth short, wide, heavy, straight, finely striated. Right valve with a large triangular, serrated pseudocardinal tooth, sometimes with a large tubercular tooth in front (giving the appearance of two large pseudocardinals) and a smaller one behind on the wide interdentum; lateral tooth short, wide, straight, finely striated, with an occasional partial lateral tooth evident on the inner side. Interdentum wide, flat; beak cavity compressed, deep. Nacre white; iridescent posteriorly.

General Distribution: Mississippi River drainage, except in its southern parts; Tennessee and Arkansas rivers.

Distribution and Ecology in Illinois: The Monkey-Face inhabits most of the medium-sized to large rivers in the state although in some smaller streams (Spoon River) it occasionally becomes established and locally numerous. It occurs most commonly in the Mississippi River above St. Louis and in the lower Wabash and Ohio rivers. The young of this species are usually found on gravel bars in shallow water, but the adults live at greater depths, in current and on a bottom relatively free of mud.

Quadrula nodulata (Rafinesque).

Warty-Back

Plate 11: C

Description of Shell: Shell somewhat rounded to quadrate, solid, moderately inflated. Beaks elevated, moderately swollen and turned forward; sculpture consists of only 1 or 2 coarse bars or ridges. These continue down

the surface of the shell as two diverging, more or less straight rows of widely separated, prominent elongated tubercles; one row is on the angled posterior ridge. Anterior end rounded; posterior end squared or truncate. Epidermis yellowish-green to light brown; rarely faintly rayed, usually shiny.

Left valve with two high, pyramidal, divergent, roughened pseudocardinal teeth; the two lateral teeth short, wide, straight. Right valve with a large, triangular pseudocardinal tooth, deeply serrated; often with a small tubercular tooth on either side; lateral tooth wide, heavy, finely striated, occasionally with a small, incomplete inner lateral. Interdentum moderately wide; beak cavity fairly deep. Nacre white, iridescent posteriorly.

General Distribution: Ohio, Cumberland and Tennessee river systems; Mississippi River drainage from southeastern Minnesota, south to Louisiana, west to southeastern Kansas and northeastern Texas.

Distribution and Ecology in Illinois: *Quadrula nodulata* is typically a species of larger rivers, and it occurs most commonly in Illinois in the Mississippi River above St. Louis and in the lower Rock, Embarrass, Illinois, Wabash and Ohio rivers. It has been collected in medium-sized rivers (Kankakee, Kaskaskia), but individuals are usually not numerous. Although the young mussels typically utilize shallow sand bars, adults are found living usually on a mud bottom at varying depths. They also occasionally inhabit bottoms consisting of sand and loose gravel.

Quadrula pustulosa (Lea).

Pimple-Back

Plate 12: A

Description of Shell: Shell rounded to somewhat quadrate, solid, moderately inflated. Beaks high, swollen, turned forward; sculpture consists of 3-4 coarse ridges. Anterior end rounded; posterior end squarish or sharply truncated. Posterior ridge prominent, rounded. Posterior two-thirds of the surface usually densely covered with rounded tubercles or pustules; occasionally with a few low, narrow ridges on the posterior end. Epidermis yellowish-green or brown in young shells, with a broad broken green ray extending from the umbone toward the ventral margin; dark brown to black in old shells.

Pseudocardinal teeth—two in left valve, one in right valve—triangular, elevated, roughened (divergent in the right). Lateral teeth short, straight, heavy. Beak cavity deep, somewhat compressed. Nacre white, iridescent posteriorly.

General Distribution: Entire Mississippi River drainage; Michigan; Lake Erie.

Distribution and Ecology in Illinois: This mussel is probably the most common and widely distributed of the five species of *Quadrula* occurring in Illinois. Found in both small streams and large rivers, it can adapt to a bottom environment varying from coarse gravel to sand and mud, and live at depths of several inches to 10 feet or more. Shells of the large river forms are more inflated and the umbones larger and more elevated than those inhabiting small streams. The Pimple-Back was one of the more valued shells used in the pearl button industry.

PLATE 11. A: *Quadrula cylindrica* (Rabbit's Foot). B: *Quadrula metanevra* (Monkey-Face). C: *Quadrula nodulata* (Warty-Back).

A

B

PLATE 12. A: *Quadrula pustulosa* (Pimple-Back). B: *Quadrula quadrula* (Maple-Leaf).

Plates 12: B; 34: B

Description of Shell: Shell typically squarish in outline, quadrate, compressed to slightly inflated, solid. Beaks elevated, only slightly inflated; sculpture consists of double loops or zigzag bars with radiating extensions behind which continue diagonally downward on the shell as two rows of raised, elongated or rounded tubercles (often arranged in a series of three). There is a row of tubercles on the elevated posterior ridge; the two rows of tubercles are separated by a wide sulcus or depression, gradually becoming progressively wider from the umbone to the ventral margin. Tubercles on the umbone are small, crowded; usually a few pustules present on dorsal surface behind umbones. Anterior end rounded; posterior end square or sharply truncated. Epidermis yellowish-green in young shells, occasionally marked with faint rays; old shells brownish to black.

Left valve with two vertically elongated, solid, divergent, roughened pseudocardinal teeth, sometimes joined above; the two lateral teeth wide, rather long, nearly straight. Right valve with a thick, heavy, roughened, triangular pseudocardinal tooth, often with a small tubercular tooth on either side, anteriorly. Interdentum usually wide; beak cavity fairly deep. Nacre pearly white; iridescent posteriorly.

General Distribution: Entire Mississippi River drainage; locally in the St. Lawrence River basin; Red River of the North; southwest into eastern Texas.

Distribution and Ecology in Illinois: Like the Pimple-Back, *Quadrula quadrula* is a relatively common and widely distributed mussel in the medium-sized and large rivers of Illinois. The Maple-Leaf also occurs in smaller streams such as branches of the Sangamon, Spoon, Little Wabash, Saline, Salt Fork (Vermilion), Embarrass and the Fox; it may also adjust to a lake environment and become abundant (for example, Lake Springfield, Sangamon Co.). It may thrive well in a few inches of water to depths exceeding 10-15 feet and with the exception of pure mud, it can be found in any bottom type.

Tritogonia verrucosa (Barnes)

Buckhorn; Pistol-Grip

Plate 13: D

Description of Shell: Shell solid, elongate, rhomboid, compressed, with a pronounced, elevated, irregular posterior ridge. Anterior end rounded; posterior end squared or obliquely truncated in the male, more compressed and expanded into a broad wing in the female. Entire surface, except the rounded wing of the female, covered with pustules. Beaks low, curved inward and turned forward; sculpture consists of pronounced, irregular ridges which are curved upwards behind, and fine radiating ridges in front of and behind them. Epidermis dark olive or yellowish, becoming brown to black in old shells.

Left valve with two solid, triangular, divergent, roughened pseudocardinal teeth; the two lateral teeth long, straight. Right valve with a large heavy, triangular, serrated pseudocardinal, with a small tubercular tooth on either side. Lateral tooth solid, high, straight, finely striated. Interdentum narrow; beak cavity moderately deep. Nacre white, posterior end iridescent.

General Distribution: Mississippi River drainage; southeast in streams draining into the Gulf of Mexico from the Alabama river systems, west to central Texas.

Distribution and Ecology in Illinois: The elongated, squared, flattened shell covered with tubercles—even in the young—makes this species easily recognizable. It is one of the largest mussels found in Illinois, often attaining a length of 6-7 inches; the largest specimens occur more frequently in small to medium-sized rivers such as the Embarrass. The Buckhorn is common, although of local occurrence, in most rivers throughout the state, living on nearly all types of bottom, and at depths varying from a few inches to 8-10 feet or more.

Uniomerus tetralasmus (Say)

Pond-Horn

Plates 13: A; 34: A

Description of Shell: Shell elongated, thin to moderately solid, inflated. Beaks somewhat full, elevated; sculpture consists of 6-7 prominent concentric ridges rounded up sharply behind, appearing to radiate from a central point. Anterior end rounded, posterior end bluntly pointed; posterior ridge long and widely rounded. Usually a few concentric, slightly elevated rest period ridges on the surface. Epidermis yellowish-brown or ashy to dark brown, sometimes banded with lighter shades, often shiny.

Left valve with two elevated (sometimes one being compressed), thin, widely-divergent pseudocardinal teeth; the two lateral teeth long, narrow, straight. Right valve with an elongated, sharp-pointed, finely serrated pseudocardinal tooth, occasionally with a low, thin ridge-like tooth anteriorly; lateral tooth long, thin, straight. No interdentum; beak cavity shallow. Nacre white, generally iridescent.

General Distribution: Mississippi River drainages from Iowa, Illinois and Indiana south to Louisiana, east to western Tennessee, west to Colorado, Oklahoma and the Staked Plains of Texas.

Distribution and Ecology in Illinois: This mussel most frequently inhabits ponds, sloughs, lakes and quiet stretches of rivers, usually on a mud bottom in shallow water. Although widely distributed in Illinois, except for the northeastern quarter, the Pond-Horn is generally uncommon and only very locally does it become numerous.

Alasmidonta calceolus (Lea).

Slipper-Shell

Plate 13: B

Description of Shell: Shell small, rhomboid, moderately solid, slightly inflated. Anterior end rounded, posterior end squared or obliquely truncated. Posterior ridge high, rounded, usually ending as a blunt point at the base of the shell. Beaks moderately swollen, only slightly elevated; sculpture consists of 5-6 irregular, heavy loops, the first one or two diagonal to the hinge line, the others somewhat concentric. Surface with uneven growth lines, the rest

periods as raised, dark-lined ridges. Epidermis in young shells a dull egg-shell white, greenish or yellowish, with numerous wavy green rays; colors darker and rays less distinct in old shells.

Pseudocardinal teeth in both valves somewhat rudimentary, or appearing as elevated, triangular projections, usually doubled in the right valve. Lateral teeth indistinct, being represented as a slight swelling of the hinge line. Beak cavity relatively shallow; interdentum narrow or absent. Nacre a dull white, posterior margin slightly iridescent.

General Distribution: Upper Mississippi River drainage; Ohio, Cumberland and Tennessee rivers; lower and middle sections of the St. Lawrence River system.

Distribution and Ecology in Illinois: Small streams constitute the main habitat of this small mussel, where it may be found buried on a sand bottom in shallow water. The Slipper-Shell occurs only in central (Spoon River) and northern Illinois; in suitable stream environment, it may become quite common locally (Panther Creek, Woodford Co.)

Alasmodonta marginata (Say).

Elk-Toe

Plates 13: C; 34: C

Description of Shell: Shell elongated, somewhat rhomboid, inflated, thin when young, thick and solid when old. Anterior end sharply rounded; ventral margin straight, posterior margin nearly so, meeting in a blunt, squared point. Posterior ridge high, sharply angled, producing a broadly truncated posterior end; numerous fine, radial ridges on the posterior end extending upward toward the margin. Beaks large, inflated, elevated, nearly centrally located on hinge line; sculpture consists of 3-4 heavy, rounded, usually double-looped bars. Epidermis yellowish-brown or greenish, usually marked with numerous greenish or blackish rays, plus many darker spots which appear in connection with the rays.

Pseudocardinal teeth thin, elongated, low; one in the right, sometimes the left with partially-divided pseudocardinal which is an additional interdental projection. Lateral teeth absent, but short hinge line thickened. Beak cavity moderately deep; no interdentum. Nacre bluish-white, slight iridescence, occasionally with shades of pink.

General Distribution: Much of the Mississippi River drainage; from western New York and Pennsylvania, west to Iowa and Missouri; north to Minnesota, Michigan and Ontario, south to Arkansas.

Distribution and Ecology in Illinois: The Elk-Toe occurs in large to medium-sized rivers such as the Rock, Fox and Kankakee, but it is more typical of smaller streams like the Kishwaukee. Occasionally specimens will become established in large rivers; like the preceding species, this mussel is found primarily in small streams and rivers of central and northern Illinois. It prefers a location with good current, a sand or gravel bottom and a depth of several inches to two feet.

PLATE 13. A: *Uniomerus tetralasmus* (Pond-Horn). B: *Alasmidonta calceolus* (Slipper-Shell). C: *Alasmidonta marginata* (Elk-Toe). D: *Tritogonia verrucosa* (Buckhorn).

Plate 14: A

Description of Shell: Shell variable, usually elongated, ovate, often somewhat elliptical or rhomboid, thin to moderately solid, inflated to swollen in the umbone region. Anterior end broadly rounded, posterior end rather bluntly pointed; dorsal margin usually forms a sharp angle with the posterior end. Beaks swollen, moderately elevated; sculpture consists of 4-5 heavy bars, the first two concentric, the rest strongly double-looped. Epidermis yellowish-green, occasionally faintly rayed in young shells; dark brown to black in old shells, often with the umbone area a lighter ash brown. Surface roughened by fine concentric ridges, which indicate rest periods.

Both valves edentulous, lacking both the pseudocardinal and lateral teeth; hinge line usually slightly thickened. Beak cavity shallow. Nacre a dull white, somewhat iridescent and often tinged or washed with cream, pink or salmon.

General Distribution: Entire Mississippi River system; upper St. Lawrence River drainage; Red River of the North; southwest to Texas; Lake Winnipeg, Manitoba, Canada.

Distribution and Ecology in Illinois: Except for areas of rock or shifting sand, the common Floater may be found on any bottom type in nearly all streams, rivers, sloughs, lakes and ponds throughout Illinois. It grows to maximum size (7-8 inches long) in the quiet, moderately deep (3-5 feet), mud-bottom sloughs and backwater ponds of the Mississippi, Illinois, Ohio and Wabash rivers.

Anodonta corpulenta Cooper.

Stout Floater

Plates 14: B; 35: D

Description of Shell: Shell nearly rhomboid, squarish, thin to moderately solid, greatly inflated; anterior end broadly rounded, posterior end diagonally truncated above, rounded below. Dorsal margin straight, meeting both anterior and posterior ends at a sharp angle; shell usually alate on both sides of the umbone, more pronounced behind. Beaks full, high, elevated; sculpture consists of 3-4 irregularly double-looped bars; sometimes appearing only as raised nodules. Surface with raised, thin concentric ridges representing growth or rest periods. Epidermis olive or yellowish-brown, faintly rayed in young shells; color becoming greenish-black in old shells.

Both valves edentulous; hinge line slightly thickened. Beak cavities broad, relatively shallow. Nacre whitish, most of it iridescent, often tinted with pink or salmon, especially in the beak cavity area.

General Distribution: Upper Mississippi River drainage; Missouri River; east to Indiana, apparently south in Louisiana and west to eastern Texas.

Distribution and Ecology in Illinois: This species of Floater is restricted in Illinois primarily to the Mississippi River and to its larger tributaries (Illinois) and backwater areas. Like the preceding species, *Anodonta corpulenta* attains its greatest development in quiet, mud bottomed sections of rivers and sloughs. Because of the thin shell and varied color of the nacre, none of the *Anodonta* group were of commercial value in the pearl button industry.

Plate 15: A

Description of Shell: Shell thin, oblong, inflated. Posterior ridge moderately angled; dorsal and ventral margins nearly straight, parallel. Anterior end rounded, posterior end rather pointed. Beaks flattened, usually flush with the hinge line; sculpture consisting of 5-6 fine, irregular, often broken, somewhat concentric ridges which are somewhat wavy, forming indistinct double-loops. Rest periods are usually marked by distinct concentric ridges, edged with black. Epidermis yellowish or greenish with numerous fine green rays.

Both valves edentulous; hinge line slightly thickened. Nacre bluish-white or silvery, outside margins and posterior end iridescent; shallow beak cavities often cream or light yellowish-brown.

General Distribution: Mississippi River and Great Lakes drainages; from southern Michigan south to Georgia; west to Kansas, Oklahoma and southwest to extreme northeastern Mexico.

Distribution and Ecology in Illinois: The Paper Pond Shell is the smallest of the floaters, rarely exceeding 3½ inches in length. It normally inhabits shallow, quiet waters of the smaller streams and backwater sloughs, or in pools and shallow bank areas of the larger rivers. This extremely thin-shelled mussel may be found in most rivers and ponds throughout Illinois, living on fine sand or, more often, in soft mud.

Anodonta suborbiculata Say.

Heel-Splitter

Plate 15: B

Description of Shell: Shell thin to moderately solid, nearly circular in outline, rather compressed. Anterior and ventral margins broadly curved; posterior margin nearly straight, slightly incurved; dorsal margin straight. Posterior ridge low but distinct, with the dorsal section of the shell behind the beaks alate. Beaks low, flattened; sculpture consisting of 4-5 pairs of slight nodules which appear as irregular or broken double-looped ridges. Epidermis light yellow to dark brown, occasionally young shells with fine green rays; surface smooth and shiny, except for the darker posterior slope.

Both valves edentulous; hinge line only very slightly thickened. Beak cavity large but shallow. Nacre white, most being iridescent, often tinged with salmon near the umbones.

General Distribution: Southern portion of the Mississippi River system; Nebraska, Iowa and Illinois, south to Louisiana.

Distribution and Ecology in Illinois: The lack of hinge teeth, nearly obliquely circular outline, and flattened shells make this large (6 inches in length) mussel easily recognizable. It is probably the least common of the *Anodonta* group in the state, although in some local, well-suited habitats (quiet, mud bottom sloughs and river pools), the Heel-Splitter may become numerous. In Illinois, this species is restricted to the Mississippi River, its backwater areas, and major tributary systems (Illinois, Sangamon, Kaskaskia).

PLATE 14. A: *Anodonta grandis* (Floater). B: *Anodonta corpulenta* (Stout Floater).

PLATE 15. A: *Anodonta imbecillis* (Paper Pond Shell). B: *Anodonta suborbiculata* (Heel-Splitter). C: *Anodontoides ferussacianus* (Cylindrical Paper-Shell)

Plate 15: C

Description of Shell: Shell thin, elliptical, elongated, moderately inflated; anterior end rounded, posterior end bluntly pointed, more inflated and rounded in females; posterior ridge rounded but usually prominent. Dorsal margin nearly straight; ventral margin with a slight indentation or depression, presenting a somewhat "pinched" appearance at mid-point. Beaks slightly to moderately swollen, flattened and only slightly raised above hinge line; sculpture consisting of 3-4 very fine, sharp, concentric ridges, bent up sharply behind. The first two ridges usually oblique to the hinge line, the others forming a distinct angle. Epidermis light green to a yellowish brown, lighter on the beaks, usually with numerous green rays, often very faint in old shells. Black, concentric bands on the surface indicative of rest periods.

Both valves edentulous, but rudimentary pseudocardinal teeth often indicated by irregular swellings on the hinge line beneath the beaks. Remaining hinge line slightly swollen. Beak cavity shallow. Nacre bluish-white, silvery, iridescent at both ends, beak cavity occasionally cream or tinted with salmon.

General Distribution: Mississippi and St. Lawrence river drainages; New York west to Colorado, Red River of the North south to Kentucky and Tennessee.

Distribution and Ecology in Illinois: This small, rather fragile, thin-shelled mussel is found mainly in the northern third of the state, living in small, quiet streams, on a sand or fine gravel bottom in shallow water. The Cylindrical Paper-Shell occasionally becomes numerous locally in clear, unpolluted lakes and streams such as Panther Creek (Woodford Co.), and the Kishwaukee River and Kent Creek in northern Illinois.

Arcidens confragosus (Say).

Rock Pocketbook

Plates 16: A; 33: A

Description of Shell: Shell thin to moderately solid, squarish to nearly rhomboid, inflated. Beaks high, full; sculpture strong, pronounced, consisting of irregular nodules or corrugations which form two loops; base of the loops swollen into knobs which continue onto the umbones and out in two radiating rows, developing into several large rounded ridges or folds on the posterior third of the shell. On either side of the beaks are numerous fine radial bars or ridges. Epidermis dark olive-green to black.

Left valve with two elongated, compressed pseudocardinal teeth, the posterior one under the beak considerably enlarged and curving upward which fits into the hinge line in the right valve; sometimes two short poorly developed lateral teeth, often only a finely serrated thickening of the hinge line. Right valve with a large, erect, triangular pseudocardinal tooth; lateral tooth incomplete or a striated thickening of the hinge line. Beak cavity shallow. Nacre white, iridescent over much of the surface.

General Distribution: Mississippi River drainage; southern Ohio west to eastern Kansas and Texas, north to Minnesota, south to Louisiana.

Distribution and Ecology in Illinois: The Rock Pocketbook is widely distributed in Illinois, mainly in the medium-sized to large rivers, although only very locally (Quiver Lake, along the Illinois River near Havana, for example) does it become numerous. Apparently it is tolerant of quiet water as well as current, usually living at shallow depths on a sand and mud bottom. It is easily recognized by the peculiar beak sculpture. Shells of old individuals may reach a length of 6½ inches (Big Muddy River).

Lasmigona complanata (Barnes).

White Heel-Splitter

Plates 16: B; 33: C

Description of Shell: Shell large, compressed, thin when young, thick when old, nearly rhomboid or irregularly elliptical in outline; including the dorsal wing, nearly as high as long. Anterior end rounded; posterior end squared or obliquely truncated; dorsal margin straight, ascending posteriorly to form a distinct wing which is often marked with several irregular ridges that extend toward the posterior margin. Beaks depressed, flattened; sculpture consists of 4-5 distinct, heavy bars, the first two being simple, the others strongly double-looped. Numerous coarse lines on the shell surface indicative of rest periods. Epidermis yellowish or green in young shells, often faintly rayed; dark brown to black in old shells.

Left valve usually with two, irregular, low, serrated pseudocardinal teeth which stem from on the hinge line; lateral teeth absent in both valves or represented as ridges or thickenings of the hinge line or interdentum. Right valve with a single (often appearing doubled), low, flattened, fan-shaped pseudocardinal tooth. Interdentum narrow, appearing as part of the hinge line. Beak cavity compressed, fairly shallow. Nacre white, most of the surface iridescent; anterior section occasionally cream-colored or pinkish.

General Distribution: Entire Mississippi River drainage north of the Arkansas River; Upper St. Lawrence River drainage, north to the Mackenzie River; Hudson Bay drainage.

Distribution and Ecology in Illinois: Both large and small rivers, as well as creeks, are inhabited by this common and widely distributed species. It prefers quiet water, generally not over two or three feet in depth, and it thrives well on a sand and mud—or only a soft mud—bottom. Occasionally the White Heel-splitter becomes numerous in ponds and lakes (for example, Lake Springfield, Sangamon Co.). This mussel often attains a length of 7 or 8 inches.

Lasmigona compressa (Lea).

Plates 17: A; 33: D

Description of Shell: Shell thin to relatively solid, somewhat rhomboid, elongated, moderately inflated; anterior end rounded, posterior end diagonally truncated. Posterior ridge rounded but usually pronounced, ending dorsally behind the beaks in a short wing which is usually more alate in young shells. Beaks slightly elevated, flattened and forward of the center of the

straight dorsal margin; sculpture consists of 5-8 bars, the first one or two concentric, the next three widely double-looped, and the remaining bars either double-looped or broken wavy ridges. Surface often with pronounced, darkened ridges indicative of rest periods. Epidermis yellowish with numerous wide green rays, often faint anteriorly and dark posteriorly; old shells occasionally become rayless and usually dark brown.

Left valve with two long, thin, nearly separate pseudocardinal teeth; the anterior one low, small, the posterior one elevated, flared upward. Lateral teeth short, thin, one appearing as a posterior extension of the pseudocardinal. Right valve with a low, elongated, thin pseudocardinal tooth, often with a second, much smaller ridge-like pseudocardinal on the hinge line. Lateral teeth short, thin, nearly parallel with the hinge line in both valves. Beak cavity very shallow. Nacre white, usually tinged with cream or salmon in and around the beak cavity; much of the surface iridescent.

General Distribution: Upper Mississippi River drainage; New York west to Nebraska, north to Minnesota, south to Kentucky.

Distribution and Ecology in Illinois: *Lasmigona compressa* is a species associated with creeks, small streams, and headwaters of the larger rivers. It may be found inhabiting sand, fine gravel or mud bottoms, usually preferring quiet waters such as pools below riffles. Apparently this mussel is absent in the southern half of Illinois, and although there are locality records for it in central portions of the state (Vermilion River), it is more numerous and widespread in the northern streams.

Lasmigona costata (Rafinesque).

Fluted Shell

Plate 17: B

Description of Shell: Shell nearly rhomboid, elongated, solid, somewhat compressed; anterior end rather sharply rounded, posterior end obliquely truncated. Posterior ridge usually well developed, with the dorsal/posterior end possessing numerous heavy, rounded flutings or ridges which are usually directed upward towards the margin. Beaks depressed, flattened; sculpture consists of 3-4 strongly developed, heavy bars, parallel with the hinge line. The first is curved, the others more or less double-looped. Surface sculpture consists of coarse lines of growth; rest periods indicated by heavy, prominent concentric ridges, edged with black. Epidermis yellowish with numerous green rays in young shells; mature shells a darker yellow, horn-colored or brownish, becoming black and rayless in old shells.

Left valve with a single (two teeth fused into one) heavy, curved, pyramidal, elevated pseudocardinal tooth. Lateral teeth in both valves represented by thickenings of the hinge line. Right valve with a heavy, low, somewhat elongated pseudocardinal tooth. Interdentum narrow or absent; beak cavity very shallow. Nacre white, with considerable variation in the amount of cream or salmon present; primarily the area between the pallial line and margin iridescent.

PLATE 16. A: *Arcidens confragosus* (Rock Pocketbook). B: *Lasmigona complanata* (White Heel-Splitter).

PLATE 17. A: *Lasmigona compressa*. B: *Lasmigona costata* (Fluted Shell).

Distribution and Ecology in Illinois: The Fluted Shell appears to be more widely distributed in Illinois than the closely related *Lasmigona compressa*, although it also occurs more commonly in the northern third of the state. Both large and small rivers are inhabited; this mussel prefers a gravel bottom in shallow water—a few inches to 2 feet—in current. Some of the heaviest and largest specimens ($6\frac{1}{2}$ inches in length) have been taken in the Embarrass and lower Wabash rivers.

Strophitus rugosus (Swainson).

Squaw Foot

Plates 18: A; 35: E

Description of Shell: Shell elliptical, somewhat rhomboid, solid, compressed when young, moderately inflated in mature and old shells; anterior end rounded, posterior end bluntly pointed and often obliquely truncated. Posterior ridge broadly rounded, either compressed or quite pronounced (especially in old shells). Beaks depressed, only slightly elevated above the hinge line; sculpture consisting of four, heavy concentric bars, somewhat oblique to the hinge line, rounded anteriorly and angled posteriorly. Epidermis yellowish or greenish, marked by greenish, often wavy rays; old shells dark brown or black, usually rayless.

Pseudocardinal tooth in left valve represented by an elongated, low thickening of the hinge line below the beak; pseudocardinal tooth in right valve appearing as a low, thick swelling anterior to the beak. Lateral teeth absent or suggested by a thickened hinge line. Beak cavity shallow. Nacre white or bluish-white, iridescent around the margins, the center and occasionally along the pallial line cream-colored or salmon.

General Distribution: Entire Mississippi River drainage; Lake Winnipeg, Canada; St. Lawrence River drainage; Atlantic drainage to North Carolina; central Texas to the Gulf of Mexico; southeast into Alabama.

Distribution and Ecology in Illinois: The Squaw Foot may be found in suitable habitat throughout the state, from small streams such as the Kishwaukee River in northern Illinois to the lower Wabash and Ohio rivers in the south. Shells of individuals inhabiting smaller streams are typically thin and compressed, while large river specimens possess solid, inflated valves. The Squaw Foot inhabits a sand or mud bottom, at a depth of a few inches to 10 feet or more.

Actinonaias carinata (Barnes).

Mucket

Plate 18: B

Description of Shell: Shell thick, heavy, moderately inflated, large (when mature), compressed when young, somewhat ovate or elliptical; anterior end rounded, posterior end bluntly pointed. Posterior ridge rounded, often slight but in some individuals quite pronounced. Beaks swollen but only slightly elevated above the dorsal margin; sculpture consisting of a few, delicate, usually distinct double-looped bars, usually evident only in young shells. Growth lines on the surface often pronounced at rest periods, becoming dark

bordered. Epidermis yellowish, greenish or brownish, with numerous broad green rays that gradually increase in width from the umbones; old shells dark brown or black, usually rayless.

Left valve with two heavy, elevated, upright, triangular, serrated pseudocardinal teeth; the two lateral teeth long, heavy somewhat elevated and finely striated. Right valve with a large, elevated, heavy, pseudocardinal tooth, usually with a small, low, cone-shaped tooth in front, more rarely another small one behind. Beak cavity fairly shallow; interdentum long, narrow, often absent. Nacre silvery-white, occasionally tinged with light pink or cream, iridescent posteriorly.

General Distribution: Mississippi River drainage; west to Kansas, north to southern Ontario and Manitoba, Canada; St. Lawrence River drainage; Lake St. Clair and Lake Erie drainages; Niagara River system; Lake Ontario.

Distribution and Ecology in Illinois: This mussel is characteristic primarily of medium-sized and large rivers, although it may become established locally in deeper portions of smaller rivers such as the Embarrass, Salt Fork and Fox. The Mucket thrives on a coarse sand and gravel bottom, more rarely on fine sand and mud; it usually occurs at depths varying from a few inches to 3-4 feet. Mature specimens having an unblemished nacre were valued in the pearl button industry.

Actinonaias ellipsiformis (Conrad).

Ellipse

Plate 18: C

Description of Shell: Shell oblong to elliptical, solid, small (not exceeding 3 inches), compressed; anterior end rounded, posterior end bluntly pointed. Posterior ridge usually distinct, rounded, with a flattened area behind. Beaks only slightly elevated above the hinge line, flattened; sculpture consists of 3-4 faintly double-looped feeble bars, usually evident only in young shells. Growth lines usually heavy, especially at rest periods, sometimes forming concentric ridges. Epidermis greenish-yellow with many dark green rays, more distinct on the posterior half of the shell.

Left valve with two thick, heavy, triangular, divergent, roughened pseudocardinal teeth; the two lateral teeth, relatively short, thick, heavy, finely striated. Right valve with a thick, heavy, triangular pseudocardinal tooth; usually an elongated, narrow, low tooth in front. Interdentum fairly narrow or absent; beak cavity shallow. Nacre bluish-white, iridescent posteriorly.

General Distribution: Upper Mississippi River drainage; western New York west to Iowa and Missouri; Red River of the North; southern Canada.

Distribution and Ecology in Illinois: The Ellipse typically inhabits streams and small rivers (Kishwaukee, Fox), and is restricted in its distribution in Illinois mainly to the northern third of the state. This small, heavy mussel is usually found on a sand and gravel bottom, commonly on riffles in swift current, and normally at depths of less than one foot.

PLATE 18. A: *Strophitus rugosus* (Squaw Foot). B: *Actinonaias carinata* (Mucket). C: *Actinonaias ellipsiformis* (Ellipse).

Plates 19: A; 35: B

Description of Shell: Shell small (not exceeding 2 inches in length), relatively solid, nearly elliptical, moderately inflated; both anterior and posterior ends rounded. Adult females are more cylindrical and swollen posteriorly. No posterior ridge; posterior slope somewhat flattened and compressed. Beaks slightly inflated and elevated above hinge line; sculpture consists of 5-6 distinct, generally concentric bars, the last 3-4 forming a blunt angle posteriorly. Epidermis thick, dark brown or black, rayless. Growth lines usually coarse, producing slightly elevated ridges.

Left valve with two compressed, somewhat triangular, elevated, roughened pseudocardinal teeth; the two lateral teeth straight, long, erect. Right valve with a thin, elongated, erect pseudocardinal tooth; lateral tooth long, thin, elevated. No interdentum; beak cavity shallow. Nacre silvery-white, generally iridescent.

General Distribution: Entire Mississippi River drainage; western New York west to Iowa, Kansas and central Texas, north to southern Canada and Michigan, south to Louisiana.

Distribution and Ecology in Illinois: The Liliput Shell is the smallest of all Illinois mussels (except for the fingernail clams), and it occurs throughout the state in small streams, large rivers, and lakes. This mussel is found most often on a mud bottom, in shallow, quiet water; it may become abundant locally (for example Lake Pana, Shelby Co.). It has also been observed inhabiting the shallow, mud banks and backwater sloughs of the Illinois River in considerable numbers.

Carunculina glans (Lea).

Plate 19: B

Description of Shell: Shell small (not exceeding 2 inches in length), relatively solid, somewhat globose; anterior end rounded, posterior end squarish or obliquely truncated. Beaks inflated, moderately elevated; sculpture consists of 3-4, distinct concentric bars, similar to the preceeding species but occasionally broken or incomplete. Epidermis thick, dark green to yellowish brown, usually faintly rayed over the anterior end in young shells.

Pseudocardinal and lateral teeth similar to *Carunculina parva*, but in some individuals becoming thicker, higher and more deeply serrated. No interdentum; beak cavity shallow. Nacre light purple, anterior and ventral margins usually white, iridescent posteriorly.

General Distribution: Ohio River drainage; southwest to Arkansas, southeast to Georgia.

Distribution and Ecology in Illinois: In an early catalogue of the mollusca of Illinois, Baker (1906) lists this species from the Little Wabash and Vermilion rivers in eastern Illinois; Goodrich and van der Schalie (1944) record it from the Wabash River. Although this species may be locally numerous in

parts of its range, *Carunculina glans* is apparently uncommon to rare in Illinois and restricted to tributaries of the Wabash and Ohio rivers. It may be found on mud, but this mussel has been reported as thriving best on sand or fine gravel beds, in shallow running water.

Carunculina texasensis (Lea).

Plate 19: C

Description of Shell: Shell oblong, somewhat elliptical, fairly thin but strong, inflated; anterior end rounded, posterior end bluntly pointed (males) or squarish or obliquely truncated. Posterior ridge prominent, rounded. Beaks low, often full and inflated in mature individuals, only slightly elevated above hinge line; sculpture consists of 5-6 strong ridges, forming a single loop and are curved upward at a sharp angle behind at the posterior ridge. Female shells often exhibit a strongly developed, rather angular swelling in front of the posterior ridge. Surface usually roughened with concentric, raised growth lines. Epidermis a dull olive-green to reddish-brown, blackish in old shells; rayless, with a satin-like finish.

PLATE 19. A: *Carunculina parva* (Liliput Shell). B: *Carunculina glans*. C: *Carunculina texasensis*.

Left valve with two thin, compressed, elevated, roughened, divergent, pseudocardinal teeth; the two lateral teeth long, thin, nearly straight (in young shells) to considerably curved (in adults). Right valve with a somewhat triangular, compressed, erect, serrated pseudocardinal tooth, occasionally with a low, thin, small tooth above it; lateral tooth long, thin, high. No interdentum; beak cavity shallow. Nacre silvery or bluish-white, the beak cavity and center area often tinged with salmon; anterior and posterior ends iridescent. Generally, this mussel is quite similar to *Carunculina parva*, only larger, and it may be only a form or variant.

General Distribution: Southern Mississippi River drainage; Texas, Louisiana and Mississippi north to Tennessee, Missouri and southern Illinois.

Distribution and Ecology in Illinois: This is the largest and most sporadic in distribution of the three species of *Carunculina* found in Illinois. Although Simpson (1914) includes "southern Illinois" within its range, this species has apparently been taken at only three localities: North Fork, Saline River (Galatin Co.), and in the Big Muddy River and Crab Orchard Lake (Williamson Co.). At Crab Orchard Lake, this mussel was very numerous in several areas, living on a soft mud bottom in 1-2 feet of water; the largest specimens measured 2¼ inches in length.

Cyprogenia irrorata (Lea).

Fan-Shell

Plate 20: A; Frontispiece.

Description of Shell: Shell inflated, thick, solid, somewhat rounded or circular. Ventral margin long, broadly rounded; posterior margin bluntly angled or slightly truncated. Posterior ridge well developed, producing a sharp angle behind the umbones, becoming rounded towards the ventral-posterior margin; sometimes with a shallow groove between the ridge and dorsal margin (on the flattened posterior slope). Posterior two-thirds of the shell covered with numerous rounded pustules and irregular knobs; those on the center of the valve often appearing in rows, being located on the distinct, elevated concentric ridges indicative of growth periods. Beaks elevated, full; sculpture consists of a few indistinct, feeble ridges. Epidermis a pale greenish-yellow, covered with a pattern of darker green flecks or dots which may appear as rays; knobs and ventral area often lighter with less green.

Left valve with two low, thick, divergent, roughened pseudocardinal teeth; the two lateral teeth are slightly curved, short, heavy (inner tooth much broader than the outer), roughened. Right valve with a low, triangular, deeply serrated pseudocardinal tooth; lateral tooth short, low, finely striated with an indication of a second, inner, flattened tooth. Interdentum wide, flat; beak cavity very shallow. Nacre silvery-white, iridescent posteriorly.

General Distribution: Ohio, Cumberland and Tennessee river systems.

Distribution and Ecology in Illinois: This attractive mussel is now restricted to the lower Wabash River in Illinois where it is relatively uncommon to rare. Shells recovered from Indian middens along the banks of the Ohio River in the southeastern part of the state attest to its former occurrence in

that stretch of the river, but recent collections have failed to recover living specimens. In the Wabash River in Illinois, this species has been found living on a coarse sand and gravel bottom, in current, and at depths of a few inches to two feet.

Dysnomia perplexa (Lea).

Plate 20: B; Frontispiece.

Description of Shell: Shell thick anteriorly, much thinner posteriorly, irregularly ovate, somewhat elliptical and inflated; anterior-ventral margin rounded, posterior end squarish or obliquely truncated. Posterior-dorsal ridge pronounced, broadly rounded, often exaggerated by the presence of low, narrowly rounded knobs. Beaks low, full, somewhat turned forward; sculpture consists of 2-3 indistinct, feeble ridges, evident only in very young shells. A diagonal row of large, narrow elongated tubercles or knobs usually present, starting near the beaks and continuing at a gradual angle to the ventral margin. In some specimens these knobs may be indistinct, while in others only 2 or 3 enlarged knobs occur. Typically a wide, shallow sulcus or depression is present between the row of knobs and the posterior ridge. Epidermis a light yellow, patterned with numerous narrow green rays; occasionally the rays are so close and numerous as to give the shell a uniform green appearance. Old shells and some forms are rayless or with very faint rays.

Left valve with two triangular, heavy, divergent, roughened pseudocardinal teeth, often joined anteriorly; the two lateral teeth short, thick, striated, slightly curved. Right valve with a center triangular, elevated serrated pseudocardinal tooth, with a small tubercular tooth in front and a low elongated pseudocardinal above; usually two lateral teeth present which are short, heavy, roughened. Interdentum relatively narrow or absent; beak cavity fairly shallow.

General Distribution: Ohio and Tennessee river drainage; Lake Erie.

Distribution and Ecology in Illinois: Presently *Dysnomia perplexa* is an uncommon or rare mussel in Illinois, occurring rather sporadically in the lower Wabash and Ohio rivers. Although typically a small species, shells collected by mussel fishermen in the Ohio River near Metropolis are large and measure 3 inches in length. It is usually found in a coarse sand and gravel bottom, in current and at depths varying from a few inches to 4-6 feet.

Dysnomia triquetra (Rafinesque).

Snuffbox

Plate 20: C; Frontispiece.

Description of Shell: Shell small (not exceeding 2½ inches in length), thick, solid, moderately inflated, triangular, somewhat four-sided. Anterior end rounded, posterior end truncated; posterior ridge sharply defined, angled, the posterior end is widely flattened. Beaks swollen, elevated above the hinge line; sculpture consists of 3-4 faint, more or less double-looped bars. Epidermis yellowish or yellowish-green, patterned with numerous dark green rays which usually appear as squarish, triangular or chevron-shaped spots; the flattened

PLATE 20. A: *Cyprogenia irrorata* (Fan-Shell). B: *Dysnomia perplexa*. C: *Dysnomia triquetra* (Snuffbox).

posterior end usually lacks the larger, irregular markings, but instead is covered with a more uniform series of very fine chevron-shaped marks.

Left valve with two elevated, strong, roughened, relatively thin pseudocardinal teeth; the two lateral teeth short, strong, serrated, elevated. Right valve with two pseudocardinal teeth, the front one thinner, lower and less massive than the large triangular, elevated, serrated inner tooth. No interdentum; beak cavity fairly deep.

General Distribution: Mississippi River drainage; western New York west to Nebraska and Kansas, north to Minnesota, south to northern Alabama.

Distribution and Ecology in Illinois: This small, thick-shelled mussel is usually found in medium-sized (Kankakee) and large (Mississippi) rivers. Although there are a few early records of the Snuffbox from the southern half of the state, it now appears to be restricted to the northern third of Illinois. It usually inhabits bottoms composed of sand and coarse gravel, often in riffles in running water, and most individuals bury themselves deeply in sand and are easily overlooked by collectors.

Lampsilis anodontoides (Lea).

Yellow Sand-Shell; Banana Shell

Plate 21: A; Frontispiece.

Description of Shell: Shell large, elongated, thick, moderately inflated. Anterior end rounded, posterior end pointed, or somewhat truncated and inflated in mature females. Dorsal and ventral margins straight, nearly parallel, posterior ridge rounded, low. Beaks full, not much elevated above the hinge line; sculpture consists of a few, indistinct ridges. Epidermis a pale to bright yellowish, rarely faintly rayed when young, smooth, shiny; beak area frequently washed with a reddish or brownish shade.

Left valve with two elevated, compressed, elongated, serrated pseudocardinal teeth; the two lateral teeth long, nearly straight, finely striated. Right valve with two pseudocardinal teeth, the front one low, elongated; the posterior pseudocardinal triangular, erect, heavy, somewhat compressed. Lateral tooth in right valve long, solid, roughened. No interdentum; beak cavity fairly shallow. Nacre silvery-white, the beak cavity area sometimes tinged with cream or pinkish; iridescent posteriorly.

General Distribution: Entire Mississippi River drainage; north to eastern South Dakota, south to northern Mexico; all of the Gulf of Mexico drainage from the Withlacoochee River, Florida, to the Rio Grande River. This distribution includes the species *Lampsilis fallaciosa*, since some authors consider it a subspecies, form or type of *Lampsilis anodontoides* because of the close structural and ecological similarities.

Distribution and Ecology in Illinois: The Yellow Sand-Shell, or Banana Shell as it is called by the mussel fishermen, occurs primarily in the Mississippi, Ohio and lower Wabash rivers and their tributaries. Smaller rivers such as the Embarrass may support abundant local populations, but it is primarily a large river species where adults reach a shell length of 6 to 7 inches. This mussel is quite diversified in its adjustment to a variety of habitats, since it has been

found living on sand, gravel and mud bottoms, in either swift or slow current, and at depths that vary greatly. Because of its uniform thickness and luster of the nacre, the Yellow Sand-Shell was perhaps the most valued shell used in the pearl button industry.

Lampsilis fallaciosa Rafinesque.

Slough Sand Shell

Plates 21: B; 35: C

Description of Shell: Shell similar to the preceding species except somewhat more cylindrical and elongated. Mature specimens often possess a slight constriction or indentation about mid-point along the ventral margin, giving it a "pinched" appearance. Beak sculpture consists of 8-10 distinct ridges which are looped and drawn together in the middle; these ridges continue anteriorly, but are often open and wavy posteriorly. These ridges are more distinct than in the Yellow Sand-Shell. Epidermis light yellow, more greenish-yellow in young shells; surface smooth and shiny, with numerous dark green rays covering the greater part. Pseudocardinal and lateral teeth, and interior similar to *Lampsilis anodontoides*.

General Distribution: Upper Mississippi River drainage; south to Tennessee and Arkansas.

Distribution and Ecology in Illinois: This species—or form—is widely distributed throughout the state in small streams as well as in the large rivers. It is often locally numerous, and is typically an inhabitant of muddy sloughs, ponds and pools of rivers where there is little current. The name Bank-Creeper has also been applied to this species, probably because it occurs most commonly in shallow water on mud banks of most of the large rivers in the state.

Lampsilis fasciola Rafinesque.

Plate 21: C; Frontispiece.

Description of Shell: Shell rather solid, thinner posteriorly, moderately inflated, somewhat ovate, oblong; anterior end rounded, posterior end bluntly pointed. Posterior ridge or slope broadly rounded; posterior-dorsal margin usually compressed, appearing alate. Beaks full, depressed, only slightly elevated above the hinge line; sculpture consists of several indistinct, fine wavy ridges. Surface shiny, usually with numerous, raised growth lines. Epidermis thin, light yellow or yellowish green, the umbones often tinged with reddish-brown; surface densely patterned with green rays of varying widths, characteristically wavy in appearance, and often interrupted at the lines of growth.

Left valve with two triangular, short, thick, rather widely separated pseudocardinal teeth; the two lateral teeth short, thick, nearly straight, widely separated. Right valve with a large, coarsely serrated heavy, erect, pseudocardinal tooth, sometimes with a suggestion of a smaller tooth on either side as slightly roughened, raised areas; lateral tooth wide, short, elevated. Interdental narrow or absent; beak cavity wide, moderately deep. Nacre white, iridescent posteriorly.

General Distribution: Entire Ohio River drainage; southern Michigan.

PLATE 21. A: *Lampsilis anodontoides* (Yellow Sand-Shell). B: *Lampsilis fallaciosa* (Slough Sand Shell). C: *Lampsilis fasciola*.

Distribution and Ecology in Illinois: Baker (1906) records this species as occurring from Cook Co. to southern Illinois in the eastern part of the state, but presently it is apparently restricted to the Big Vermilion River and its tributaries in east-central Illinois. Specimens have been found at a few other locations, but this species can be considered fairly uncommon throughout its range in Illinois. Individuals collected in Middle Fork and Salt Fork, tributaries of the Big Vermilion River, were found on a coarse sand and gravel bottom, with little mud, in current, and in less than one foot of water.

Lampsilis orbiculata (Hildreth).

Plate 23: B

Description of Shell: Shell thick, solid, somewhat compressed, elliptical or rhomboid; anterior end rounded, posterior end rounded in the male, squarish or truncated in the female. Posterior ridge rather sharply angled, compressed or flattened above. Beaks large, broad, depressed, usually eroded, with the sculpture of faint ridges evident in only very young specimens. Epidermis thin, dull buff or yellow; rarely feebly rayed, usually rayless.

Left valve with two low, solid, triangular, serrated, divergent pseudocardinal teeth; the two lateral teeth short, heavy, finely striated, the inner tooth higher, thicker and larger than the dorsal one. Right valve with a low, thick, triangular pseudocardinal tooth, usually with a much smaller tubercular tooth on either side; lateral tooth short, straight, wide, roughened. Interdentum moderately wide; beak cavity fairly deep. Nacre white, iridescent along the hinge line area and posteriorly, beak cavity and center area usually tinged with salmon or pink.

General Distribution: Ohio and Cumberland river systems.

Distribution and Ecology in Illinois: This mussel is limited in its habitat to large rivers, and in Illinois it occurs in the Ohio River and possibly the lower Wabash River. Apparently little is known concerning typical depths and bottom types in which this species occurs except that it is taken by mussel fishermen usually in deep water. *Lampsilis orbiculata* is an uncommon to rare mussel in Illinois.

Lampsilis bigginsii (Lea).

Higgin's Eye

Plate 23: A

Description of Shell: Shell oval, elliptical or rhomboid, somewhat inflated, thick heavy; anterior end rounded, posterior end bluntly pointed in the male, truncated in the female. Beaks directed forward, swollen, elevated; sculpture consists of a few, slightly looped feeble ridges. Posterior ridge rounded but distinct. Surface usually shiny marked by irregular growth lines which are more pronounced at rest periods where they become dark colored. Epidermis yellowish or olive, with faint to quite distinct green rays.

Left valve with two triangular or pyramidal, thick, erect, divergent, serrated pseudocardinal teeth; the two lateral teeth heavy, moderately thick and short, roughened. Right valve with a large, erect, massive, triangular pseudocardinal tooth, usually with a much smaller, curved, roughened, tubercular tooth in front. Interdentum fairly narrow; beak cavity deep. Nacre silvery-white, often tinged with pink; iridescent posteriorly.

General Distribution: Mississippi River and its larger tributaries.

Distribution and Ecology in Illinois: *Lampsilis bigginsii* appears to be the Mississippi River counterpart of the Ohio River species *Lampsilis orbiculata*; possibly one is only a form or variant of the other. Although Simpson (1914) found this mussel "fairly abundant in the Illinois River near Utica," it no longer occurs in that river and appears to be restricted primarily to the upper Mississippi River. Even within its present range, this mussel is uncommon and, like the Ohio River form *Lampsilis orbiculata*, little is known about its habitat requirements other than it is a large river, deep water form.

Lampsilis siliquoides (Barnes)

Fat Mucket

Plate 22: A

Description of Shell: Shell thin to very thick and heavy in large river forms, moderately large, somewhat elliptical or ovate; rather compressed in males and in young individuals, more swollen in females and old shells. Anterior end rounded, posterior end bluntly pointed (males) or obliquely truncated (females); posterior ridge rounded although usually indistinct, the shell often flattened dorsally. Beaks flattened, only slightly elevated above the hinge line; sculpture consists of 6-10 fine, wavy, double-looped bars. Epidermis yellowish, often tinged with reddish-brown, smooth, shiny, usually with numerous dark green rays which vary considerably in width and quantity; old individuals darker. Growth lines often distinct, especially at rest periods.

Left valve with two, widely-divergent, erect, elongated and thin to triangular and thick, roughened pseudocardinal teeth; the two lateral teeth usually straight, thin to moderately heavy, erect. Right valve with an erect, somewhat flattened, thin to heavy pseudocardinal tooth, usually with a low, thin ridge-like tooth in front. No interdentum; beak cavity shallow. Nacre silvery or bluish-white; iridescent posteriorly and often over much of the surface.

General Distribution: Entire Mississippi River drainage; western New York west and north to Minnesota and North Dakota, southwest to Texas, southeast into Louisiana; all of Canada east of the Rocky Mountains.

Distribution and Ecology in Illinois: The Fat Mucket is wide-ranging and often locally abundant in Illinois, occurring in small streams as well as in the large rivers where individuals usually develop a heavy, inflated shell. However, it is normally less numerous in large rivers. This mussel may be found in nearly all bottom types, but usually in areas of quiet and relatively shallow (less than 3 feet) water. Because of its uniform thickness and clear luster of the nacre, it was highly valued for buttons.

PLATE 22. A: *Lampsilis siliquoidea* (Fat Mucket). B: *Lampsilis ventricosa* (Pocketbook). C: *Lampsilis ovata* (Pocketbook).

Plates 22: B; 33: B

Description of Shell: Shell large, thin when young, solid and often heavy when old, somewhat ovate or elliptical, inflated, swollen and high in old females. Anterior end sharply rounded, posterior end bluntly pointed at the union of the dorsal and ventral margins; posterior slope flattened or slightly convex. Anterior area in front of umbones often extended and somewhat alate. Beaks swollen, elevated; sculpture consists of 4-5 coarse bars, of which the second and third may appear slightly double-looped, the others indistinct. Lines of growth usually distinct, sometimes elevated into low ridges at rest periods. Epidermis smooth, shiny, yellowish-green, the umbones often a lighter tan; usually with numerous dark green rays of varying numbers and widths.

Left valve with two heavy pseudocardinal teeth, somewhat compressed, elevated and roughened in young individuals, squarish or stumpy in old specimens; the two lateral teeth high, straight, fairly long, striated. Right valve with a heavy, erect, high, somewhat triangular pseudocardinal tooth, usually with a thin, elongated, moderately elevated tooth in front, and occasionally a small peg-like tooth behind; the lateral tooth is high, straight and characteristically squared-off or abruptly truncated at the posterior end. Interdentum very narrow; beak cavity broad, deep.

General Distribution: Mississippi River drainage; New York west to eastern Kansas, north to Minnesota, south to northern Arkansas and Tennessee; St. Lawrence River drainage; southern drainages of Hudson Bay.

Distribution and Ecology in Illinois: This mussel inhabits a variety of habitats in most of the streams and large rivers throughout the state. It occurs commonly in such rivers as the Wabash, Little Wabash, Kaskaskia, Mississippi, Vermilion and Rock, but in some rivers where it was once numerous (Sangamon, Illinois) it has nearly disappeared. The Pocketbook thrives on a sand or gravel bottom, in current and at depths of less than one foot to over 10 feet. Because of its size and depth of the valves, shells of this species were used extensively by prehistoric Indians for spoons.

Lampsilis ovata (Say).

Pocketbook

Plate 22: C

Description of Shell: Shell similar in structure and outline to *Lampsilis ventricosa*, but more ovate, inflated, globose; umbones large, full, greatly elevated above the hinge line. Posterior-dorsal ridge high, prominent, sharply angled; the dorsal surface wide, flattened. Epidermis a dull yellowish to yellowish brown, darker on the posterior slope, mostly rayless except for occasionally a few thin, faint green rays on the umbones; young specimens sometimes with numerous dark green rays. The two pseudocardinal teeth in both valves thick, compressed, elevated; the lateral teeth slightly curved, short, high. Interdentum narrow; beak cavity large, wide, deep. Nacre pearly white; iridescent posteriorly.

General Distribution: Ohio River drainage.

Distribution and Ecology in Illinois: *Lampsilis ovata* is decidedly a large river species, and in Illinois it occurs only in the lower Wabash and Ohio rivers. This mussel is closely related to the preceding species of Pocketbook, and some authorities consider *Lampsilis ventricosa* as a form or variant of this large river species. As one progresses downstream (in the Wabash and Ohio rivers), the shell of the more common and diversified northern form *Lampsilis ventricosa* changes; the beaks are more centrally placed and the posterior ridge is higher and more sharply angled. These southern forms are then identified as *Lampsilis ovata*. In its true form, this species of Pocketbook is rare in the lower Wabash River, and only moderately common in the Ohio River where it occurs in deep water (usually 6-10 feet or more), in current and on a sand or gravel bottom.

Leptodea fragilis (Rafinesque).

Fragile Paper Shell

Plate 24: A; Frontispiece.

Description of Shell: Shell large, thin, brittle, compressed, somewhat elliptical, oblong; anterior end rounded, posterior end obliquely truncated. Posterior ridge indistinct, the dorsal area behind the umbones flattened and extended into a wing, the alate condition reaching maximum development in mature shells, becoming greatly reduced or obliterated in old individuals. Beaks flattened, only slightly elevated above the dorsal margin; sculpture consists of 3-4 feeble bars, the first being concentric, the others double-looped, but all usually very faint. Epidermis smooth, yellow or yellowish-green, usually with numerous light green, indistinct rays, but rayless yellow shells are not uncommon. Surface marked with concentric growth lines, often dark at the rest periods.

Pseudocardinal teeth—two in the left valve and one in the right valve—low, small, thin, compressed, parallel with the hinge line. Left valve with two long, thin, compressed lateral teeth, the inner one often weakly developed; the right valve with one long, thin, elevated lateral tooth. No interdentum; beak cavity shallow. Nacre silvery-white, usually tinged with pink dorsally and posteriorly; much of the inner surface iridescent.

General Distribution: Mississippi River drainage; New York west to Kansas and Iowa, south to Texas, Mississippi and Alabama, north to Minnesota. St. Lawrence River drainage; Red River of the North; Hudson River.

Distribution and Ecology in Illinois: The Fragile Paper Shell is wide-ranging and usually common in both the smaller streams and large rivers of Illinois. It is apparently tolerant of a variety of bottom types, from pure sand to an all mud bottom, and it may occur in both deep and shallow water, although usually in quiet areas. Because of the thin, brittle shell, it was of no commercial value.

A

B

PLATE 24. A: *Leptodea fragilis* (Fragile Paper Shell). B: *Leptodea laevis* (Pink Paper Shell).

Plate 24: B

Description of Shell: Shell similar in structure and outline to the Fragile Paper Shell; thin, compressed ventrally and posteriorly, slightly inflated at the umbones. Anterior and posterior ends rounded. Posterior ridge broadly rounded, indistinct; the dorsal area behind the beaks alate. Beaks compressed, flattened, not elevated above the dorsal margin; beak sculpture consisting of several small, indistinct, nodulous broken ridges. Surface with prominent growth lines, raised into low ridges at rest periods. Epidermis shiny, yellowish or olive-green, tan, dark brown or blackish in old shells; usually rayless.

Pseudocardinal teeth—usually two in each valve—thin, long, low, slightly roughened. Left valve with two long, thin, elevated lateral teeth, the inner one weakly developed. Right valve with a long, thin, straight, high lateral tooth. No interdentum; beak cavity shallow. Nacre typically light pink, bluish-iridescent anteriorly and posteriorly.

General Distribution: Mississippi River drainage; western New York west to Kansas and eastern Texas, north to Minnesota, south to Louisiana.

Distribution and Ecology in Illinois: This species of Paper Shell, sometimes referred to as the Fragile Heel-Splitter, is restricted primarily to medium-sized and large rivers in the southern half of the state. It is generally common in the Mississippi River as far north as the mouth of the Rock River; the species is uncommon to rare in the Rock River, however. The Pink Paper Shell may be found abundantly in lower Wabash and Ohio rivers—and formerly in the Illinois and Sangamon rivers—but in other river systems where it occurs (for example, the Kaskaskia, Spoon, Embarrass), it is uncommon to rare. Like the Fragile Paper Shell, this mussel may inhabit sand, gravel or mud bottoms, in quiet water or in current, and at greatly varying depths. Occasionally this Paper Shell becomes established in lakes (for example, Lake Springfield) where it may become extremely numerous.

Ligumia recta (Lamarck)

Black Sand Shell

Plate 23: C

Description of Shell: Shell large, solid, elongated, somewhat elliptical and compressed; anterior end rounded, posterior end pointed, dorsal and ventral margins usually straight, parallel. Posterior-dorsal ridge rounded, more distinct just behind the umbones and flattened above. Beaks low, only slightly elevated above the hinge line; sculpture consists of 3-5 indistinct, double-looped bars. Epidermis dark green, brown or blackish; young shells with numerous faint green rays, usually obliterated in older, dark shells; surface often marked by color bands of dark green or black, indicative of rest periods, sometimes raised into ridges.

Left valve with two somewhat triangular, compressed, serrated, divergent pseudocardinal teeth; the two lateral teeth long, straight, elevated. Right valve with a heavy triangular, erect, roughened pseudocardinal tooth, usually

with a small low, flattened tooth anteriorly. Interdentum narrow or absent; beak cavity shallow. Nacre sometimes white, usually pink to deep purple, light iridescence posteriorly.

General Distribution: Mississippi River drainage; western New York west to South Dakota and Kansas, north to Minnesota; Manitoba, Ontario, and Quebec, Canada; south to Louisiana, Alabama and Georgia.

Distribution and Ecology in Illinois: The Black Sand Shell is usually associated with medium-sized to large rivers throughout the state, although it tends to reach maximum size and is most numerous in such rivers as the Rock and Fox in northern Illinois. This mussel is usually found in areas of strong current, on coarse sand or gravel bottoms, and at depths varying from a few inches to 3-4 feet.

Ligumia subrostrata (Say).

Pond Mussel

Plates 23: D; 34: D

Description of Shell: Shell fairly solid, elongated, somewhat elliptical, moderately inflated; anterior end rounded posterior end bluntly pointed, more sharply so in the male. Posterior-dorsal ridge prominent, rounded, the shell sometimes appearing slightly alate dorsally behind the umbones. Beaks full, slightly elevated above the hinge line; sculpture consists of 6-10 distinct, delicate ridges drawn up in the middle. Shell of the mature female narrower in front, with an enlarged, rounded swelling on the posterior end, starting at about the center of the valve. Epidermis a dull, greenish-yellow, changing to a dark reddish-brown or black in old individuals; usually with faint, dark green rays on posterior half of shell.

The two pseudocardinal teeth in each valve compressed, thin, moderately elevated, divergent in the left valve, the edges roughened. Lateral teeth—two in the right valve, one in the left—long, straight, thin. Interdentum very narrow or absent; beak cavity fairly shallow. Nacre white, iridescent posteriorly and in the adductor muscle scars.

General Distribution: Entire Mississippi River drainage; north as far as Wisconsin and South Dakota.

Distribution and Ecology in Illinois: Shallow lakes, ponds, sloughs and quiet pools in rivers are the preferred habitats of this species. Individuals are usually found in less than a foot of water on a mud bottom. It is a widely distributed and locally common mussel in Illinois waters, and it may become exceeding abundant in some areas (for example, Crab Orchard Lake, Williamson Co.; Lake Springfield, Sangamon Co.).

Villosa (= *Micromya*) *iris* (Lea).

Rainbow-Shell

Plates 25: A; 35: A

Description of Shell: Shell small (not exceeding 3 inches in length), elongated, nearly elliptical, compressed; fairly solid anteriorly, posterior half much thinner. Anterior end rounded, posterior end bluntly pointed; posterior ridge

broadly rounded, sometimes often indistinct or absent. Beaks small, only slightly elevated above hinge line; sculpture consists of 4-6 fine, distinct bars, the first concentric, the others usually double-looped. Epidermis yellow or greenish-yellow, patterned with characteristic wide, usually straight dark green rays, often broken and forming elongated squarish bands. Rest periods are indicated by darker bands of color, or by a regular interruption of the rays.

Left valve with two triangular, solid, elevated, divergent, roughened pseudocardinal teeth; the two lateral teeth long, straight, thin. Right valve with a heavy, somewhat triangular, erect, serrated pseudocardinal tooth, usually with a small, low, flattened tooth in front; lateral tooth long thin, fairly high, roughened. No interdentum; beak cavity shallow. Nacre silvery-white, the thin posterior third or half iridescent.

General Distribution: Upper Mississippi and Ohio river drainages; western New York west to Wisconsin, north to North Dakota and Ontario, Canada.

Distribution and Ecology in Illinois: This small mussel is found most often in creeks and small to medium-sized shallow rivers. Presently it occurs in such rivers as the Kankakee, Fox and Vermilion, and is generally restricted to these and other streams in the northern third of the state. The Rainbow-Shell lives on a sandy or sand/mud bottom, in or below riffles, usually in less than 2 feet of water.

Villosa (= *Micromya*) *lienosa* (Conrad).

Plate 25: B

Description of Shell: Shell small (not exceeding 3 inches in length), thin but strong with the anterior half being the thickest, moderately inflated, somewhat elliptical in outline. Anterior end rounded, posterior end in the male rounded or bluntly pointed, in the female squarish or obliquely truncated. Posterior ridge broadly rounded; shell of the female considerably inflated posteriorly, with the dorsal area behind the umbones somewhat compressed and alate. Beaks moderately inflated and elevated above hinge line; sculpture consists of 4-6 fine, distinct, more or less double-looped bars. Epidermis usually a uniform chestnut or dark brown; some individuals faintly rayed with green.

Lateral and pseudocardinal teeth similar to those of the Rainbow-Shell, except the pseudocardinals usually more compressed and elevated in left valve of *Villosa lienosa*. Nacre whitish, often tinged with salmon or pink; the thin, posterior area iridescent.

General Distribution: Lower Mississippi River drainage; north to lower Ohio and Wabash rivers; northern Florida west to Texas.

Distribution and Ecology in Illinois: Baker (1922) reported this species from tributaries of the Big Vermilion River and from the Spoon River, and there are earlier records of it from the Saline River and "southern Illinois." However, it is now apparently very sporadic in its occurrence in southern and eastern Illinois, and may be considered rare. This mussel inhabits streams and small rivers, and is usually found in shallow water on a sand/mud bottom.

PLATE 25. A: *Villosa iris* (Rainbow-Shell). B: *Villosa lienosa*.

Obliquaria reflexa Rafinesque.

Three-Horned Warty-Back

Plate 26: A; Frontispiece.

Description of Shell: Shell solid, thick, inflated, generally oval in outline; anterior-ventral end broadly rounded, posterior end usually bluntly pointed, somewhat truncated. Posterior ridge well developed. A row of 3-5 large, rounded, elevated, elongated knobs present and extending from the beaks to the center of the ventral margin; the knobs of one valve alternate in position with those of the other valve. Often a broad, shallow sulcus or depression present between the row of knobs and the posterior ridge. Beaks elevated, prominent, curved inward; sculpture consists of 4-5 heavy, parallel ridges, low in front and curved upwards behind. Epidermis a dull yellow or yellowish-brown, often becoming a dark reddish-brown or black in old shells; usually—but often faintly—rayed with numerous fine, dark green, broken rays.

Left valve with two strong, heavy, somewhat elevated, ragged pseudocardinal teeth, sometimes joined anteriorly; the two lateral teeth straight, short, wide, serrated. Right valve with a massive, deeply serrated, pseudocardinal tooth, having the appearance of rising from a pit, often with the area in front slightly elevated and roughened, producing a low curved tooth; lateral tooth wide, short, striated, sometimes with a second low, incomplete, lateral tooth evident. Interdentum flat, usually fairly wide; beak cavity moderately deep. Nacre pearly-white; iridescent posteriorly.

General Distribution: Mississippi River drainage; western Pennsylvania west to Kansas, Oklahoma and Texas; Ontario, Canada; north to Minnesota; southeast to Georgia.

Distribution and Ecology in Illinois: The Three-Horned Warty-Back is a medium-sized to large river species, although it may occasionally inhabit smaller rivers such as the South Fork, Sangamon River, and in the upper reaches of such rivers as the Rock and Kaskaskia. It is most numerous in the lower Wabash, Ohio and Mississippi rivers where it thrives on a coarse sand or gravel, more rarely mud-bottom, in flowing water, and at depths varying from several inches to 6 feet or more.

Obovaria olivaria (Rafinesque).

Hickory-Nut

Plate 26: B

Description of Shell: Shell thick, heavy, ovate or elliptical, inflated; anterior end broadly rounded, posterior end broadly rounded in the female, more bluntly pointed in the male. Posterior ridge broadly rounded, often indistinct or absent. Beaks swollen, curved inward, placed and directed forward on the shell, elevated considerably above hinge line; sculpture consists of 4-5 delicate bars, more or less wavy or double-looped in appearance, usually evident only in young shells. Surface usually with concentric, dark colored, growth lines, forming low ridges at rest periods. Epidermis olive-green or yellowish, becoming dark brown in old individuals.

Left valve with two thick, solid, roughened, triangular pseudocardinal teeth, sometimes joined anteriorly; the two lateral teeth slightly curved, wide, heavy, fairly long. Right valve with a large, massive, serrated, triangular pseudocardinal tooth, usually with a small, low compressed tubercular tooth anteriorly; lateral tooth wide, elevated thick, often with an inner secondary, low, incomplete lateral tooth developed. Interdentum narrow; beak cavity shallow. Nacre silvery-white, iridescent posteriorly.

General Distribution: Upper Mississippi and Ohio river drainages; western New York west to Kansas, Iowa and Missouri, north to Minnesota; Quebec, Canada; south to Arkansas, Tennessee and northern Alabama.

Distribution and Ecology in Illinois: This mussel inhabits the larger rivers of the state, and it is especially numerous locally in the lower Wabash, Ohio and Mississippi rivers. During periods of low water, the Hickory-Nut may be collected in the lower Wabash River in depths of less than a foot, but normally it occurs in deeper water (4-6 feet or more), usually on a sand or gravel bottom in good current. Another large river, closely related species, *Obovaria retusa* (Lamarck) formerly occurred in the lower Wabash and Ohio rivers, but it has apparently now disappeared from these rivers.

Obovaria subrotunda (Rafinesque)

Plate 26: C

Description of Shell: Shell elliptical to circular in outline, solid, heavy in old individuals, inflated; all margins generally rounded, the posterior end sometimes blunt in females. Posterior-dorsal ridge or slope rounded, indistinct.

A

B

C

PLATE 26. A: *Obliquaria reflexa* (Three-Horned Warty-Back). B: *Obovaria olivaria* (Hickory-Nut). C: *Obovaria subrotunda*.

Beaks centrally placed, high, full, curved inward, elevated well above the hinge line; sculpture consists of a few indistinct, concentric ridges, usually evident only on very young shells. Surface with lines of growth evident as concentric, dark, raised ridges, often becoming greatly exaggerated in old shells. Epidermis a greenish-olive to dark brown or blackish, usually rayless; posterior-dorsal surface marked by a distinct, lighter, yellowish streak or band.

Left valve with two thick, roughened, somewhat triangular, elevated, divergent pseudocardinal teeth; the two lateral teeth slightly curved, fairly short, heavy. Right valve with a large, massive, serrated, triangular pseudocardinal tooth, usually with a small, low, compressed tubercular tooth on either side; lateral tooth short, thick, roughened, often with a secondary inner low, incomplete lateral tooth. Interdentum narrow or absent; beak cavity fairly deep. Nacre silvery-white; iridescent posteriorly.

General Distribution: Ohio, Tennessee and Cumberland river systems; western Pennsylvania and southern Michigan south to Louisiana and the Tombigbee River drainage.

Distribution and Ecology in Illinois: A species of medium-sized and large rivers, *Obovaria subrotunda* is known in Illinois from the lower Wabash and Ohio rivers and their tributaries; it is apparently uncommon in these two large rivers, however. Baker (1922) recorded this mussel as fairly common at several places in the Big Vermilion River and its tributaries. Presently it is locally numerous in the Embarrass River, where it occurs on a sand or gravel bottom, in current, and at depths of several inches to 4-5 feet.

Plagiola lincolata (Rafinesque)

Butterfly

Plate 27: A; Frontispiece.

Description of Shell: Shell solid, heavy, compressed, female shells generally more inflated and swollen posteriorly, somewhat triangular in outline; anterior end broadly rounded, posterior end bluntly pointed. Posterior-dorsal ridge prominent, sharply angled; dorsal surface flattened. Beaks compressed, pointed, directed forward, only slightly elevated above hinge line; sculpture consists of a few delicate, fine, double-looped ridges. Surface usually marked with low, irregular, concentric ridges. Epidermis a dull yellow or yellowish-green, with scattered brownish or greenish rays of varying widths which are generally broken into irregular squarish blotches. Very old shells are often rayless, a uniform dark brown, thick and large (5-inch-long specimens have been taken from the lower Wabash River).

Left valve with two heavy, solid, roughened, low, triangular pseudocardinal teeth; the lateral teeth—usually two in each valve—straight, thick, striated, short. Right valve with a large, deeply serrated, triangular pseudocardinal tooth, usually with a small, low, roughened, tubercular tooth on either side. Interdentum wide, flat; beak cavity compressed, fairly shallow. Nacre silvery-white; iridescent posteriorly.

General Distribution: Mississippi River drainage; western Pennsylvania west to Iowa and Kansas, north to Minnesota, southwest to Oklahoma, southeast to Alabama.

Distribution and Ecology in Illinois: One of the most attractive mussels found in Illinois, the Butterfly occurs primarily in the lower Wabash, Ohio and Mississippi rivers. It is only moderately common, living on a sand or gravel bottom, especially on bars, in current at depths of 4-6 feet or more. *Plagiola* is apparently less tolerant of silting and pollution than many species; it was once fairly common and widespread in the Illinois River, but has now completely disappeared as a result of these factors. Uniform thickness of shell, and good color and luster of the nacre made the Butterfly a valuable button shell.

Proptera alata (Say).

Pink Heel-Splitter

Plate 28: A

Description of Shell: Shell thin in young individuals, solid and strong in old shells, somewhat triangular in outline, compressed to moderately inflated; anterior end sharply rounded, posterior end bluntly rounded to obliquely truncated. Posterior ridge area broadly rounded, the dorsal area behind the umbones strongly alate, the wing being compressed and large. Beaks flattened, pointed, only slightly elevated above the hinge line; sculpture consists of 3-4 fine bars, the first concentric, the rest double-looped, rarely evident except in very young shells. Surface with elevated concentric growth lines, especially prominent at rest periods. Epidermis a dark brownish-green, usually becoming black in old individuals; young specimens typically marked with dark green rays which become fainter with age.

Left valve with two somewhat compressed, small, triangular, serrated pseudocardinal teeth; the two lateral teeth long, slightly curved, thin. Right valve with a triangular, elevated, serrated pseudocardinal tooth, usually with a small, low thin, compressed tooth anteriorly; lateral tooth long, slightly curved, thin, high posteriorly. No interdentum; beak cavity shallow. Nacre pearly-white tinged with pink in young shells, mature and old individuals deep salmon or purple; iridescent posteriorly.

General Distribution: Entire Mississippi River drainage; New York west to Kansas, north to Wisconsin; Red River of the North; Lake Erie; Lake St. Clair; southeastern Ontario, Canada; south to Tennessee and Arkansas.

Distribution and Ecology in Illinois: Except for portions of the upper Mississippi and Rock rivers, this large mussel is confined primarily to medium-sized and large rivers in the southern half of Illinois. It is common in the lower Wabash and Ohio rivers, and locally numerous in the Kaskaskia and Embarrass rivers where it occurs on either a sand/gravel or mud bottom, usually in moving water, and most often at depths of 2-4 feet. Formerly common in the Illinois and Sangamon rivers, populations of the Pink Heel-Splitter are now greatly reduced in these rivers.

PLATE 27. A: *Plagiola lincolata* (Butterfly). B: *Ptychobranchus fasciolaris* (Kidney-Shell). C: *Truncilla donaciformis* (Fawn's Foot). D: *Truncilla truncata* (Deer-Toe).

Plate 28: B

Description of Shell: Shell greatly inflated, globose, slightly oblong to circular in outline, thin to moderately solid; anterior end rather sharply rounded, posterior end broadly rounded. Posterior ridge high, somewhat sharply angled, with the dorsal area flattened or slightly excavated; anterior part of shell appearing alate. Beaks greatly inflated, elevated; sculpture consists of a few faint, oblique ridges. Surface usually smooth, shiny, occasionally the rest periods present as low but distinct, dark, concentric ridges. Epidermis yellow or yellowish-tan, becoming a darker yellowish-brown in old individuals; rayless.

Hinge line curved. Both valves with two compressed, thin, elevated, roughened pseudocardinal teeth which are located in front of the beaks and parallel with hinge line. Lateral teeth—two in the left valve, one in the right—curved, short, erect. Interdentum narrow or absent; beak cavity wide, deep. Nacre silvery- or bluish-white, sometimes tinged with salmon, often generally iridescent.

General Distribution: Lower Ohio River drainage; portions of the Mississippi River north to Iowa and Minnesota, southwest to the St. Francis River, Arkansas, Tennessee.

Distribution and Ecology in Illinois: The Fat Pocketbook is a large river species, and although it occurs in the Mississippi River, it is most numerous in the lower Ohio and Wabash rivers—especially in the latter. This species might be confused with the other two pocketbooks (*Lampsilis*), but the globose, rayless shell, inflated umbones, and pronounced S-curve of the hinge line will serve to distinguish it. This mussel has been taken on both a sand and mud bottom, in flowing water, and at depths of only a few inches (lower Wabash River) to 8 feet or more.

Ptychobranhus fasciolaris (Rafinesque)

Kidney-Shell

Plate 27: B

Description of Shell: Shell elongate, elliptical, solid, heavy and thick in old individuals, compressed; anterior end rounded, posterior end bluntly pointed. Posterior-dorsal ridge prominent but rounded. Beaks flattened, compressed, low; sculpture consists of several, fine, indistinct, wavy ridges. Surface marked with numerous, usually prominent, coarse growth lines. Epidermis yellow or yellowish-green, becoming a dark chestnut-brown in old shells; the dark green rays usually wide, often wavy, usually interrupted or broken.

Left valve with two thick, heavy, low, serrated, triangular pseudocardinal teeth; the two lateral teeth nearly straight, short, heavy, usually widely separated. Right valve with a heavy somewhat compressed and pyramidal, elevated pseudocardinal tooth, sometimes with a low, roughened tubercular tooth on either side; lateral tooth wide, heavy, elevated, serrated. Interdentum long, wide; beak cavity shallow. Nacre pearly-white, the posterior half or third iridescent.

PLATE 28. A: *Proptera alata* (Pink Heel-Splitter). B: *Proptera capax* (Fat Pocketbook).

General Distribution: Ohio, Tennessee, and Cumberland river systems; Lake Erie; Lower Peninsula of Michigan, west to Kansas, south to Arkansas, Oklahoma and Tennessee.

Distribution and Ecology in Illinois: This mussel typically inhabits small to medium-sized rivers, although it may become established in large rivers in sections (riffles) of normally shallow water. In Illinois, it is now apparently confined to the lower Wabash River where it is an uncommon to rare mussel. Specimens of *Ptychobrancheus* attain maximum size ($4\frac{1}{2}$ -5 inches in length) and thickness in the larger rivers; a few individuals collected recently in the Wabash River were taken on a coarse sand and gravel bottom, in current and at a depth of 2-3 feet of water.

Truncilla donaciformis (Lea).

Fawn's Foot

Plate 27: C

Description of Shell: Shell small (not exceeding 2 inches in length), elongated, somewhat ovate, relatively thin but strong, compressed to moderately inflated; anterior end rounded, posterior end bluntly pointed. Posterior-dorsal ridge prominent, often sharply angled with the dorsal surface flattened. Beaks full, elevated slightly above the hinge line; sculpture consists of 3-4 fine bars, the first concentric, the others double-looped. Epidermis a dull yellow or greenish, patterned with numerous, rather striking dark green rays which are interrupted or broken up into zigzag, triangular, or arrowhead lines.

Left valve with two thin, compressed, divergent, elevated, serrated pseudocardinal teeth; the posterior one located directly below the beak, and is more erect and flared upward. Right valve with a flattened, somewhat triangular, elevated pseudocardinal tooth. Lateral teeth—two in the left valve, one in the right—thin, nearly straight, elevated, slightly roughened, long. No interdentum; beak cavity shallow. Nacre silvery or bluish-white; iridescent posteriorly.

General Distribution: Mississippi River drainage; western Pennsylvania west to Kansas, north to Minnesota, southwest to Texas, south to Louisiana and Alabama.

Distribution and Ecology in Illinois: The Fawn's Foot is one of the smallest and most wide-ranging of the mussels found in Illinois. It is especially common locally in the lower Wabash, Ohio, Rock and Mississippi rivers, and in medium-sized rivers such as the Embarrass and Kaskaskia; approximately 10 years ago (1955), this small species was very abundant at several locations (Naples, Quiver Lake) in and along the Illinois River. It may thrive on a mud bottom as well as on sand or fine gravel, usually in current but also in quiet areas, and in both shallow and deep water.

Plate 27: D; Frontispiece.

Description of Shell: Shell somewhat triangular in outline, solid, moderately inflated; anterior end rounded, posterior end pointed, obliquely truncated. Posterior ridge prominent, sharply angled, often with a shallow depression in front; dorsal surface behind the umbones wide, flattened. Beaks full, curved inward, elevated well above hinge line; sculpture consists of 3-4 fine ridges, the first concentric, the others double-looped. Growth lines often prominent, raised as low ridges, darker at rest periods. Epidermis yellow, yellowish-brown, or greenish; sometimes rayless, especially in old shells, but usually with numerous distinct, green rays of varying width, often marked with darker zigzag or wavy blotches.

Left valve with two strong, somewhat compressed, elevated, serrated, triangular pseudocardinal teeth; the two lateral teeth moderately long, thin, elevated, roughened. Right valve with a heavy, triangular, serrated erect pseudocardinal tooth, sometimes with a low tubercular tooth in front; lateral tooth high, compressed, roughened, occasionally with an incomplete, smaller inner lateral developed. Lateral teeth slightly curved, directed ventrally. Interdentum narrow or absent; beak cavity fairly shallow. Nacre silvery-white; iridescent posteriorly.

General Distribution: Mississippi River drainage; western Pennsylvania west to Iowa and Kansas, north to Minnesota and Michigan, south to Tennessee, Alabama and Texas.

Distribution and Ecology in Illinois: Like the Fawn's Foot, this species is rather generalized in the type of bottom environment and size of rivers it inhabits. The Deer-Toe appears to be more common in the medium-sized (Saline) and large (Wabash, Mississippi) rivers, where it is usually found in current, in shallows or at depths of 6 feet or more, on a sand or mud bottom. This mussel may also become well established in lakes (for example Lake Decatur, Macon Co.) where there is some current or flowing water.

Species of Doubtful Occurrence in Illinois

A great many changes have taken place in the physical and chemical structure of rivers and lakes in Illinois, especially since the turn of the century. Increase in the number of dams and a constant rise in content of silt and pollutants have been principal causes in reducing or exterminating aquatic animal life. Most of the comprehensive studies dealing with aquatic mollusks of the state were undertaken at least 40 or 50 years ago. Many species of mussels recorded for a particular area or river system (for example, W. S. Strode on the Spoon River) have since become restricted or localized in their distribution, rare, and in some cases have entirely disappeared.

The following species of mussels have been recorded from Illinois or from rivers bordering the state, but because they have not been found during the past 10 or 15 years and are now either extremely rare or have apparently disappeared completely, descriptions of their distribution and shell structure are brief.

Fusconaia subrotunda (La).

Plate 29: A

Goodrich and van der Schalie (1944) state that, for Indiana, this large river species is confined to the Ohio and its tributaries, and in larger portions of the Wabash River. It may still be of rare occurrence in these rivers.

Shells are thick, solid, somewhat compressed, squarish to oblong; rounded anteriorly, the posterior end obliquely truncated. Beaks full, elevated, directed forward. Epidermis yellow to yellowish-brown, the umbone area in young shells usually with dark green rays. Pseudocardinal teeth—two in left valve, one in right—triangular, thick, elevated, serrated, considerably below the laterals. Lateral teeth wide, heavy, roughened, nearly straight; two in left valve, one in right. Interdentum wide, flat; beak cavity compressed, deep. Nacre white, iridescent posteriorly. Mature specimens measure 4 inches in length.

Lastena lata (Rafinesque).

Plate 29: B

Goodrich and van der Schalie (1944) record it for the Ohio and Wabash rivers, indicating it is a rare shell throughout its range. Baker (1906) lists two early references of this species for the Illinois River and "Southern Illinois."

Shell thin but fairly strong, greatly elongated, compressed; anterior end rounded, posterior end bluntly pointed or truncated. Beaks flattened, even with the hinge line; sculpture consists of 4-5 strong ridges. Epidermis dark brown to blackish, with faint green rays. Pseudocardinal teeth consisting of a slightly raised tubercular knob, one in each valve; lateral teeth represented by a thickening of the hinge line. No interdentum; beak cavity very shallow or absent. Nacre a bluish-iridescence, usually pink in the beak cavity area.

Plethobasus cicatricosus (Say).

Plate 29: C

Goodrich and van der Schalie (1944) indicate that this is a rare species (in Indiana) and has been found only in the Wabash River; Baker (1906) lists two references to it as occurring in the Ohio River and "Southern Illinois."

Shell solid, heavy, elongated, somewhat ovate, inflated, ventral and posterior margins rounded. Beaks moderately inflated, elevated above the hinge line and directed forward. Surface usually with a diagonal row of several raised, prominent knobs, starting from below the umbone area and extending to the ventral margin. Epidermis a dull yellow or yellowish-green, becoming yellowish-brown in old shells; rayless. Pseudocardinal teeth—two in left valve, one in the right—triangular, thick, deeply serrated, erect. Two lateral teeth in the left valve, and the one in the right, slightly curved, fairly short, wide, elevated, roughened. Interdentum narrow to fairly wide; beak cavity shallow. Nacre silvery-white; iridescent posteriorly.

Plethobasus cooperianus (Lea).

Plate 29: D

Goodrich and van der Schalie (1944) state that this rare species is confined to the lower Wabash and Ohio rivers.

Shell thick, solid, nearly circular to elongate, moderately inflated. Beaks full, elevated, directed forward. Posterior two-thirds of the surface covered with numerous, high pustules. Epidermis yellowish-brown to dark reddish brown. Pseudocardinal teeth—two in the left valve, one in the right—wide, low, massive, triangular, roughened. Lateral teeth—two in the left valve, one in the right—wide, short, heavy, serrated. Interdentum wide; beak cavity compressed, deep. Nacre white; iridescent posteriorly. Mature specimens measure 3-4 inches in length.

Pleurobema clava (Lamark)

Plate 30: A

In Illinois, this typically small and medium-sized river species has been recorded for the Wabash River (Baker, 1906; Goodrich and van der Schalie, 1944).

Shell solid, thickest anteriorly, somewhat triangular in shape, elongated, inflated in the umbone area. Anterior end, dorsal and ventral margins nearly straight, posterior end pointed; posterior ridge rounded, prominent, usually with a wide, shallow depression in front. Epidermis a dull yellow or yellowish-brown; dark green rays—often interrupted and forming irregular blotches—prominent, especially on the umbones. Pseudocardinal teeth—two in the left valve (often united anteriorly), one in the right—somewhat compressed, triangular, serrated, erect. Two lateral teeth in the left valve, one in the right, long, thin, elevated. Interdentum narrow; beak cavity shallow. Nacre white, the posterior half iridescent. Mature specimens rarely exceed 3 inches in length.

A

B

C

D

PLATE 29. A: *Fusconaia subrotunda*. B: *Lastena lata*. C: *Plethobasus cicatricosus*. D: *Plethobasus cooperianus*.

Simpsoniconcha ambigua (Say)

Plate 30: B

Baker (1898) stated that "This species also seems to be restricted to the Desplaines River and its tributaries, and is very abundant; when one is found, dozens or even hundreds of individuals may be found near by." Goodrich and van der Schalie (1944) record it from the Wabash River, but indicate the species is very sporadic in distribution.

Shell small (not exceeding 2 inches in length), thin, fragile, considerably elongated, inflated, especially along the broadly rounded posterior ridge. Beaks somewhat compressed, only slightly elevated above the hinge line; sculpture consists of 4-5 fine but prominent ridges drawn up in the middle. Anterior and posterior ends rounded; dorsal and ventral margins nearly straight, parallel. Epidermis a dull yellowish-tan. A small, thin, flattened pseudocardinal tooth present in each valve; lateral teeth represented by a swelling of the hinge line. No interdentum; beak cavity shallow. Nacre a dull bluish-white; posterior half iridescent.

Dysnomia foliata Hildreth

Plate 30: C

Goodrich and van der Schalie (1944) list this mussel as relatively rare, occurring in the lower Wabash and Ohio rivers.

Shell heavy, solid, somewhat compressed; generally squarish in outline in the male, "leaf-like" in the female. Anterior-ventral margin rounded; posterior and squared or obliquely truncated in the male, while in the female it is considerably extended and ends in a blunt point. A wide, moderately deep sulcus or depression separates the prominent, rounded posterior-dorsal ridge from a diagonal, elevated row of prominent elongated nodules or knobs that begins below the umbones and continues to the ventral margin. Beaks somewhat flattened, elevated, ventrally located. Epidermis a dull yellow or yellowish green, usually with numerous dark green rays. Pseudocardinal teeth—two in the left valve, one in the right—triangular, heavy, deeply serrated, erect. Lateral teeth, two in the left valve, one—sometimes with a smaller second tooth—in the right valve, short, wide elevated, roughened. Interdentum fairly wide; beak cavity shallow. Nacre silvery-white, iridescent posteriorly.

Dysnomia sulcata (Lea).

Plate 30: D

Goodrich and van der Schalie (1944) record this species from the Ohio and Wabash rivers, and indicate that it is a relatively rare mussel.

Shell solid, heavy, somewhat ovate, oblong to squarish, inflated. Anterior-ventral margin rounded, posterior end truncated. Beaks large, full, elevated and directed anteriorly. Posterior ridge prominent, rounded, often roughened with low, elongated ridges on the growth lines that appear as a row of knobs.

PLATE 30. A: *Pleurobema clava*. B: *Simpsoniconcha ambigua*. C: *Dysnomia foliata*. D: *Dysnomia sulcata*. E: *Dysnomia sampsoni*. F: *Dysnomia personata*.

A diagonal row of low, elongated knobs extends from the umbones to the ventral margin; between this row of knobs and the posterior ridge is a relatively wide, deep sulcus or depression. Epidermis yellow to yellowish-tan, patterned with numerous fine green rays. The two pseudocardinal teeth in each valve elevated, deeply serrated, ragged, heavy; the two lateral teeth in each valve wide, fairly long, curved, roughened. Interdentum moderately wide; beak cavity broad, shallow. Nacre white; iridescent posteriorly.

A very closely related species, *Dysnomia personata* (Say), (Plate 30: F), which might be considered only a transition form between *Dysnomia foliatus* and *Dysnomia sulcata*, occurs (rarely) in the lower Wabash River. It very closely resembles—and is nearly inseparable from—*Dysnomia sulcata*.

Dysnomia sampsoni (Lea)

Plate 30: E

This is also a rare species (now absent?), known in recent times only from the lower Wabash River in Illinois (Goodrich and van der Schalie, 1944). Several typical valves were recovered at the "Little Chains" archaeological site in White Co., Illinois, thus indicating its prehistoric distribution in the lower Wabash River at a point only 10 miles from its confluence with the Ohio River.

Shell similar in structure to *Dysnomia sulcata* but with the posterior ridge more sharply angled, the row of knobs higher, and with the umbones much larger, greatly inflated and elevated well beyond the hinge line. Goodrich and van der Schalie (1944) have suggested that *Dysnomia sampsoni* may be a large river form or variant of *Dysnomia perplexa*.

Leptodea leptodon (Rafinesque)

Plate 31: B

Baker (1928) states that "This is apparently a rare species in most places. It occurs on the Illinois shore of the Mississippi at Savanna, Carroll Co." It has also been reported from the lower Wabash and Ohio rivers (Goodrich and van der Schalie, 1944); these authors also record a closely related species (or form?), *Leptodea blatchleyi* (Daniels) which has been found only at "Grand Chains," Wabash River, Posey Co., Indiana. It exhibits a close similarity in both anatomy and shell characters to *Leptodea leptodon*, and "More study is necessary to determine the relationship of *blatchleyi* to *leptodon*, which occurs with it."

Shell elongated, thin, compressed; anterior-ventral margins rounded, posterior end bluntly pointed. Posterior ridge prominent, rounded. Beaks small, compressed, about even with the hinge line. Epidermis yellowish or olive green, often with numerous, wide, faint green rays; surface roughened with growth lines. A pseudocardinal tooth in each valve reduced to a very small, tubercular swelling; two low, incomplete, indistinct lateral teeth in left valve, one slightly stronger lateral tooth in the right valve. Lateral teeth long, the anterior parts evident as a swelling of the hinge line. No interdentum; beak cavity very shallow or absent. Nacre purplish or salmon, especially the upper half; the rest a bluish iridescence.

PLATE 31. A: *Villosa fabalis*. B: *Leptodea leptodon*. C: *Obovaria retusa*. D: *Dromus dromas*.

Villosa (= *Micromya*) *fabalis* (Lea).

Plate 31: A

Baker (1906) lists the Wabash River as the only locality for this species in Illinois.

Shell small (not exceeding 1½ inches in length), somewhat ovate, elongate, very solid to heavy, moderately inflated. Beaks pointed, somewhat compressed, elevated. Epidermis an ashy-green, marked with greenish-brown, often wavy rays; surface with irregular growth lines. Pseudocardinal teeth—two in the left valve, one (sometimes with a smaller tubercular tooth on either side) in the right—solid, roughened, triangular; lateral teeth low, heavy, wide, two in the left valve, often partly double in the right valve. No interdentum; beak cavity shallow. Nacre whitish or bluish-white; iridescent posteriorly. In Indiana, it is reported as being most common in small streams where it lives deeply buried in a sand or gravel bottom around the roots of aquatic vegetation.

Obovaria retusa (Lamarck)

Plate 31: C

In Illinois this large river species has been reported from the Wabash and Ohio rivers (Goodrich and van der Schalie, 1944). Valves of this mussel have been recovered from several prehistoric Indian sites located along both of these rivers.

Shell solid, thick, somewhat ovate to circular in outline with rounded margins, inflated. Beaks high, full, swollen, considerably elevated beyond hinge line and directed forward. Some specimens with a prominent elevated posterior ridge. Epidermis yellow or yellowish-green, occasionally dark brown or blackish. Two pseudocardinal teeth in left valve heavy, triangular, elevated, roughened, divergent; right valve with a large, thick, triangular, serrated pseudocardinal tooth, usually with a smaller but well-developed tubercular tooth on either side. The two lateral teeth short, curved, wide, elevated. Interdentum moderately wide; beak cavity deep. Nacre within the pallial line a deep salmon or purple, white around the margins with a slight iridescence posteriorly.

Dromus dromas (Lea)

Plate 31: D

Baker (1906) lists one early reference to the occurrence of this mussel in the Ohio River; it is a fairly common shell in the upper Ohio River in Indiana and Ohio.

Shell solid, thick, somewhat compressed, nearly circular in outline. Beaks low, flattened, only slightly elevated above the hinge line. Surface with a few to several, highly variable, raised, concentric ridges or broadly rounded, elongated knobs. These structures may appear as elevated ridges, or as an irregular, median row of nodules, or a combination of both. Epidermis yellowish, densely

patterned with dark green, occasionally wavy interrupted rays. Heavy concentrations of the dark green irregular blotches appear as several distinct broad rays. Pseudocardinal teeth—two in the left valve, one in the right—low, triangular, roughened, divergent (in the left). The lateral teeth, two in the left valve, one or two in the right, are short, wide, curved, serrated. Interdentum wide, flat; beak cavity compressed, deep. Nacre pearly-white, slight iridescence posteriorly.

Introduced Species

Corbicula cf. manillensis

Asiatic Clam

This introduced fresh-water clam was first observed in the United States in 1938 in California, and since then it has spread as far east as Alabama and Florida. The Asiatic Clam has become well established in the Ohio and Tennessee river systems where locally it is extremely abundant. In Illinois, this clam may be found throughout the lower Ohio River which borders the state; although it has not as yet ascended the Mississippi River above Cairo, *Corbicula* has become established in the lower Wabash River as far north as White County.

This clam has been collected in large numbers on a sand and mud bottom, usually in quiet water, and most commonly at depths of 2-4 feet. Unlike species of native fresh-water mussels, young of the Asiatic Clam do not pass through a parasitic larval or glochidial stage; development is direct.

Shell small (not exceeding 2 inches in width), solid, ovate when young, triangular in outline when mature. Beaks high, full, directed inward, elevated well above the hinge line, and centrally located. Growth periods indicated by thin, prominent concentric rings. There are three pseudocardinal teeth (directly below the beaks) in each valve, with two lateral teeth on each side in the right valve and one on each side in the left valve. Beak cavity deep. Epidermis cream colored in immature clams, changing with age to tan, olive, and, finally, dark brown to black in old individuals. Very young individuals possess a characteristic dark stripe on the anterior-central part of the valves, often with more narrow, less distinct rays on the posterior margins. Nacre a shiny light purple, darkest along the lateral teeth and in the beak cavity; the entire inner surface of adults a very light purple or whitish.

PLATE 32. The Asiatic Clam, *Corbicula*, showing growth stages.

PLATE 33. A: *Arcidens confragosus*. B: *Lampsilis ventricosa*. C: *Lasmigona complanata*.
D: *Lasmigona compressa*.

PLATE 34. A: *Unio merus tetralasmus*. B: *Quadrula quadrula*. C: *Alasmidonta marginata*. D: *Ligumia subrostrata*.

A

B

C

D

E

PLATE 35. A: *Villosa iris*. B: *Carunculina parva*. C: *Lampsilis fallaciosa*. D: *Anodonta corpulenta*. E: *Strophitus rugosus*.

Hosts for the Glochidia (from Baker, 1928)

MUSSEL	HOST SPECIES
<i>Cumberlandia monodonta</i>	Unknown.
<i>Amblema costata</i>	Probably the same as <i>A. peruviana</i> .
<i>Amblema peruviana</i>	Black and white crappie (<i>Pomoxis</i> spp.), large-mouth bass (<i>Micropterus salmoides</i>), sauger (<i>Stizostedion canadense</i>).
<i>Cyclonaias tuberculata</i>	Unknown.
<i>Elliptio dilatatus</i>	Unknown.
<i>Elliptio crassidens</i>	Unknown.
<i>Fusconaia ebenus</i>	Skipjack (<i>Alosa chrysoschloris</i>).
<i>Fusconaia flava</i>	Unknown.
<i>Fusconaia undata</i>	White crappie (<i>Pomoxis annularis</i>)?, black crappie (<i>Pomoxis nigromaculatus</i>)?
<i>Megaloniaias gigantea</i>	Gizzard shad (<i>Dorosoma cepedianum</i>), white crappie (<i>Pomoxis annularis</i>), white bass (<i>Roccus chrysops</i>), bowfin (<i>Amia calva</i>), flathead catfish (<i>Pylodictus olivaris</i>).
<i>Plethobasus cyphus</i>	Sauger (<i>Stizostedion canadense</i>)?
<i>Pleurobema cordatum</i>	Bluegill (<i>Lepomis macrochirus</i>).
<i>Quadrula cylindrica</i>	Unknown.
<i>Quadrula metanevra</i>	Bluegill (<i>Lepomis macrochirus</i>), sauger (<i>Stizostedion canadense</i>).
<i>Quadrula nodulata</i>	Crappie (<i>Pomoxis</i> spp.), largemouth bass (<i>Micropterus salmoides</i>).
<i>Quadrula pustulosa</i>	Channel catfish (<i>Ictalurus punctatus</i>).
<i>Quadrula quadrula</i>	Catfish spp.
<i>Tritogonia verrucosa</i>	Unknown.
<i>Uniomerus tetralasmus</i>	Unknown.
<i>Alasmidonta calceolus</i>	Unknown.
<i>Alasmidonta marginata</i>	Unknown.
<i>Anodonta grandis</i>	Carp (<i>Cyprinus carpio</i>), yellow perch (<i>Perca flavescens</i>), bluegill (<i>Lepomis macrochirus</i>), rock bass (<i>Ambloplites rupestris</i>), white crappie (<i>Pomoxis annularis</i>).
<i>Anodonta corpulenta</i>	Skipjack herring (<i>Alosa chrysochloris</i>).
<i>Anodonta imbecillis</i>	Sunfish (<i>Lepomis</i> sp.).
<i>Anodonta suborbiculata</i>	Unknown.
<i>Anodontoides ferussacianus</i>	Unknown.
<i>Arcidens confragosus</i>	Unknown.
<i>Lasmigona complanata</i>	Unknown.
<i>Lasmigona compressa</i>	Unknown; artificially on carp and other species.
<i>Lasmigona costata</i>	Unknown.
<i>Strophitus rugosus</i>	Unknown.
<i>Actinonaias carinata</i>	Sunfish and bluegill (<i>Lepomis</i> spp.), bass (<i>Micropterus</i> spp.), striped bass (<i>Roccus chrysops</i>), white crappie (<i>Pomoxis annularis</i>), yellow perch (<i>Perca flavescens</i>).
<i>Actinonaias ellipsiformis</i>	Unknown.
<i>Carunculina parva</i>	Unknown.
<i>Carunculina glans</i>	Unknown.
<i>Carunculina texasensis</i>	Unknown.
<i>Cyprogenia irrorata</i>	Unknown.
<i>Dysnomia perplexa</i>	Unknown.
<i>Dysnomia triquetra</i>	Unknown.

MUSSEL	HOST SPECIES
<i>Lampsilis anodontoides</i>	Longnose gar (<i>Lepisosteus osseus</i>); possibly sunfish (<i>Lepomis</i> sp.), crappie (<i>Pomoxis</i> sp.), bass (<i>Micropterus</i> sp.).
<i>Lampsilis fallaciosa</i>	White crappie (<i>Pomoxis annularis</i>), shortnose gar (<i>Lepisosteus platostomus</i>), shovelnose sturgeon (<i>Scaphirhynchus platyrhynchus</i>).
<i>Lampsilis fasciola</i>	Unknown.
<i>Lampsilis orbiculata</i>	Unknown.
<i>Lampsilis higginsii</i>	Sauger (<i>Stizostedion canadense</i>).
<i>Lampsilis siliquioidea</i>	Bluegill (<i>Lepomis macrochirus</i>), yellow perch (<i>Perca flavescens</i>), walleye (<i>Stizostedion vitreum</i>); possibly sunfish (<i>Lepomis</i> spp.), bass (<i>Micropterus</i> spp.).
<i>Lampsilis ventricosa</i>	White crappie (<i>Pomoxis annularis</i>), sauger (<i>Stizostedion canadense</i>); possibly bass (<i>Micropterus</i> spp.), bluegill (<i>Lepomis macrochirus</i>), yellow perch (<i>Perca flavescens</i>).
<i>Lampsilis ovata</i>	Probably the same as <i>L. ventricosa</i> .
<i>Leptodea fragilis</i>	Unknown.
<i>Leptodea laevisima</i>	Fresh-water drum (<i>Aplodinotus grunniens</i>), white crappie (<i>Pomoxis annularis</i>).
<i>Ligumia recta</i>	Bluegill (<i>Lepomis macrochirus</i>), white crappie (<i>Pomoxis annularis</i>).
<i>Ligumia subrostrata</i>	Unknown.
<i>Villosa iris</i>	Unknown.
<i>Villosa lienosa</i>	Unknown.
<i>Obliquaria reflexa</i>	Unknown.
<i>Obovaria olivaria</i>	Unknown.
<i>Obovaria subrotunda</i>	Unknown.
<i>Plagiola lineolata</i>	Fresh-water drum (<i>Aplodinotus grunniens</i>).
<i>Properta alata</i>	Unknown.
<i>Properta capax</i>	Unknown.
<i>Ptychobranchus fasciolaris</i>	Unknown.
<i>Truncilla donaciformis</i>	Fresh-water drum (<i>Aplodinotus grunniens</i>), sauger (<i>Stizostedion canadense</i>).
<i>Truncilla truncata</i>	Unknown.
Species of Doubtful Occurrence in Illinois	
<i>Fusconaia subrotunda</i>	Unknown.
<i>Lastena lata</i>	Unknown.
<i>Plethobasus cicatricosus</i>	Unknown.
<i>Plethobasus cooperianus</i>	Unknown.
<i>Pleurobema clava</i>	Unknown.
<i>Simpsoniconcha ambigua</i>	Mudpuppy (<i>Necturus maculosus</i>).
<i>Dysnomia foliata</i>	Unknown.
<i>Dysnomia sulcata</i>	Unknown.
<i>Dysnomia personata</i>	Unknown.
<i>Dysnomia sampsoni</i>	Unknown.
<i>Leptodea leptodon</i>	Unknown.
<i>Villosa fabalis</i>	Unknown.
<i>Obovaria retusa</i>	Unknown.
<i>Dromus dromas</i>	Unknown.
Introduced Species	
<i>Corbicula</i> cf. <i>manillensis</i>	None.

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