NOTES ON THE NAIAD FAUNA OF THE UNITED STATES

In 1900 Dr. C. T. Simpson published a Synopsis of the Naiades or Pearly Fresh Water Mussels of the world. It is simply a check list. with brief descriptions, making a bound book of over 500 pages. It was included in the Annual Repart of the United States National Museum of that year. It served its purpose as a brief manual for collectors interested in these most fascinating shells. which, during the present century, have become of very much commercial importance, due to their pearly nature.

In 1914, the same author, with the co-operation of Dr. Bryant Walker, then of Detroit, as sponsor, a Descriptive Catalogue of the Naiades or Pearly Fresh Water Mussels of the world was brought up to date. It is really 3 large volumes in one, making a book of 1.500 pages. There are no illustrations.

During this decade much intensive study was made of this class of shells, much new nomenclature was established, and the whole fauna of Pearly Mussels of the world was put on a substantial basis. I believe that a few brief notes of his conclusions will be of interest to all collectors at this time, as no general work has been issued since.

The great difficulty was the lack of live and gravid material, as countless species were only known from their shell characteristics and they are seldom conclusive. In many species the male and female species are totally different, in shell forms. A study of the first genus in my check list, Dysnomia, will be found most interesting. Male and female forms abound in most every species, and are most remarkable. They differ radically from all other forms of Naiades. The shells seem to be alike until about half grown, when the peculiar development of what he terms as the marsupial swelling commences. They are so radically different when fully adult it is no wonder that expert students of former times named them as different species. His key to the species of this genus will enable one to easily separate them.

In the genus *Micromya,* the shells are mostly thin, some being rayed and all usually inhabit small ponds or very small creeks. They were formerly all included in the great genus Lampsilis.

The genus *Lampsilis* was erected in 1820 by Rafinesque and is still retained in restricted form. They range from very thin to very large and heavy, the latter being good button shells. They do not rank as high as the Dysnomia, as there is less essential difference in the sexes. Since this last book was published, further study has placed some of the forms in separate genus such as Carunculina, Proptera, etc. At the present time about 50 sepecies are included, finding their greatest development in the rivers east of the Mississippi.

The *Obovaria* was also described by Rafinesque in 1819. The shells are oval, rounded, solid, inflated, thick in front, thinner behind, with high beaks. Nacre runs from white to purple. About ten species are recognized at present.

Ptychobranchus are usually triangular, solid, rather flat, epidermis usually painted with wavy hair lines or bars. The group is mostly confined to the Mississippi and Alabama River drainage, but one species and variety extends into the St. Lawrence area. Half-dozen species are recognized, all of which are very distinct from other forms.

Dromus includes only the one species which I have illustrated, and which ranges through the Cumberland and Tennessee River drainage.

The *Strophites* present no unusual characteristics being mostly thin, of no commercial value and have a strong resemblance to some of the Anodontas. In all cases the hinge line is incurved in front of the beaks while in Anodontas it is usually straight. There are 10 recognized species.

The genus *Anodonta* is world wide in distribution. Shell is usually inflated, generally smooth and shining. Muscle scars rather faint and some species attain huge size. In collecting it is a good plan immediately after the shells are cleaned and wiped dry to immerse in a solution of white shellac, diluted one-half with alcohol. This will quickly dry and preserve the shells from cracking up in the cabinet, as many of them will surely do, if they are not protected from the action of the air. An immense number of varietal forms was described in the last century, but at the present time about 25 species are recognized. They are much affected by ecological conditions and some shells are rather difficult to name for this reason.

Lasmigona are rather flat shells, some thin, others much thicker and at least one form attains huge size. Nacre usually white. Nine species are now known as compromising this genus.

Alasmidonta are closely allied to the preceding, but shell is usually more rhomboid with a well developed posterior ridge. The species vary much in size and form, some are rather difficult to find, and much restricted as to territory. I have recognized eight species.

The genus *Elliptio* which is found extensively in the Eastern states from Maine to Florida is our closest shells to the true Unios of Europe. At the time Dr. Simpson wrote this last volume they were still called Unio but all were later classified as Elliptio. Nearly 90 species are now in distribution. The form Complanatus is found in practically every stream from Maine to Florida and it would be possible to secure a hundred shells all different in some respect. Doubtless no other species has such a wide range under such varying conditions as to climate.

The *Pleurobemas* are solid, triangular or rhomboid, usually with a prominent umbonial region. The mollusk is generally yellowish to salmon-red, sometimes more or less brown or blackish. Many species are rather local in distribution and some of the forms in this work are now placed in the synomymy. The species found in the far south differ radically from others further north, and it is believed that some of the forms are near extinction. The group as a whole is rather distinct in form of shells.

The *Fusconia* are closely allied to the Plueurobemas and the Quadrulas that follow, but in most cases quite distinct from either. They are fine solid shells, ranging from Wisconsin rivers to the Tennessee and Cumberland River drainages. I had several thousand shells specially collected and found them in many cases extremely hard to decide as to names. Many are superbly knobbed and some have the richest of irradascent nacre. Altogether a fascinating lot.

The *Quadrula* are triangular, quadrate, or rhomboid, solid, often inflated, some richly colored and knobbed. Usually short and solid they are quite commonly inflated and almost without exception the beak cavities are deep. This characteristic almost invariably separates them from the Pleurobemas.

The *Amblema* and *Megalonaias* comprise about 12 species and are the largest and heaviest of all forms of mussels. They nearly all have a high commercial value and are

shipped from many parts of our country every year by the carload. They also produce some of the finest pearls. Nacre usually white. Outside usually wrinkled and in the Megalonaias the beaks are adorned with chevron markings.

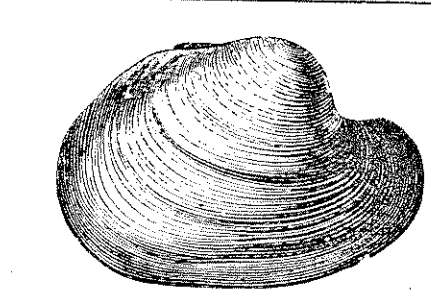
The *Margaritana* contains two species, one of which is world-wide in distribution and the other found in Alabama. Then there is a sub-genus called Cumberlandia which contains shells of similar form, long, slender and thin. Easily crack in cabinet if not protected as do the true Margaritana.

There are a number of other small genera containing one or more species equally as fascinating and well worthy of a more extended notice. But every collector should have Dr. Simpson's last work mentioned above. It cost $10 to print, but can now be had for only $5. I have sold many copies to collectors of our local fauna. It will soon be out of print and then unobtainable at any price.

Dr. Simpson considered the Dysnomia as the highest development of Naiad life and doubtless the latest. If you make a study of the extensive literature on the Naiades you will likely come to the conclusion that the first forms migraded from Asia via Alaska, as some of the Quadrulas of Siberia are much like our own forms in general outline. That the exensive list of varieties south of the Ohio River is partly due to the ice-cap extending that far in glacial times. Starting with the Dysnomia as the highest developed species and the most recent, it is possible to trace each genus, and form a very good idea how a large share of the 450 or more known species in the limits of the United States have developed. Of one thing we may be very sure, the New Dealers had nothing to do with it whatever, and we can be very thankful for that.

One of the most unique of all species, ever discovered in our country is Elliptio spinosus, Lea. This fine shell is about 3½ inches and has prominent spines an inch long on each valve. It was found in the wide shallow waters of the Altamaha River some 10 miles from the sea. In former times and possibly yet, there was wide stretches of this river where the water was only about a foot deep or less, and on these sand flats this most remarkable shell was found. But it has not been found in many years. The last lot I know that had been collected was by a man in the employ of my old friend Berlin H. Wright. This chap secured some 45 fine shells and, disregarding the instructions of Mr. Wright how to pack them if they should be found, they were all thrown in loose with other heavy Naiades of the region and arrived totally worthless, the spiness all broken. In recent years this river has seldom if ever cleared up in the summer season as it did a couple of decades ago. Collectors scouring the region, hoping to find this very rare shell, finally turned to small streams that emptied into the great Altamaha. In these streams they found identical spinosus but all without spines. It is now believed that the spines were due to ecological conditions which are not similar in the smaller streams, but were they? Here is a nice little problem for collectors to work on. Hundreds of collectors all over our country would like to have one of these fine rare shells, and no wonder.

This and hundreds of other similar problems will be the work of years to come, when we will have hundreds of collectors of our U.S.A. shell fauna where we now have one. You will find some fascinating reading along this line in the Naiades of Pennsylvania by Ortmann. His was one of the keenest minds of his time, but unfortunately died in the prime of life when he had so very much to live for, and Conchology surely lost one of its greatest writers and defenders.



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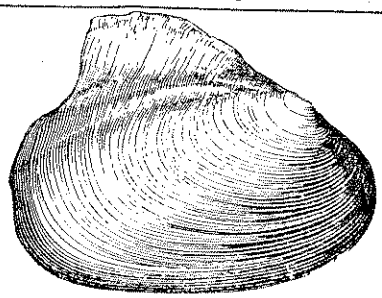

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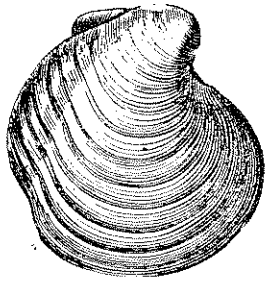

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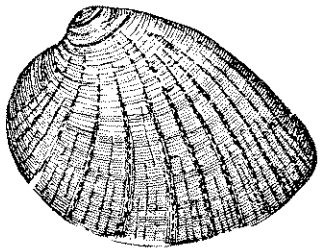

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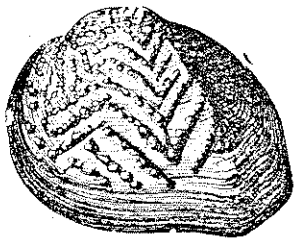

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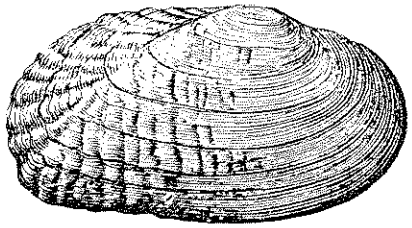

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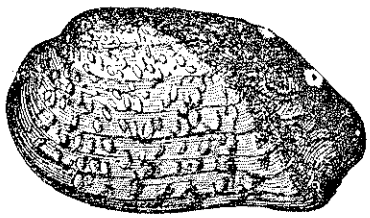

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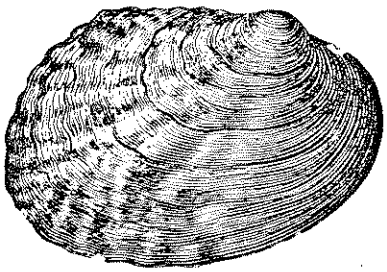

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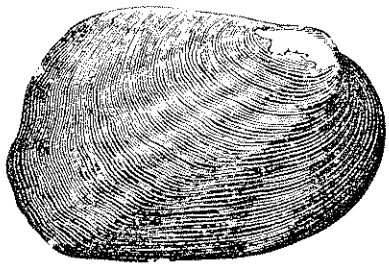

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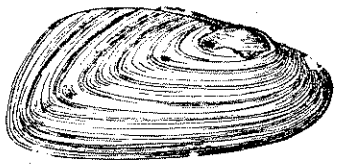

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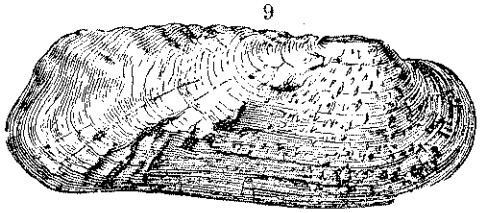

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Plate 49

1. **Lampsillis ventricosus satura,** Lea. Arkansas to Texas. A variety of the main species, which is a large 5″ shell and common all thru the Mississippi drainage. There are about 50 species in the genus. The female shells are always enlarged at the base and can be easily recognized.

2. **Proptera alata,** Say. Entire Mississippi drainage. The genus contains 8 species and varieties, one or two of which seem to be getting quite rare of late years, as my collectors failed to find them. This species attains 7″.

3. **Obovaria retusa,** Lam. Ohio River drainage. Most of the ten species of this genus are circular or nearly so, but this fellow is entirely different. The interior is of a rich purple color which easily identifies it.

4. **Plagiola lineolata,** Raf. (securis) Ohio River drainage. There is only one species in the genus, oblong, flat and pointed. No other shells quite like it and easy to identify. Is usually rayed.

5. **Quadrula quadrula,** Raf. Mississippi River drainage. The cut is not a typical shell of this species, but the form that used to be called apiculata and a beauty at that. There is some little variation in the 3 to 4″ shells from various rivers, but as a rule one can be quite certain of their identity.

6. **Strophites rugosus,** Swain. Eastern U. S. In old collections, mainly from Delaware and Schuylkill Rivers. A thin 3″ shell, the interior is often orange color. There are 10 species in the genus.

7. **Tritogonia verrucosus,** Raf. Mississippi River drainage. This grand shell attains 6 to 7″ but there are short, stubby varieties in some of the southern rivers. Usually white inside, some forms are pink. Its knobby surface is very attractive when well cleaned. There is only one named species and one variety.

8. **Amblema costata,** Raf. Mississippi River drainage. A good size solid 4 to 5″ shell found over a wide range and naturally varies much in size and shape in the various rivers. It is a good commercial shell as it has thick pearl.

9. **Amblema peruviana,** Lam. Northern States. The plications in this shell are often much stronger than the cut would indicate. Very fine specimens were sent me from northern Minnesota. One of the best pearl shells.

10. **Gonidea angulata,** Lea. Central California. There is only one species and one variety in this genus. Both are very distinct in their angular form. Rather thin and not real common. Average size 3 inches.

11. **Quadrula cylindrica,** Say. Ohio River drainage. A fine, oblong, knobby 3″ shell that is often very smooth to the touch and highly mottled. I found some of the finest species in the rivers of the Ozark region of Arkansas.

I furnish collectors of Unios an up to date check list of all species for 20c. Also a splendid work on the Unios of the whole world, about 1500pp describing all species in all countries for only $5. This book cost $10 to produce and is really 3 volumes in one.

The Fungia coral are a most remarkable group. They assume circular or elliptical disks and are usually free and unattached species. There are other compound species which assume the shape of long narrow troughs inverted, rude caps, dishes or cups. The attached Fungia sometimes grow in simple leaves, to the side of other coral rock, like a lichen on a stump, but there are forms which assume hemispherical clusters of leaves, or as vases or massive columns. They are all very unusual forms of coral life.

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In collecting sea stars it is advisable to put into weak preservative at once and allow to remain a week. If not of proper shape desired, tie down to a piece of board until hardened. Then in due time dry in shade, when they will keep indefinitely without any odor. Do not crush the spines if it can be avoided, as they add much to the beauty of the dry specimen. Many stores now exhibit specimens on cards covered with cellophane and full data entered in its proper place.

The Sea Fans illustrated herein are not true corals but are closely related. They differ in the method of secreting the skeleton. This is usually done by the foot of the polyps. The skeleton is elastic and often of very great hardness. The internal skeleton of the Sea Feathers is particularly so. While it is very flexible the internal part cannot be readily cut with a knife.

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You will find very extensive literature on Sea Urchins, Sea Stars and other similar organisms, in the reports of the various Biological Stations on both of our coasts. Those maintained by the Rockefeller Foundation, various Educational Institutions, States along the sea coast and our government covers most of them. Many of these stations are richly endowed, and have issued exhaustive reports. The Curator of this class of animals in the National Museum has issued a number of fine books as also have the Museum of Comparative Zoology at Cambridge, Mass. I had practically all of them in my library and found them of great interest. While the text is usually very technical, the thousands of illustrations give some idea of the vastness of the subject. I had in my private collection at one time some 500 species of them, and after making a brief study of their distinguing characteristics, disposed of them to a foreign museum.

* * *

The corals of the sea have been objects of profound study for generations. I remember forty years ago securing a series of volumes on the Madreporariae, which were issued by the British Museum. It gave me my first insight into the Great Barrier Reefs of Australia and what is to be found there. Later I secured other works as I found the study fascinating. But one of the finest books of recent years, is one issued in Australia. It is called the Wonders of the Great Barrier Reefs. A scientist of that great commonwealth conceived of the idea of taking pictures of sea life and corals under water with colored films. Then issuing a book with colored plates, so that people who would likely never have the pleasure of visiting these great reefs, the largest in the world, could form a very good idea of what is to be found there. The book sells for about $4.50 and I have imported a large number of copies for my friends. It is not in any way technical. Australia is issuing many books in color at a popular price showing all of the many wonderful natural history objects which are to be found there. Another fascinating book is Combing the South Seas. I have copies on hand at $2. Finely illustrated with some colored plates.

* * *

The glass bottomed boats that take tourists out to visit the marine gardens, found on both of our coasts, do a brisk business. You can look through the bottom into the clearest of sea water, 30 feet or more and see vast gardens of Sea Feathers, Sea Fans, some coral, many brilliant colored fishes and some of the curios on this plate 63. I spent several hours in one of these boats at Nossau in the Bahamas. As I was to some extent familiar with all of the objects seen, it was a great pleasure to view them in their native habitat. In the old days of Spanish Conquest the buccaneers gathered the Sea Feathers, big ones, 6 feet high, stripped the outer coralline, leaving the black interior. This was braided into whips and carried as regular equipment for use on sailors or prisoners who needed punishment. They are now a rather scarce curio as have not had one for many years.

* * *

The Sponge Fisheries of Greece have been famous for centuries. Many of these Greeks came to this country and where they had been sponge fishermen, they naturally gravitated to those parts of our coast where sponges were to be found. A visit to Tarpon Springs, Florida is worth your while. Here you will see sixty or more sponge boats, many almost exact replica's of those found at Athens. You will see one of the finest Sponge Exchanges in the world, where millions of sponges change hands every year. Naturally a host of small curious stores have sprung up. They offer sea curios and novelties, anything that will attract the tourist trade. You will see old men, former divers, with their beloved sponges, such as are shown on this page and other common curios. In the old days they were all of that type but the later generations, American born and well educated, are doing a successful business and many of making real money.

COLLECTING FRESH WATER BIVALVES

Under the above classification we have the small bivalve genera of Pisidium, Sphaerium, Musculum, etc. These shells are mostly under a half inch in length and cover several hundred species. You will find them in the very smallest ponds and streams and usually in more abundance than elsewhere. A small hand sieve such as you can find in any ten cent store will be found useful, or if it is advisable to reach out several feet, use a stout pole with as strong a fine mesh sieve as you can find.

Scoop up the mud from the bottom, rinse it out in the water, and what remains may be a quantity of these little fascinating shells. They can be immersed in jars of preservative and after a few days laid out to dry. The mollusk in all cases will be preserved in the shell and useful for study if so desired.

The larger Naiades or Fresh Water Mussels are a different proposition. While a host of species can be collected in shallow riffles you will not find them all in such situations. One of my men in Tennessee found 45 species of Naiades in two miles of shallow shoals. This is the largest number I have record of.

Florida and likely other states have hundreds of small lakes where there are no mussels and the reason is there are no fish. No fish, no mussels every time. You will understand why when you study the way they propogate.

In the great rivers of the country where fresh water shelling is a business of thousands of people, they have a wide arm attached to a boat with numerous lines tied to same and a hook on the other end. By dragging this outfit through a stream, the hooks catch into the gaping valves of the live mollusks, the shells quickly close up and by pulling up the strings, boat loads are collected. These are cleaned of the soft parts, with sharp eyes looking for pearls, and the product shipped by the car load to button factories. The price depends entirely on supply and demand.

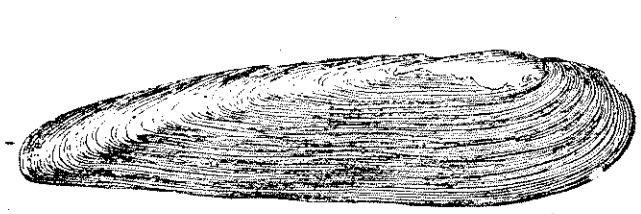
Many states now only allow two months. like July and August when you may legally fish for these clams. The making of pearl buttons is a many million dollar industry. They have almost entirely superceded the pearl from the tropics, which was formerly used.

In northern streams like Wisconsin you will find certain musstls in deep rushing water, and collectors often have to dive for them. I remember one chap who always collected them in a bathing suit. He would locate fine specimens with his toes and then stoop down and bring them up. And he sure was a fine collector, securing many choice specimens, which was the envy of his friends.

Whatever method you pursue, clean your specimens promptly and at the first opportunity. thoroughly wash them in clean water. using if necessary a small brush which can be secured at any dime store. A solution of oxalic acid will be found useful where the shells are coated with matter not easily removed with a brush. Keep careful data on all collections and work up the names of your specimens as soon as possible.

You will come to enjoy your leisure hours making your catch as fine looking as possible. Many forms are beautifully rayed specially in the moderate size specimens. In very old specimens these rays are not to be found.

The author of this book, address on title page, has the largest stock of United States Shells on sale ever brought together. Also over 15,000 varieties of foreign shells.



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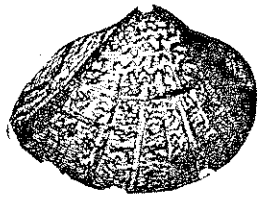

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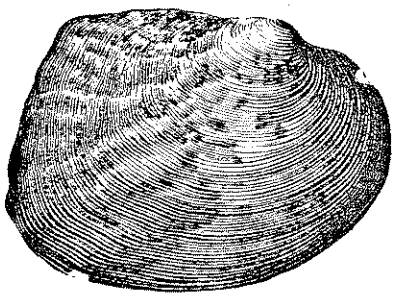

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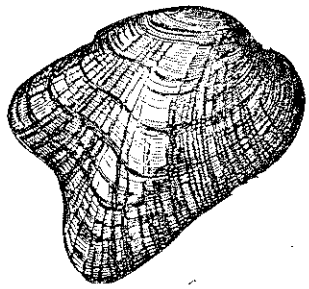

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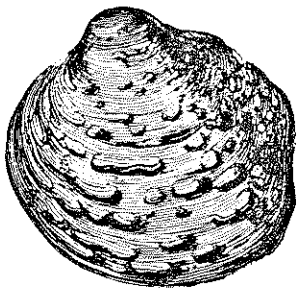

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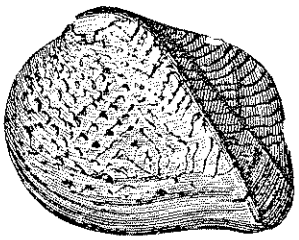

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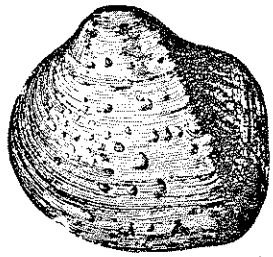

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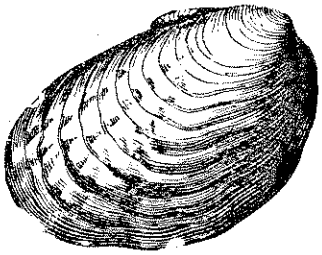

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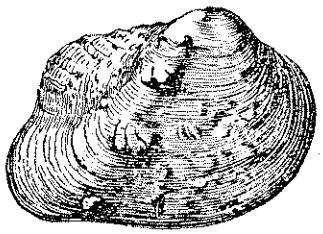

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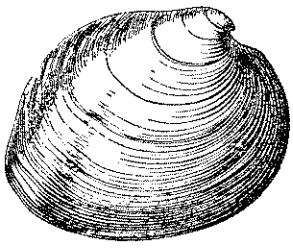

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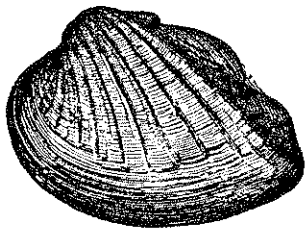

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Plate 50

1. **Elliptio shepardianus,** Lea. Altamaha River, Georgia. This shell attains 6 to 7″, long and slender, it is much larger than any similar form. I have found it quite rare of recent years, although it may be found to be more common in the tributaries of the main river.

2. **Truncilla truncata,** Raf (elegans) Mississippi River drainage generally. The three species which comprise this genus are all neat, well ornamented shells, often with zigzag markings. They range from 1½ to 2½″.

3. **Megalonaias gigantea,** Barnes. Mississippi River drainage. One of the largest of all known U. S. A. Unios and with one other large form (triumphans) comprises the genus. It can always be identified by the chevron-like markings at the umbones of the shell, although they do not show up well in the cut.

4. **Dysnomia foliata,** Hild. Ohio River. This rare form is believed to be extinct, and I have figured it, hoping it will encourage collectors to look for it. I would be pleased to hear if they find it. Look for it in all streams draining into the Ohio. This shell is about 2″. There are 26 species in the genus, most of which are not at all common.

5. **Cyclonaias tuberculata,** Raf. Great Lakes and Ohio River drainage generally. There are 4 species and varieties in the genus. This one is the most common and has the widest range. Average size 3″ but I have seen much larger specimens. The pearl is of a rich purple, and the shellers call it the Purple Pimple Back. Much used commercially.

6. **Quadrula forsheyi,** Lea. Alabama River. A handsome finely ridged shell not real common anywhere. It is very easy to identify as there are no other shells which closely resemble it. 2 to 3″.

7. **Quadrula stapes,** Lea. Alabama and Tombigbee Rivers drainage. I have not found this species a very common shell as my collectors on those rivers found very few of them. It is 2 to 3″ and well marked.

8. **Plethobasis cyphium,** Raf. Ohio River drainage. This genus contains four species of which this is one and usually considered the most common. It is a very dense and hard shell, the pearl being unusually difficult to polish. 2 to 3″.

9. **Quadrula metanevra,** Raf. Tennessee River drainage. A fairly common shell over a wide range. Strong, knobby and heavy, it is a real beauty. There are 27 species in the genus and they are a wonderful lot, when you see a complete series properly arranged.

10. **Diplodon granosus,** Brug, Brazil. British Guiana. This genus covers a fine lot of forms from the above territory. The shells are all quite distinct but much resemble some of our U. S. species. I have had a large number of species the whole length of the East Coast of South America.

11. **Pleurobema cordatum coccineum,** Con. Ohio River Drainage. This is one of the large heavy forms of the genus, as are most of the cordatum series of varieties. In the old works there were about 125 species of the genus but of late years many of the names have gone into the synonym and there are now only about 40 species recognized. You are quite likely to find some lots, which do not seem to fit in anywhere. Mostly strong solid shells some southern forms are only about 2″.

12. **Tetraplodon retusus,** Hupe (Ambigua). You will find this shell in old collections under the name of ambigua. The genus contains many of the finest species of South American Unios, some of which resemble our U. S. forms, but they can always be instantly separated even if found unnamed. A collection of even two hundred species of foreign Unios are very interesting to compare with our very great variety.

The sponge divers of West Florida often bring up sponges which are cured and sold as curios, that are three feet across and two feet wide and a foot or more thick. They are usually longer than wide and of oval form, readily bringing $5 or more per specimen. Other types are more round, often of a lighter color when bleached and 12 to 15 inches in diameter. They make splendid background specimens for a marine room.

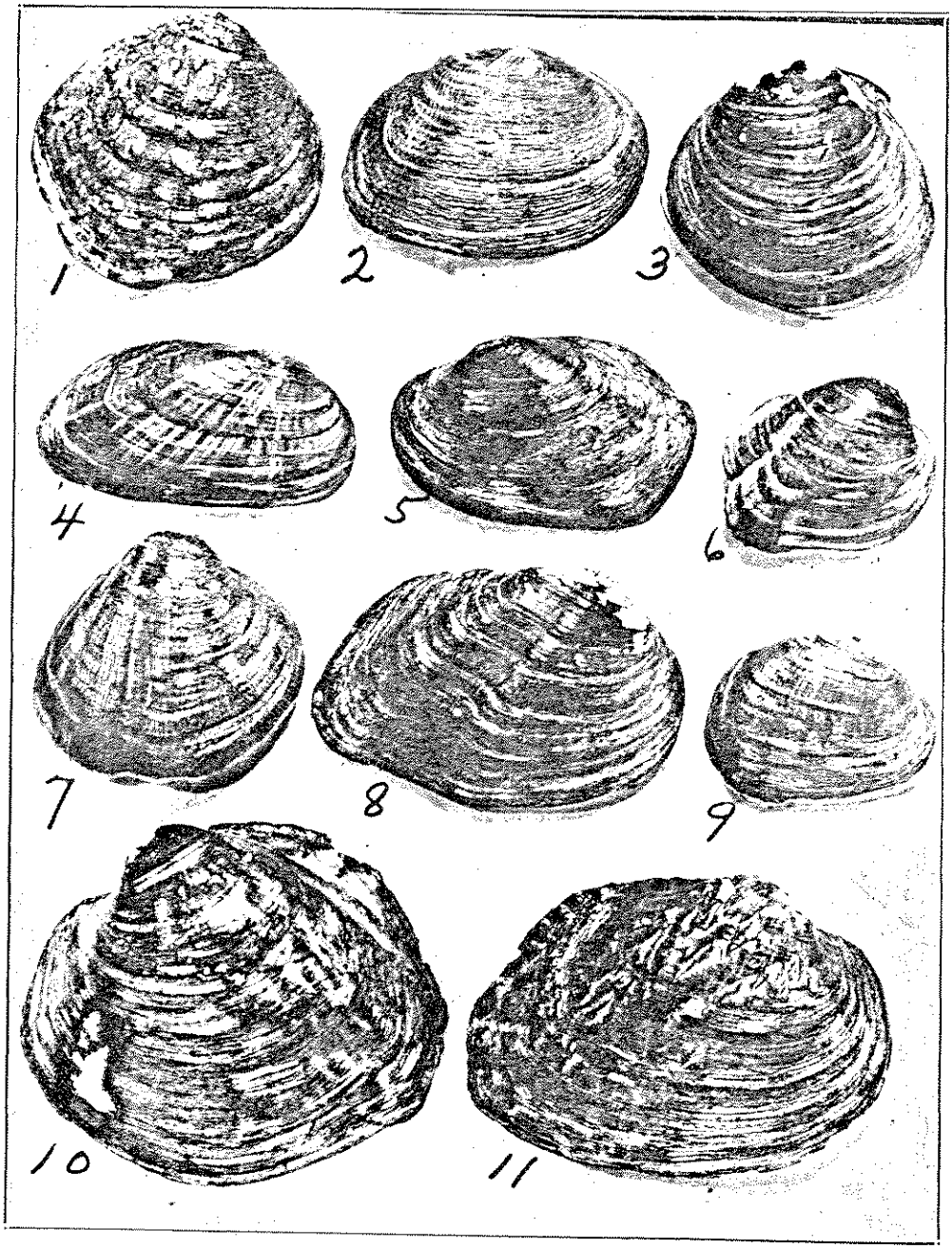

Plate 51

1. **Cyprogenia irrorata,** Lea. Tennessee River. There are two species and one variety in this genus. They are all rather round, solid pimply shells much admired by real collectors. Mostly range thru Kentucky and Tennessee. 2".

2. **Dysnomia capsaeformis,** Lea. Rather common in Rivers of Eastern Tenn. and Western Virginia. Waters of some of the rivers of this territory reaches the Atlantic and in others the Gulf of Mexico, so that the fauna is a fascinating study. This is a typical male shell but the female specimens are flattened out quite thinly on one end. 2½".

3. **Lexingtonia dolabelloides,** Lea. De Kalb Co., Tenn., where I found them rather common. A round, solid shell, one of only two species in the genus. It is 2".

4. **Micromya iris,** Lea. Eastern U. S. A. Formerly we found very finely rayed shells in the Erie Canal. It is about the most attractive shell of the genus. 2½".

5. **Micromya vanuxemensis,** Lea. Virginia in Western part specially, where it is common in the Powell River and other streams. The cut illustrates a female shell which is wider at one end than the other. 2¼".

6. **Dysnomia haysiana,** Lea. Lebanon. Tenn. My collectors all consider this a rather rare shell, not common anywhere. The female and male shells are entirely different, the former much the largest. 1½ inches.

7. **Dromus dromus,** Lea. Tenn. Rivers. There is only this species and one variety of same in the genus. Shells vary greatly in size as in some rivers they were fully twice the size of those found elsewhere. A rather flat solid shell with finely rayed surface. 2".

9. **Dysnomia brevidens,** Lea. Powell River, Tenn. The shell has a rounded thick edge, one end more rounded than the other. A rather distinct species with little variation. 2".

10. **Arkansia wheeleri,** Ortman. Arkadelphia, Arkansas. While Mr. Wheler was serving a pastorate in this lively Arkansas city, he discovered this shell, which was so radically different from its nearest relative Arcidens confragosa, Say, it was described by Mr. Ortman, the then Curator of the Carnegie Museum. It is a good species I believe that will stand the test of time, but I also believe it is a true Hybrid shell. I am backed up in this decision by professional shellers of that vicinity who have spent their life collecting Clams for the pearl and pearls. Some of these men have more knowledge of the shells they have handled for so many years than the scientists who study them. The shell is the only species in the genus. Surface very dark, wrinkled, and interior pearl usually shows some yellow color. The periostracum is so very thick and strong it will imediately break up the shell when dry. So it is best as soon as collected and wiped dry, immerse them for an instant in white shellac diluted one-half with alcohol. This keeps the air away from the outer covering and will preserve the shell forever. 3".

11. **Arcidens confragosa,** Say. Oklahoma and Louisiana rivers and near by territory. Somewhat similar to preceding species but can always be easily separated. In fact, I suspect that all of the shells you find very far away from Arkadelphia, Arkansas, will be this species as the previous species has only been found near Arkadelphia in Old River. 3 to 4".

A collection of the Sea Stars of our two coasts are quite as fascinating as the shells. There are numerous people who have found it profitable to spend their entire time collecting the specimens, preparing them in an attractive manner and disposing of them at wholesale to curio stores and institutions. While these animals may look repulsive to some people when alive in the sea, they are not so when finely prepared and often mounted on cards and covered with cellophane so they can be easily handled without danger of breakage. In the last few years much has been accomplished that could not be attempted heretofore. They have in some cases been mounted between sheets cellophane so both sides can be studied perfectly. Make your cabinets attractive and you will find greater enjoyment, and so will your friends.

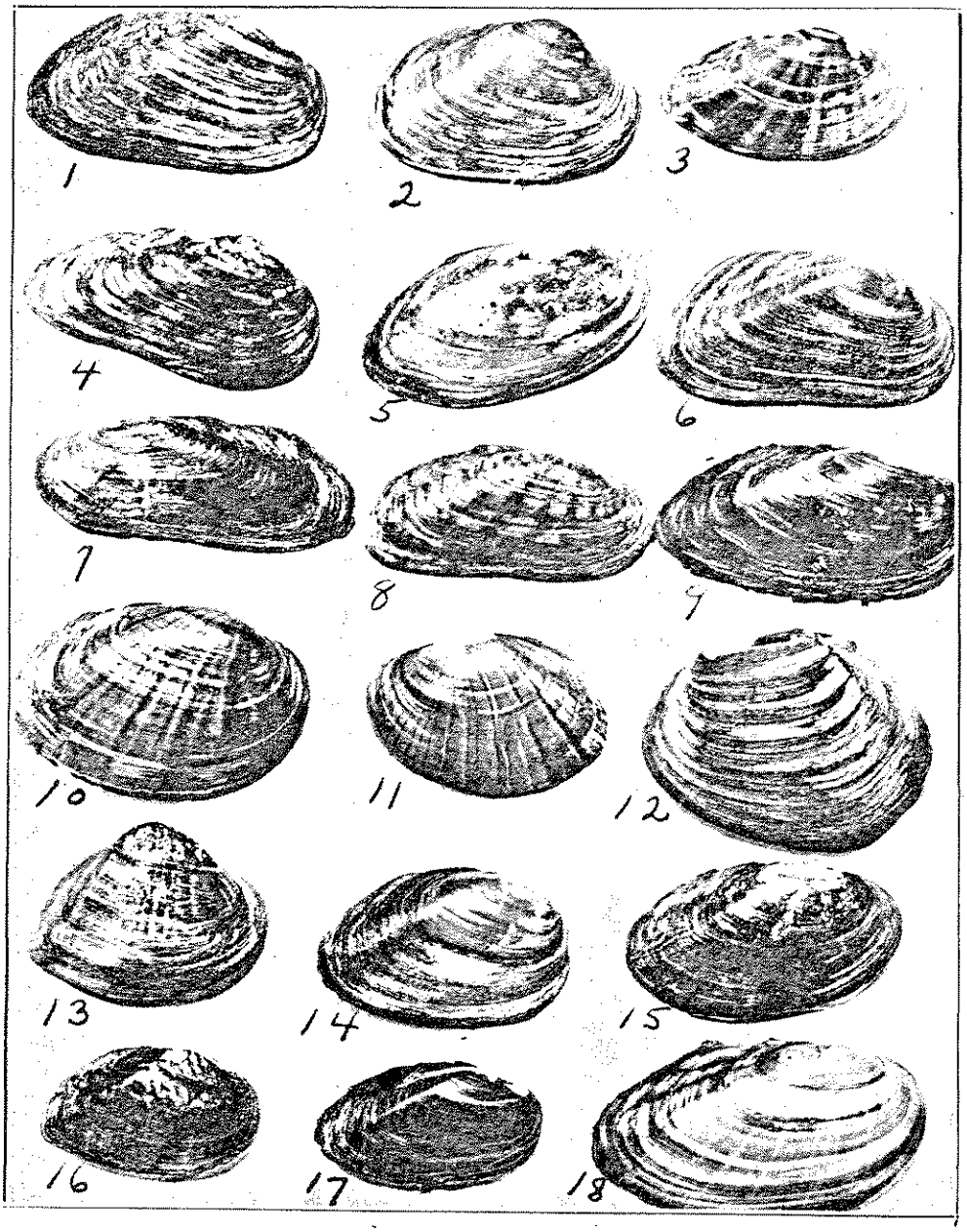

Plate 52

1. **Unimerus obesus,** Lea. Silver Springs, Florida. There are 10 species and varieties in this genus. Shells are usually thin, and inhabit rather small rivers, creeks or small lakes. 2½".

2. **Ptychobranchus greeni,** Con. Black Warrior River, Alabama. A rather small shell for this genus of six varieties. 2".

3. **Lampsilis subangulata,** Lea. Tallassee, Florida. I suspect this is the most brilliantly colored shell of the genus if not the world. Brilliantly streaked with green. Natural high polish. 2½".

4. **Micromya fabalis,** Lea. Obey River, Tenn. There are 24 species in this genus. Shells usually thin and range from small to medium size. Inhabit the very smallest streams where most of them are very common. This shell is rather thicker and stronger than the others. 2".

5. **Lampsilis anadontoides floridensis,** Lea. New River, Florida. Usually only half the size of the type. Both are light yellowish shells with white nacre but I have had shells with brilliant salmon nacre.

6. **Unimerus tetralasmus declivis,** Say. Alabama. The type is the largest form of the genus, but this variety is about half size, thin and very common in the South.

7. **Cumberlandia monodonta,** Say. Clinchport, Tenn. I illustrate this shell as many collectors have never seen it. It belongs to the Margaritana tribe which is world wide in distribution, even found in this country, so this fine shell which is a strictly American form is placed in this sub-genus. They are hard to find. My collector dived into ten feet of water to secure every shell he sent me. Ranges up to five inches. Illustration is a small shell.

8. **Ptychobranchus subtentum,** Lea. Tennessee River in Eastern part of state specially. A finely mottled shell as per cut. 3".

9. **Elliptio hinkleyi,** Lea. Florida. There are a lot of similar forms in the Sunshine State. This one is a beauty and when polished shows all the rays of the setting sun. The genus Elliptio was erected to contain all of the shells that most generally resemble the true Unio shells of Europe. In the early days of our country, all Fresh Water Clams were either Unios or Anodontas, but now we have 43 genera and they are the finest in the world.

10. **Lampsilis pectorosa,** Raf. Kingport, Tenn. Very finely rayed when about half grown as shown in cut. Older shells seldom show the rays as well. Ranges from 2½ to 4".

11. **Lampsilis spillmanni,** Lea. Murray Co., Georgia. Illustration is of a youngish shell which shows the fine rays. Attains 2½ inches.

13. **Dysnomia triquetra,** Raf. Tennessee Rivers. A rather triangular shell, differing from all of the other 24 species in the genus. This genus is believed to be the youngest of all the Fresh Water Clams and it sure is one of the most fascinating. In some of the species the female and male shells are so radically different, you would never dream they were the same.

14. **Elliptio Webbiana,** B. H. Wright. Lake Consuleo, Florida. A fine new reddish brown species discovered by one of my collectors, while working the rivers of the northern part of the state. I have seen no similar form from the U. S. but have had species of about the same shape and color from Central America. 2¼".

15. **Strophites alabamensis,** Lea. Murray Co., Georgia. The genus Strophitus come just before the Anadontas. The shells are mostly smaller than Anadons and not quite so thin. 10 species are recognized and some of them vary greatly over their wide range. I have had the same species from ten localities all of which looked different and rather difficult to name. But this form is quite distinct.

16. **Quincuncina burkei,** Walker. Dade Co., Georgia. This genus contains 2 species and one variety. They are all small and finely reticulated. This form is rather more elongated than the others. 1½".

17. **Elliptio coruscus,** Gould. Florida. Very common over a wide territory inhabiting shallow rivers and lakes. It is a fine, smooth polished shell. 2".

18. **Anadonta imbecillis,** Lea. Medina River, Texas. A shell often brilliantly rayed with green but some localities only produce dull colored shells. Ecological conditions often cause great changes in all the shells of the Anodons. 2½".

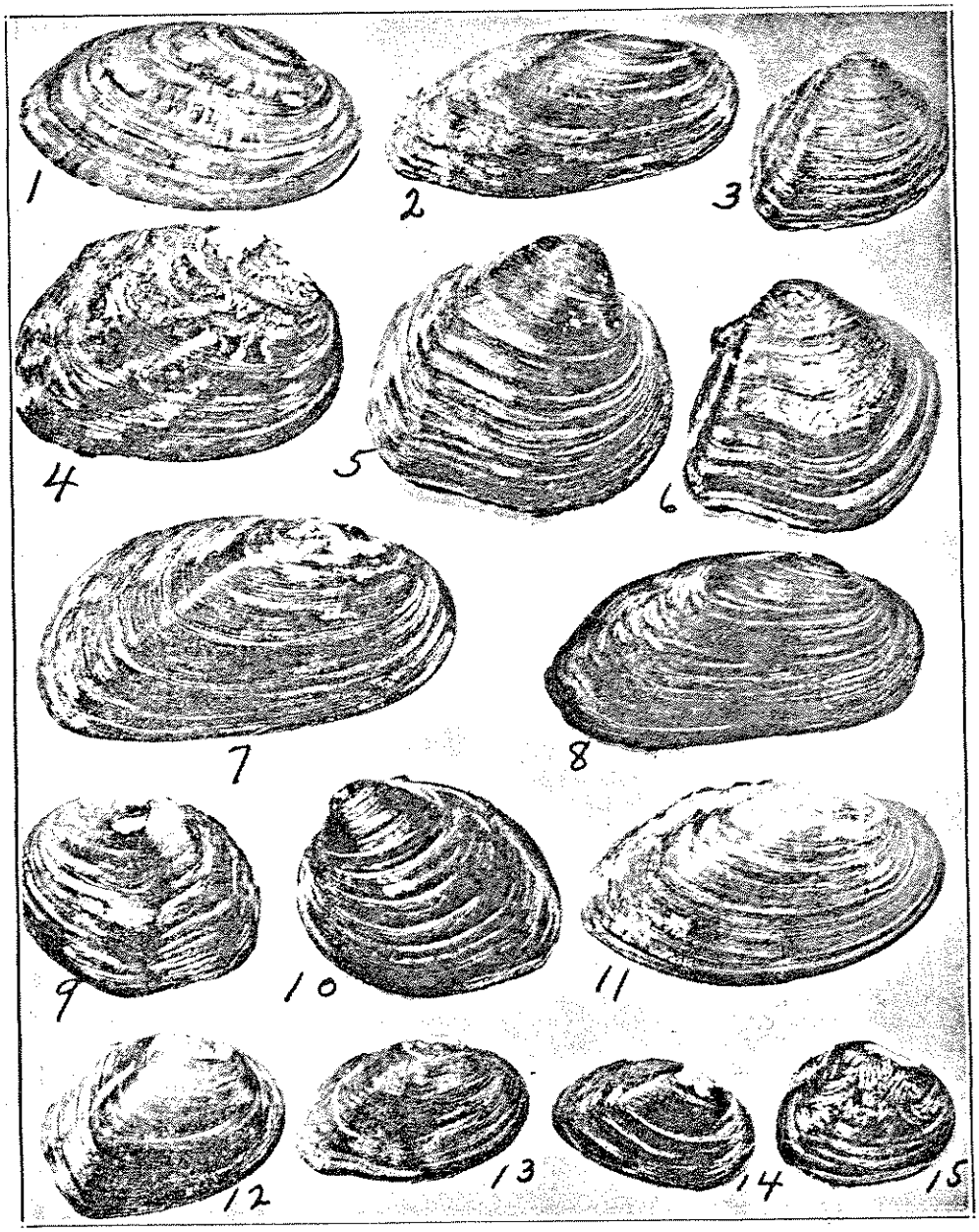

Plate 53

1. **Ptychobranchus fasciolare,** Raf. Ohio River and southward. One of the finest species of the genus, rather thick and solid. There has been one good variety named from Chautauqua Lake, N. Y.

2. **Ligumia nasuta,** Say. Northern Ohio and near by. A fine, dark shell pointed at one end and fairly common over a wide territory. There are 7 varieties in the genus, the largest and heaviest being recta, Lam which the Shellers call the Black Sand Shell, and is of real commercial importance. Polished, it is a brilliant pink, but nasuta is thin and of no real value in commerce. 3".

3. **Fusconia rubidula,** Frierson. Elrod, Alabama. A neat thick, solid dark, fairly smooth shell, as per cut. 1½".

4. **Plectomerus dombeyana,** Val. Widely distributed in the rivers of the lower Southern States. Rather square in shape, it is thick, and pearl is of deep purple color. Button manufacturers prefer shells with white pearl, but this would be a fine one for colored pearl objects. A brilliant shell when polished. The only species in the genus, with one variety. 4".

5. **Fusconia undata,** Barnes. All Mississippi drainage. The shell illustrated comes from Arkansas. Those cold mountain rivers of the Ozark region contain some of the finest clams to be found anywhere. The water is seldom sluggish, hence leaves do not accumulate and create the acid which so quickly erodes all fresh water shell life. I had thousands of shells from this region that were entirely free from erosion. A solid fine 2 to 2½" species.

6. **Truncilla donaciformis,** Lea. Tenn. Rivers. A genus that now consists of three species, all somewhat similar to this one, which is a thick chunked shell, rather triangular in form. Some of the shells are finely adorned with zigzag markings, and one of the species used to be called zigag. That splendid name which properly described the shell had to be dropped for a name that meant exactly nothing. Truly the advance of science is wonderful. 2".

7. **Elliptio complanatus,** Dill. Quebec to Florida. It covers the whole Atlantic drainage and through a half a century about a hundred forms, more or less, were described. You could not blame these authors either as the only conveyance for traveling was horseback and later a carriage. I have had several drawers of this shell covering a host of forms one would readily call different species but they are most all now just complanatus. One of the commonest 3 to 4" shells in the Eastern Rivers.

8. **Margaritana hembeli,** Con. Escanaba River, Florida, and adjacent. This is the one true Margaritana we can call our own. It is a very dark shell of about 3". The other species in the genus, as I have mentioned elsewhere, is world wide in distribution.

9. **Obliquaria reflexa,** Lea. Mississippi River drainage. You will notice two prominent knobs on the valve shown in cut. The other valve also has two knobs but they are exactly between these two. This odd characteristic will always identify this fine solid medium size, wrinkled shell. The Shellers call it the Two-horned Warty Back. They always have common names for all the shells of commercial importance which they collect and sell by the car load. The buttons made from Fresh-Water Clams runs into many millions of dollars a year, and thousands of men make their living collecting the shells. In fact, the business has become so very extensive, several states have laws protecting the species. In many localities they can only be collected two months a year. 2½".

10. **Fusconia ebenus,** Lea. Most all of the Middle West. Called Niggerhead by the Shellers. In some rivers they are all 2-3". Always the form of cut, they are small, but in others they will run up to thick and solid. I have had shells with a rich red pearly interior, but they are not common except in certain rivers.

11. **Anadonta grandis benedictensis,** Lea. Lake Champlain. The true Grandis is one of our noblest species. In some rivers they will be very large, 6 to 7" and thin, but in the Erie Canal I have found

many old, large and thick shells. Such shells of this genus should be dipped, as mentioned elsewhere, to preserve them. A very large number of varieties of this shell were described in the 19th century, but we now recognize about 5 varieties. This is one of the smaller forms about 3".

12. **Fusconia succissa,** Lea. Alabama. A little beauty that holds rather true to type. It is a smooth shiney fine species. 1½ inches.

13. **Actinonaias pleasi,** Marsh. Spring River, Arkansas. A rather small form of no particular importance. There is one other species in the genus somewhat similar, and then there is A. carinata, Barnes which the shellers call the Mucket. It attains such a large heavy size I did not try to illustrate it. A very good commercial shell. I mention it here for another reason. A few years ago in an old mussel collection, I found a very large 6" shell of this species. At some time in the past, a good sized June bug of fully one inch got under the mantle of the mollusk, had coated the bug with nacre thru the middle but had left both the head and tail open to view. Doubtless in time, It would have covered the insect completely. I thought it so interesting it was placed in a museum, where others may see it.

14. **Lampsilis amygdalum,** Lea. Florida. A rather roundish small, thin, dark form common to rivers of that state and small lakes. Only a few of the fifty species in this genus are as small as this one. 1½".

15. **Quincuncina securiformis kleineriana,** Lea. North Florida. A very handsome, rounded, well ornamented shell, of which there is only two species and this one variety in the genus. They are very distinct from all other forms of mussels.

For a century or more it was believed by some writers that the sexes of all Naiad species were separate and by others that the mollusks were hermaphrodite. It is now quite generally believed that the more highly organized genera, those which have two forms of shells, the sexes are always separate. In the more simply organized Uniondae, those with one form of shell, the sexes may or may not be separate. There is much chance for further study along this line, and one of the best time of the year is in the spring season when the shells are gravid. Collect the shells, drown the mollusk and immerse complete with shell in alcohol for further study.

* * *

While many forms of ancient life show a complete cycle in a single geological age. The Unionidae have held on unbroken from the Triassic or perhaps from an earlier geological age until now. Almost every important type of the family among the fossil species, are found somewhere to-day among the living ones. They seem to have migrated to a certain region, made a slight advance over the characters of their predacessors, and to have continued down with but little change until today. When a new migration was made, the same thing was enacted again.

* * *

If the Unionidae originated in North America during the Triassic or some earlier age, we may suppose that some members of the family migrated into South America during that or at a later period. The radial beak sculptura, the young contained in the inner gills, all point to that conclusion. Then again by an old, now partly submerged land bridge in the Antartic region, it is probable that a migration took place from South America to New Zealand and Australia. An examination of the shells of the southern part of the world, warrants this conclusion. Still another migration took place to Southeastern Asia and from there, there was another to Tropical Africa, possibly from Southern India over an old but now lost landway. Again the shells of the region seem to warrant this conclusion. It is quite likely that the genus quadrula developed in Asiatic streams, where it is still represented. You find it abundantly represented in the Tertiary strate of Eastern Europe and Asia. The beak sculpture is very similar. There probably existed at that period an old landway across from Northeastern Asia to Northwestern North America, and one which lasted a long time. It may have been submerged and then reappeared again, for it is apparent for long ages, there has been a highway for migrating Unionidae.

It seems very reasonable to suppose that the immediate progenitors of the magnificent and diversified series of Unio found fossil in the Laramie beds in the United States came over from Asia as their general form closely resembles those of Siberia. In the genus Pleurobema the shell is solid and rather triangular, the beaks are high and typically well forward, the beak sculpture is broken and we see similar and closely allied genera in the Oriental countries. This genus has an immense development in the Tennessee River drainage and may have originally migrated from the northwest. That the southern outflow of the Tennessee ceased a long time ago is shown by the fact that in the Alabama drainage all the northern species have a peculiar aspect and several entire groups have developed which are distinct from anything found in Tennessee.

* * *

It is likely that the true Unios next developed with simple oval to elongated shells and moderate beaks, showing a variety of sculpture. The genus is found throughout a large part of the Palearctic region and North America generally, except beyond the Rocky mountains.

* * *

Throughout the entire Mississippi Valley, part of the Atlantic drainage, in most of the streams flowing into the Gulf of Mexico, in eastern Mexico and Central America we find shells which are more or less winged like the Proptera. The nacre is quite generally purple. As we do not find any similar fossil forms, it seems quite likely these genera originated in North America.

* * *

Dysnomia marks the highest development of Naiad life and may be taken as the latest. The shells are smooth and generally highly painted, the beak sculpture is fine and doubly louped, the hinge teeth are well developed. There is a surprising difference in the male and female shells. The whole genus exhibits a great variety of form, and we must believe that it has been in existance for a long time.

* * *

As Dr. Simpson says in one of his works on the Naiads, remarks of this kind may be mere conjecture, still it may well be founded on fact. We can only judge of the relationship and age of living forms by a study of their soft parts and the fossil forms discovered to date. May be in the future Paleontology will give us more conclusive facts. Students generally agree that the living forms of Unionidae show a gradual development from the simplest, lowest and earliest types up to the highest, most recent and most complicated and stand as a sort of index to the progress of the family in the past.

* * *

Any one can see from these few brief remarks there is an unlimited opportunity for study of the United States Naiad life and is just another argument which I have used for many years, that the collectors of shells now living, should give more attention to the shell life of our own great country. Every state is now so very easily accessable, and collecting during the summer season, make one of the most enjoyable vacations.

* * *

The Pleuroceras which somewhat resembles the Thiaras of the rest of the world, are very prolific in the streams of our country. Thy range from slender nobby sorts to giants of their kind, for the temperate zone, as we must not compare them with tropical forms such as are found in Guatemala or Madagascar. If you have an opportunity to study the 125 or more species in the genus, I am sure you will agree with me, they are a wonderful array of forms which have no equal anywhere. All the countries of the world have some forms somewhat similar but not even the tropical regions, such an array o fspecies as are found living in our own country. You will have to form a real collection of them to understand fully what I mean.

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Collectors in the southland are now cleaning and bleaching coral with chlorax. This fluid can be purchased at most grocery stores. First clean off dirt in usual manner with brush or hose and then place in bleaching fluid for a few hours, then rinse.

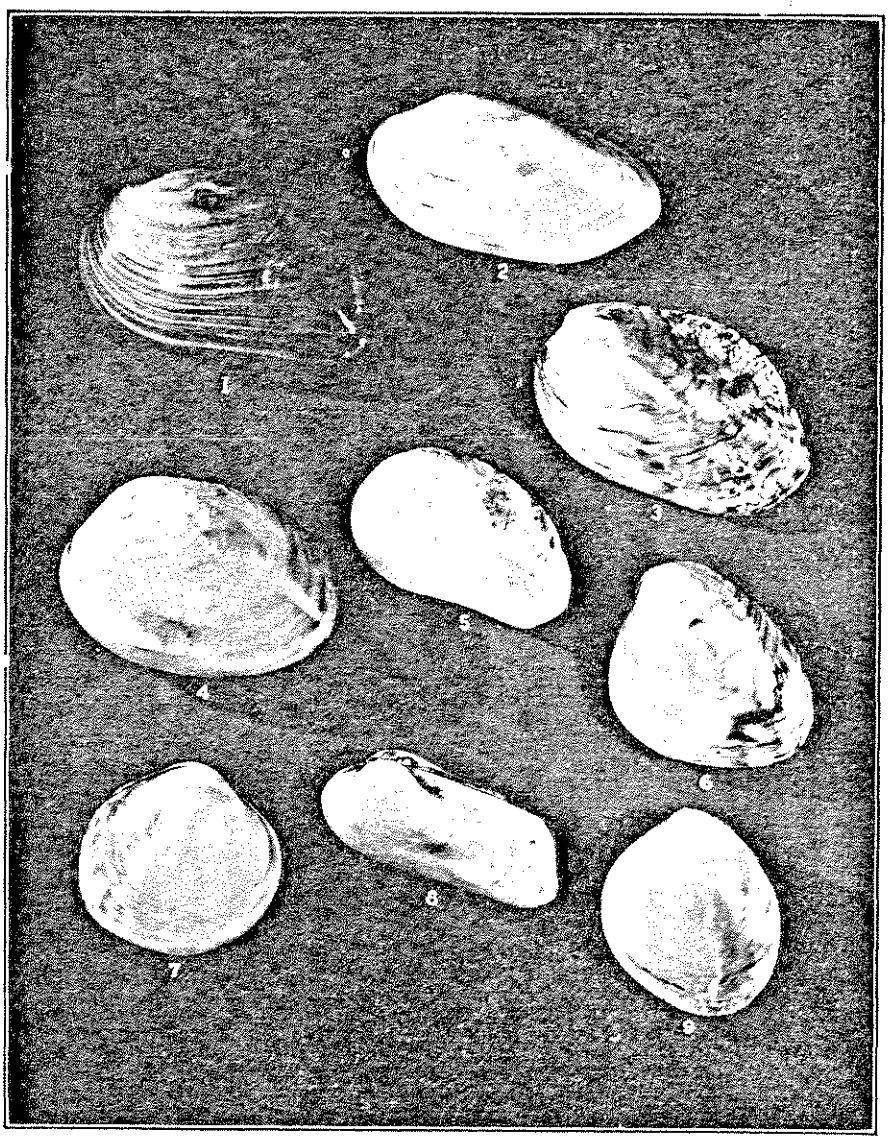

Plate 54

The Pearl found in the Fresh Water Mussels of the United States is the finest in the world. They show a marvelous array of colors such as White, Damask, Purple, Violet, Reddish, and many are irradescent, with all the tints of the rainbow. A glass cabinet with glass shelves and a couple hundred pair of these shells, will attract wide attention.

1. **Elliptio crassidens,** Lam. Tennessee River. Rich, purple nacre. 4½".

2. **Lampsillis anodontoides,** Lea. Mississippi River drainage. White and occasionally with yellow nacre inside. 4½".

3. **Amblema plicata,** Say. Mississippi River drainage. Finely ridged with irridescent colors. 4".

4. **Lampsillis orbiculata,** Hild. Most of Eastern U. S. White, brilliant nacre. 3½ inches.

5. **Tritogonia verrucosa,** Raf. Mississippi River drainage. Of damask shades of white nacre. 4½".

6. **Pleurobema pyramidatum,** Lea. Tennessee River. Brilliant white pearl. 2½ inches.

7. **Quadrula pustulosa,** Lea. Most of Central U. S. Brilliant white pearl. 2½".

8. **Quadrula cylindrica,** Say. Most of Eastern U. S. Undulated, pearly surface. 3½ inches.

9. **Dromus dromus,** Lea. Tennessee River. Pearl is extremely hard, more so than most other species. 2½".

In the great depths of the ocean, you find Dentalium and its allies, Philene, Cylichna, Utriculus, Scaphander, Actaeon, Pleurotoma, Fusus, Scissurella, Puncturella, Cyclostrema, Arca, Limopsis, Nucula, Leda, Malletia, Lima, Pecten, Amussium, Axinus, Synodesma and Brachiapods. There are of course many other less known genera but most of these mentioned above are rather small shells, some even minute.

* * *

The West Coast Psammobiidae are all interesting shells and rather attractive when well cleaned. Ranging from the true Psammobia californica, Con. through Sanguinolaria, Heterdonax, Tagelus you find a great variety of color and form. Mostly thin shells, some have a rich periostracum, and the Heterdonax exhibit quite a range of color but are usually about one inch shells. The sailors call the Tagelus californianus, the Jackknife Clam which others call it the usual name of Razor Clam. But whenever you wish to call it, its habits are worthy of much study. You will have to dig them out, as they burrow deep and make a real home in the sea sand.

* * *

The Naticidae of the West Coast is represented by Polinices only which have a leathery operculum. The largest species is P. lewisii and one could write a good sized book on the habits of this one species. Its truly gigantic size, being one of the largest and heaviest in the world and remarkabl habits, are worthy of much study and observation. Their enormous foot enables them to cling to the sand with great tenacity. They push along in the soft sand, finding a clam of suitable size, clap the foot over the whole mollusk shell, smother it, then devour the contents at their leisure. As every species of mollusca in the ocean has its own particular enemies, this big fellow is no exception. The big many rayed sea star, Pycnopodia, can easily wrap its arms about the heavy shell, and quickly suffocate him. The Indians of the region have used this shell for food for centuries and the shells are often found in shell heaps scattered along the coast. I had sent to me the huge collars six inches or more in diameter in which this shell lays its mass of eggs, but found them hard to preserve, as they are built of lightly cemented shore sand.

* * *

The Indians who live along our southern border are still fond of the bright Olivella biplicata, Sow. which grows up to one inch and is of a pearl, gray or white color. They form strings of the shells for adornment as have their ancestors for centuries. Shell mounds often contain pierced shells of this species in quantities. Walking along the beaches at low tide ,you will see the marks in the sand showing where they have crawled just below the surface. You will usually find all classes of Oliva just below the surface.

* * *

The spines of sea urchins are an interesting study. There is a very large number of species of these urchins over the world. Some of the spines are like needles, some like stones, others hollow, others with serrated edges.