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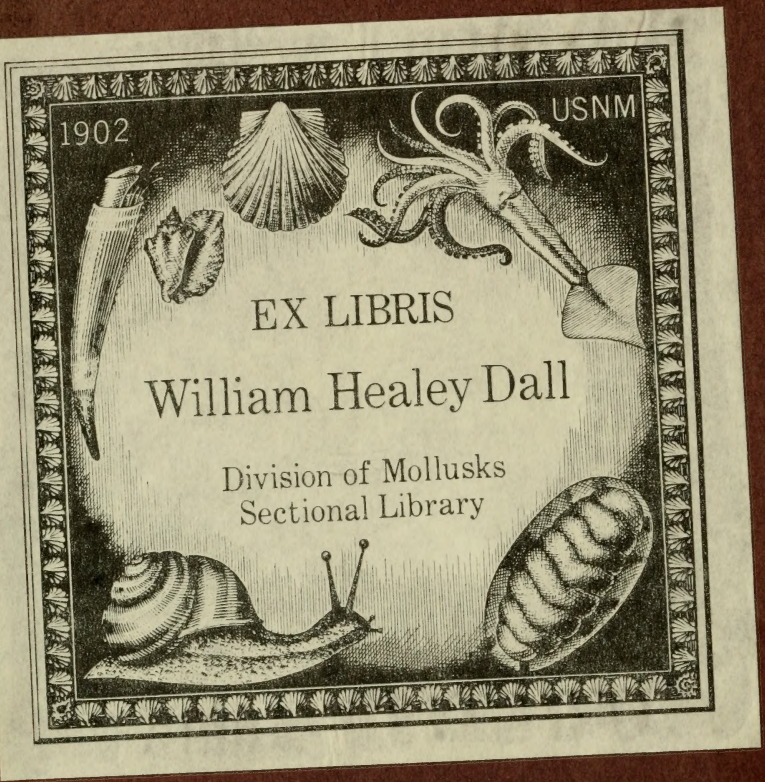
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A STUDY OF THE UNIONIDÆ OF ARKANSAS, WITH INCIDENTAL REFERENCE TO THEIR DISTRIBUTION IN THE MISSISSIPPI VALLEY.

By R. Richard Ellsworth Call, M. Sc., M. A., M. D.

There exists very little published information concerning the abundance, varieties, and geographic distribution of the great molluscan family of *Unionidæ*, within the limits of the State of Arkansas. A few forms were originally accredited to it; some of these have not since been found in the State, nor have some others ever occurred outside its boundary. Of the mollusks of no other one State in the Union is less known.

During the progress of the investigation the results of which are herein recorded, opportunity to consult a number of original types has been afforded with some very interesting results connected with the nomenclature of this great group of mollusks. To those who have not had access to original publications and to original specimens, much of the synonymy herein developed will, perhaps, prove a matter of surprise. The task which one thus assumes is not without its share of responsibility. To do strict justice to those most excellent early investigators, who so completely have rendered all successive students their debtors, is no easy task. That each one did the best he could, or knew, we scarcely can doubt; measured by the faulty notions of species that prevailed during their time they could, perhaps, for the most part, have done little better. A half century spent upon this great family by the veteran Dr. Isaac Lea must, in itself, entitle his opinions to confidence and to weight. But authority may never stand in place of Nature and in place of fact. If so be a more modern notion of what constitutes specific value, coupled with proper regard for environmental factors,

has necessitated the reduction to synonymic rank of very many forms it is only because the facts justify the reduction, and the interests of sound scientific reasoning require it. Of so much synonymy as grew out of personal differences between former students it were better not to speak. It will always stand as a reproach that the best interests of science have thus suffered.

Most of the opinions herein expressed, regarding the specific value of very many forms, are based upon an extensive private collection of *Unionidæ*, which is geographically and numerically all but complete. Added thereto are very many facts gleaned during an engagement of some months in the Smithsonian Institution, at Washington, the time of which was largely devoted to the *Unionidæ*, which had previously been studied by my old friend and preceptor, the competent and painstaking Dr. James Lewis. Many facts, chiefly, however, connected with geographical distribution, were thus collated.

A considerable number of American *Unionidæ*, most of which are represented in the fauna of Arkansas, were originally described by the great French naturalist, Lamarck. Concerning these species there has been much difference of opinion, and even yet, in certain cases, opinions are divergent. To facilitate a correct understanding of Lamarck's species his original descriptions are herein reproduced, and fuller and more complete descriptions added, of forms which are believed to be authentic. These descriptions are accompanied by drawings in the several plates; some of these were executed by the careful hand of Mr. Harry A. Pilsbry and are duly accredited to him on the plates; the remainder were drawn by the writer. Added to the data thus assembled will be found, for Lamarck's species, most of the synonyms which have been erected as species upon his older described forms. The determination of these synonyms was in no sense a patriotic matter, but proceeded on the hard lines recognized in science as just and right. The great naturalist made serious errors, but these could not well be avoided with scanty material and not too full locality references. It is hoped that this rather full synonymy,— which is

not complete, we too well know, — will eliminate from the trade-lists of amateurs species names which should no longer burden our faunal lists. In the matter of other bibliographic references the rule adopted has been to give the volume, page, plate, figure and date reference where the form was first described; added to these are occasional references to well-known and easily accessible works. There has been made no attempt, in the case of the greater number of forms listed, to exhibit but a moiety of the bibliographic matter. Beginning with *Unio elegans* Lea, references have been made to Reeve's great work, the Conchologia Iconica; this has been done in the hope that those to whom access is given to that work will find the critical notes, which are sometimes appended, of service. Many American shells are therein wrongly named but the fault lies in the sending abroad of misnamed specimens of American *Unionidæ*. Some of these errors are corrected by Reeve in the addenda to the Genus *Unio;* the rest remain to puzzle the naturalist. The opportunity to examine and use this great and costly work was afforded by the generous courtesy of Mr. Truman H. Aldrich, of Cincinnati, who kindly loaned me these volumes for a long period of time.

Not the least interesting fact connected with the study of the *Unionidæ* is the one that numerous species have been duplicated by describing the forms assumed by the sexes as of specific value. This has occurred in a number of instances, and is responsible for a considerable number of synonymic names. Among the forms so described, the following may stand as examples: —

Unio donaciformis Lea is the female of *Unio zigzag*, Lea.

Unio ater Lea is a synonym of *Unio purpuratus* Lamarck, and is based on the female form.

Unio patulus Lea is based on the female of *Unio clavus* Lamarck.

Unio lens Lea and *Unio leibii* are both synonyms of *Unio circulus* Lea and are based on the female form. *Unio leibii* is a dwarfed form of *U. circulus*.

Unio brevidens Lea is a male form of a species the female of which was afterwards described as *Unio arcæformis* Lea.

Unio subovatus Lea was based on the male of Say's *Unio ovatus.*

This list, illustrating what appears to have been the misinterpretation of sexual differences, might be extended indefinitely; when extended to its limits the student of the *Unionidæ* will be astonished at the results which he will reach.

Aside from personal collections, made in the intervals of field work in geology, and which were made in the St. Francis, Ouachita and Saline rivers, help has been derived from specimens collected by Professor R. T. Hill, in the Ouachita, by Mr. L. S. Griswold, in the Ouachita well up toward its source, and by Mr. F. A. Sampson, in the White river and in other portions of northern Arkansas. Dr. John C. Branner, State Geologist, has furnished an occasional specimen. Other shells have been sent, for identification, from the Little Red river. It is a matter of regret that more full and exhaustive collections could not be made preliminary to a final paper; it would better represent the wealth of the State in this group of natural objects. It will be noticed that three streams and as many localities furnish the major portion of the species here listed. Reasoning from this fact it is fair to assume that very many forms yet remain to be added to the list on complete examination of the State.

REGISTER OF SPECIES.

UNIO ABERTI Conrad.

Proc. Phila. Acad. Nat. Sci., p. 10, (1850); Jour. Phila. Acad. Nat. Sci., 2d series, Vol. II, Plate XXVI, Fig. 1, (1851).

Unio lamarckianus Lea. Trans. Am. Philos. Soc., 2d series, Vol. 10, Pl. 17, Fig. 20, (1852).

Unio popenoi Call. Bull. Washburn Coll. Lab'y of Nat. Hist., No. II, pp. 48–49, Pl. II, (1885).

This form was described by Lea from the Caddo river, under the name of *Unio lamarckianus*, the specimens of which were submitted to him by Dr. Byrd Powell. Additional examples were submitted by Dr. Hale who collected them in the Ouachita river, near the Hot Springs. The specimen figured by Doctor

Lea is a young one and is by no means a fair illustration of the shell. In the description of the species he mentions the numerous small nodules found over its surface but the figure shows the shell as smooth. The very young shells are nearly as triangular as the well known *Unio elegans* Lea.

In 1885 the writer, without then having access to the complete bibliography of the species, and misled by the great size of the specimens submitted to him, described the form as new, giving it the name of its Kansas discoverer. Later the error was discovered by him and the facts fully stated.* In this last named paper the remarkable character of the ctenidium was made known and illustrated from specimens collected in the Verdigris river, Kansas, by Mr. J. R. Mead.

This species has thus far been only found in the Arkansas and Red river drainage basins. It has not occurred to us in our collecting in the State.

UNIO ALATUS Say.

Nicholson's Encyc., Am. ed., Vol. IV, Pl. IV, Fig. 2, 1816. Also figured in the Am. Jour. of Science and Arts, 1st series, Vol. XIV, Fig. 17*a* and 17*b*. Another good figure may be found in Conrad's Monograph of Unio, Plate XXXI. A figure has recently appeared, in Bull. U. S. Fish Commission, Vol. XIII, Pl. 36, 1893, that is characteristic in all respects, except its alate features. Both alæ are broken in the specimen figured.

This species has not been found abundantly in Arkansas. Its sole occurrence to us was in the St. Francis river, near Wittsburg, in Cross county. It has been seen by the writer from the Ouachita river, Indian Territory, and without doubt will be found in the Arkansas portion of that stream. It is not readily confounded with any other known *Unio* being, when perfect, easily separated from other symphynote species by its dark purple coloration within and its flattened disk. I have received it under the name of *Unio purpuratus* from which species, however, it is entirely distinct.

From the Cedar river, Iowa, were secured very large and

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* See American Naturalist, September, Vol. xxi, 1887, p. 860.

fine specimens of this form. One of these measures in length 175 mm., in height 105 mm., in breadth 51 mm.

UNIO ANODONTOIDES Lea.

Trans. Am. Philos. Soc., Vol. IV, Pl. VIII, Fig. 11, 1830.

Unio teres Rafinesque, *vide* Conrad's Monograph, Pl. XXVIII.

St. Francis river, at Wittsburg and Madison; Saline river, at Benton.

This species is very widely distributed over the United States from western New York to Alabama and Texas, ranging north to Indiana, Minnesota, and Kansas. It is well marked and is distinct from *Unio luteolus* Lamarck, with which it is often confounded. The St. Francis specimens are very large and fine.

Conrad's figure of *Unio teres* is said by him to be based upon a specimen in Mr. Poulson's cabinet, which was said to have been labeled by Rafinesque himself, who collected it "in the west."

UNIO ARKANSASENSIS Lea.

Jour. Phila. Acad. Nat. Sci., 2d series, Vol. V, Pl. XXX, Fig. 275.

The only Arkansas specimens seen came from the Saline river, near Benton. One is quite imperfect while the other, of the two, is a good representative of the female of the species. The original specimens came from "Hot Springs" and presumably from the Ouachita river.

UNIO BREVICULUS Call.

Plate XVII.

Proc. U. S. Nat. Mus., Vol. 10, p. 499, Plate XXVIII, 1887.

White river, Carroll county; Little Red river, Clinton, Van Buren county, Arkansas. Jack's Fork of Current river, Missouri; Big Creek, tributary to Jack's Fork, Texas county, Missouri.

Shell smooth, ovate elliptical, inequilateral, subinflated, biangular posteriorly, circularly rounded before, somewhat

incrassate; umbones slightly elevated, so much eroded that minute characters are indeterminate; ligament large, thick, black, or dark brown; epidermis yellowish horn-color, smooth, polished, rayed with dark green over the whole disk, the rays often interrupted by the lines of growth, which are numerous, but somewhat indistinct; umbonal slope rounded, depressed in the male, slightly elevated in the female; posterior outline emarginate in the female ventrad of the siphonal area, dorsal outline rounded; cardinal teeth double in the left and single in the right valve, short, erect, triangular, solid, smooth, or scarcely crenulate; plate connecting laterals with cardinal teeth thick, somewhat arched; lateral teeth rather short, thick, slightly curved, smooth; anterior cicatrices distinct, large, deeply impressed; posterior cicatrices confluent, well impressed, that of the *retractor pedis* muscle at tip of base of lateral tooth but not on it; dorsal cicatrices numerous and deeply impressed in the cavity of the umbones; nacre salmon colored, occasionally white. Length 71.00 mm.; breadth 27.20 mm.; height 45.50 mm.

Animal dirty, yellowish white; labial palps short, ovately triangular, adherent at base, laterally united so as to form an oval groove, midway from the extremities of which is placed the mouth. In the specimens examined only the anterior one-third of the external branchiæ contained ova. This portion was characterized by the heavy deposit of pigmentary matter at the apex of the chambers, while the remaining margins of the branchiæ were uniform in coloration with the mass of the animal. The posterior borders of the mantle were, as usual, differentiated into a series of tentacular folds; those surrounding the incurrent and excurrent orifices were yellow and brown, the remainder were black.

While the females sustain a general resemblance to *Unio clarkianus* Lea and *Unio gerhardtii* Lea the emarginate character of the female form is utterly unlike anything exhibited by the females of Lea's types.

The above description is repeated from the original, that this form, which has recently been found abundantly near Clinton, Arkansas, may not remain unknown to those persons in that State who take any interest in its natural objects.

UNIO CALIGINOSUS Lea.

Trans. Am. Philos. Soc., 2d series, Vol. 10, Plate VII, Fig. 21, 1845.

St. Francis river, Wittsburg; White river, Carroll county; Ouachita river, Malvern; Saline river, Benton.

These localities all furnished numbers of this form and of great perfection. Among the Uniones with which it groups are *Unio intercedens* Lea, *Unio fallax* Lea, and *Unio subrostratus* Say. The group is widely distributed in the southern States and is characterized by the emargination of the female, on the ventral border.

UNIO CAPAX Green.

Described by Dr. Green in "Cabinet of Natural History and American Rural Sports," Vol. II, p. 290, Phila., 1832.

Figured as *Symphynota globosa* Lea, in Trans. Am. Philos. Soc., Vol. V, Pl. IV, Fig. 12, 1832.

Dr. Green's description has priority by some weeks, though these authors published their diagnoses in the same year. Green's specimens came from the Falls of St. Anthony, and Bayou Teche, La., the localities being widely separated. Dr. Lea's specimens came from the Ohio river, about 150 miles below Louisville.

The species has occurred in our collections from Arkansas only in the St. Francis river at Wittsburg and is represented by two fine examples. It has the habit of *Unio occidens*, with which it groups, preferring muddy bottoms and still waters. It is fairly common throughout the Mississippi valley, in the larger streams that flow into the main river.

A closely related form, from the Altamaha river, Georgia, was described by Dr. Lea under the name of *Unio dolabræformis*, *vide* Trans. Am. Philos. Soc., 2d series, Vol. VI, p. 103, Pl. XXIV, Fig. 113, 1838. It is probably synonymous.

UNIO CASTANEUS Lea.

Trans. Am. Philos. Soc., Vol. IV, p. 91, Pl. XI, Fig. 21, 1830,. Described from the Alabama river, Alabama.

Numerous examples of this shell have been taken in the

Little Red river, in Van Buren county, one fine example of which we have seen, together with a poorer one. It came to us under the name of *Unio arkansasensis* Lea. From Claiborne Parish, Louisiana, we have seen about fifty good examples. The large and old shells resemble much some forms of *Unio ellipsis* Lea.

Unio cerinus Conrad.

Monograph of Unio, p. 95, Plate LII, 1838. Reeve, Conchologia Iconica, Vol. XVI, *Unio*, Plate LXXXVII, Fig. 468.

The only Arkansas example which we have seen was taken in the Little Red river, and was loaned to us for examination by Mr. W. A. Marsh. It is a fine female and a very characteristic form. Mr. Lea makes this shell a synonym of his *Unio rubiginosus*, but does so wrongly. Before us are forty or more specimens from Louisiana, the original home of the species, some of which are sufficiently perfect to disclose undulations on the beaks such as no *rubiginosus* ever possessed. They rather ally Conrad's shell to those peculiarly marked Mexican and Central American forms that have similar beaks. No shell with which I am acquainted so well presents similar characters as the common Texan form to which Gould gave the name of *Unio petrinus*, the original examples of which came from Mexico. This species will certainly not fall under *rubiginosus* whatever else may become of it.

Unio clavus Lamarck.

Plate I.

This shell is one of those prolific sources of synonymy with which the descriptive matter of American fresh-water conchology has become so burdened. In the hope that it will subserve a useful purpose the original description of Lamarck follows, and the synonymy as now understood, excepting only those names which have not been accompanied by figures.

The following description is taken from Volume VI, "Historie Naturelle des Animaux sans Vertebres," page 537, 1838.

"*U. testa sublongitudinali, oviformi, inferne tumida, obtusa; postico latere brevissimo; dente laterali prælongo.*

Var. testa versus extremitatem lateris antici sensim depressa, magis attenuata.

Unio modioliformis Say, Amer. Conch.

*Habite dans le lac Erie. Michaud fils. * * * Test tres blanc. Longueur apparente 72 millimetres. La variete b vit dans la riviere de la Nouvelle-Ecosse. * * * Longueur apparente 53 millimetres.''*

Lamarck's brief description is no doubt responsible for very much of the confusion which attends the separation of this form. To aid in its correct determination the following description has been drawn, from specimens collected in the Duck river, Tennessee. The specimen figured is one of those employed in this diagnosis.

Shell smooth, somewhat elliptical, most of its mass posterior to a line drawn vertically from the umbones, laterally subcompressed, somewhat pointed posteriorly, circularly rounded before; umbones prominent and pointed anteriorly, apiculate; ligament large, thick, light brown; epidermis honey-yellow, smooth, often polished, rayed from the tips of the umbones with green lines over the first formed half of the disk, the rays broadening downward, occasionally interrupted by the lines of growth which are numerous and strongly impressed giving to the lower third of old specimens a striate appearance; umbonal slope rounded anteriorly but compressed posteriorly; in the female, the posterior slope is rather less flattened than in the male, while the outline of the disk is less pointed; cardinal teeth single in the right, double in the left valve, rather short and incrassate, crenulate; plate connecting laterals with the cardinal teeth disposed to folding in the left and pitted in the right to correspond, thick, slightly arched; lateral teeth long-lamellar, curved ventrad, striate; anterior cicatrices confluent, deeply impressed, that of the *retractor pedis* impression very deep and circular and at the end and lower margin of the lateral teeth and partly on them; dorsal cicatrices numerous, small and impressed in an irregular line on the under side of the plate between the cardinal and lateral teeth; nacre pure white, with a very marked iridescence posteriorly between the pallial cicatrix and the margin.

Animal not observed.

Length, 53.00 mm.; breadth, 18.50 mm.; height, 30.00 mm.

The synonymy of this species has been but partially worked out, but it is certain that it will include the following forms:

Unio patulus Lea. 1829. Trans. Am. Philos. Soc., Vol. III, p. 409, Pl. XII, Fig. 20.

Unio decisus Lea. 1830. Trans. Am. Philos. Soc., Vol. IV, p. 92, Pl. XII, Fig. 23.

Unio chattanoogaensis Lea. 1858. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. IV, 1859, p. 209, Pl. XXV, Fig. 90.

Unio consanguineus Lea. 1861. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. V, p. 67, Pl. VII, Fig. 217.

Unio pallidofulvus Lea. 1861. Jour. Acad. Nat. Sci. Phila., 2d, series, Vol. V, pp. 83–85, Pl. XI, Fig. 232.

Unio interventus Lea. 1861. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. V, p. 84, Pl. XI, Fig. 233.

Unio concolor Lea. 1861. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. V, p. 89, Pl. XII, Fig. 237.

Unio anaticulus Lea. 1861. Jour. Acad. Nat. Sci. Phila., 2d series, 1862, Vol. V, p. 92, Pl. XIII, Fig. 240.

Unio crebrivittatus Lea. 1861. Jour. Acad. Nat. Sci. Phila., Vol. VI, 1866, p. 43, Pl. XV, Fig. 41.

Unio curtus Lea. 1859. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. V, 1861, pp. 92–103, Pl. XVII, Fig. 253.

Both this last named form and *Unio anaticulus* were based on deformed specimens of *Uniones* and are, in a certain sense, pathologic forms. To this synonymy must be added those other names under which Say described this species a leading term of which will be *Unio modioliformis*, as had been noted by the editors of Lamarck, in 1838. Other great groups of *Uniones* there are which exhibit a far larger synonymy than does that group which this species of Lamarck heads.

So far as known this form does not occur west of the Mississippi, nor has any member of the group been found which may be located west of that stream. It has its greatest development in the mountain regions of Georgia, Alabama, Kentucky, and Tennessee, though it ranges, as specimens at hand prove, from western New York to Ottawa river, Canada, thence west to Illinois and south to middle Alabama, where some of its forms are exceedingly abundant in the

streams of north-central Alabama, notably in the Coosa, Alabama, and Cahaba rivers.

A good illustration of this form may be found in Conrad's Monograph, Pl. III, fig. 1. Also in Tenney's Zoölogy, Manual, edition of 1872, p. 492, Fig. 460. Reeve, Conchologia Iconica, Plate LXIX, Fig. 354, also well exhibits its chief features, but the beaks are represented to be more decurved than in any specimen we have ever seen.

UNIO CORNUTUS Barnes.

Am. Jour. of Sci. and Arts, 1st series, Vol. VI, p. 122, Fig. 5*a*, 5*b*, 1823;

Unio reflexus Rafinesque, in Conrad's Monograph, Pl. IV, Fig. 1, 1838.

This species has been seen by us from only one Arkansas locality. That one was the St. Francis river, at Wittsburg, in Cross county. It has a wide range in its geographical distribution since it occurs from western New York to Kansas and south to Alabama and Texas.

UNIO CRASSIDENS Lamarck.

Plate II.

Unio niger Rafinesque, in Conrad's Monograph of Unio, Pl. XXVI, 1836.

Unio incrassatus Lea. Trans. Am. Philos. Soc., 2d series, Vol. VIII, Pl. XVI, Fig. 34, p. 217, 1840.

Unio cuneatus Barnes, Am. Jour. of Sci. and Arts, 1st series, Vol. VI, p. 263, 1823.

Lamarck's description included several varieties, some of which were improperly included in the species as limited. Such, for instance, is his variety *a* which is said by Dr. Lea, who saw the type in Paris, to be his *Unio trapezoides* and which is entirely distinct from *crassidens*. The original description here follows from the *Animaux sans Vertebres, 2d Edition*, Vol. VI, p. 532, 1838.

"*U testa ovali, tumida, crassa, postice rotundata, antice, angulis binis ternisve subsinuosa, dente cardinali crassissimo lobato, angulato, striato.*

Habite l'Amerique septentrionale, dans le Mississippi, l'Ohio, et plusieurs lacs. * * *"

The remainder of the description is concerned with the diagnoses of the varieties which Lamarck considered as belonging to this form. Variety *a* is from the Mississippi; variety *b* from Lake Erie, variety *c* from the Ohio. But each variety appears to be a distinct species.

The following description is based upon specimens obtained from the Cumberland river, at Nashville, Tennessee, where the species is very abundant; also facts are included from characters exhibited by abundant material from the Etowah and Oostanaula rivers, in Georgia. The species is likewise abundant in the Cahaba, Alabama, and Coosa rivers, in Alabama.

Shell smooth, elliptical, compressed, incrassate anteriorly, biangular and much thinner posteriorly; epidermis rather thick, black in old specimens and deep reddish brown in young ones, striate, often with curved, dark green rays extending ventrad from the umbones, in the young shell; the dorso-posterior margin much and quite regularly-curved; posterior umbonal slope eradiate, somewhat flattened, separated from the lateral slope by a marked angle, with a prominent raised line, sometimes two, extending from the umbones and joining the posterior margin at the angles, the whole posterior slope is, commonly, strongly and coarsely striate; umbones small, scarcely prominent, slightly incurved; ligament long, thick, curved with dorsal margin, black; cardinal teeth short, heavy, triangular, striate, single in the right, double in the left valve, the posterior portion of the double left tooth nearly equal in size and shape to the single right tooth; lateral teeth long, thick, straight or nearly so, crenulate, in old specimens this is strongly marked; dorsal plate connecting the lateral with the cardinal teeth scarcely marked, smooth, rounded; anterior cicatrices distinct, deeply impressed, that of the adductor muscle much roughened and pitted with numerous small pits arranged in a row near the edge of the plate forming its upper margin; pallial cicatrix well impressed anteriorly and markedly crenulate throughout; posterior cicatrices distinct, that of the adductor deeply impressed and extending to the posterior end of lateral teeth,

striate, that of the *retractor pedis* muscle deep, pit-like, sometimes confluent with that of the adductor; cavity of the beaks shallow, with a row of minute pit-like dorsal cicatrices some distance within the margin of the plate; nacre rich purple, light, iridescent, the latter feature especially marked posteriorly.

Animal not observed.

Length, 111.25 mm.; breadth, 40.00 mm; height, 69.00 mm.

In very good specimens, not too old, small and well marked foldings, disposed at an angle with the umbonal angle and increasing in number towards the umbones, may be noticed. These are characteristic, and serve to indicate the possible affinities of this species and *Unio incrassatus* Lea, from the Chattahoochee, Oostanaula, and other Georgia streams.

The figure given herewith is drawn from a fine specimen obtained in the Cumberland river, Tennessee, at Nashville, where the form is very abundant. Larger but less perfect specimens are common. In nearly all the great rivers of the south, west of the Appalachian system, this form occurs and usually in great abundance. It has not yet been obtained west of the Mississippi, so far as present information extends.

Unio cuneus Conrad.

Monograph of Unio, Pl. LVIII, Fig. 1, 1836.

Four specimens were found in the Saline river, at Benton. The species was described from the Little Red river, Arkansas, by T. A. Conrad. It has long been properly regarded as identical with *Unio coccineus* Hildreth and should no longer be distributed under its Conradian name. Doctor Ward, of Ohio, many years ago distributed the white-nacred variety of this form under the manuscript name of *Unio gouldianus* Ward, but never described it. The name was adopted by Dr. John Jay, of New York, and published by him in his "Catalogue of Shells in the Jay collection."

The typical forms have a warm pink nacre but are not so common as the white-nacred variety. The range of the species is from western New York to North Alabama and west to central Kansas. In the rivers of Iowa it is both abundant and fine.

In further history of the form it may be stated that the real author of the species was Dr. Hildreth, of Marietta, Ohio, who sent it to Mr. Lea with the manuscript name of *Unio coccineus*. Hildreth did not describe it under that name, even in manuscript, and Mr. Lea, adopting the proposed name, described the species as new in the Trans. Am. Philos. Soc., Vol. VI, Pl. V, Fig. 12, 1834. A good figure may also be found in Conrad's Monograph, Pl. XIII, Fig. 1. The white-nacred variety is figured by Conrad, on the same plate, under the name of *Unio catillus*, from the Scioto river, Ohio.

UNIO CYLINDRICUS Say.

Plate XI.

Unio cylindricus Say, in Nicholson's Encyc. Am. Ed. Article Conchology, Pl. 4, Fig. 3, 1816.

Unio naviformis Lamarck. Deshayes Encyc. Meth. Vers ,Tome II, p. 580, No. 5, 1830.

Unio naviformis Lamarck. Animaux sans Vertebres, Tome VI, p. 537, No. 20, edition of 1838. From the Ohio.

Unio cylindricus Say, Barnes, in Am. Jour. of Sci. and Arts, 1st series, Vol. XIV, Pl. I, Figs. 13a, 13b.

This species is abundant in the St. Francis, Saline, and Ouachita rivers, Arkansas, from which localities many specimens have been seen. In the Cumberland and Harpeth rivers of Tennessee, the largest and finest specimens noticed have been taken. In geographical range the species extends from western New York to Indiana, Kansas, and Texas, and south to Central Alabama, in the Alabama river, at Selma. The specimen figured is from the White river, Indiana, and was contributed by Professor Barton W. Evermann.

UNIO DONACIFORMIS Lea.

Trans. Am. Philos. Soc., Vol. III, p. 266, Pl. IV, Fig. 3, 1827. Described from Ohio.

Unio zigzag Lea. Trans. Am. Philos. Soc., Vol. III, p. 409, Pl. XII, Fig. 19, 1829. Described from Ohio.

This species is abundant in the St. Francis river, at Witts-

burg. It is reported also from the Ouachita river, near the boundary of the Indian Territory, but we have seen no specimens from that stream. The probable identity of these forms, as given in the above synonymy, was suspected by Mr. Lea himself; it seems, therefore, now more than useless longer to attempt their specific distinction.

UNIO EBENUS Lea.

Trans. Am. Philos. Soc., Vol. IV, p. 84, Pl. IX, Fig. 14, 1830.

Unio subrotundus Lea. Trans. Am. Philos. Soc., Vol. IV, p. 117, Pl. XVIII, Fig. 45, 1831.

Unio lesueurianus Lea. Trans. Am. Philos. Soc., Vol. VIII, p. 195, Pl. VIII, Fig. 6, 1840.

Unio globatus Lea. Jour. Phila. Acad. Nat. Sci., 2d Series, Vol. VIII, p. 5, Pl. I, Fig. 1, 1874.

Unio subglobatus Lea. Jour. Phila. Acad. Nat. Sci., 2d series, Vol. VIII, p. 7, Pl. I, Fig. 3, 1874.

Specimens have been studied from the following Arkansas localities: St. Francis river, Wittsburg; Ouachita river, Malvern. The geographical range of the species is from western New York to Texas, north to Kansas and Minnesota. The species is very abundant in the Mississippi river, at Moline, Illinois; in the Cumberland, at Nashville, Tennessee, in the Alabama, at Selma, and is a common form in the larger rivers west of the Mississippi. This shell is peculiar, though it shares this feature with several other forms, in occurring only in large streams. It is a mud-loving form and commonly abounds in muddy localities, where it occurs at all. The synonymy indicated above is illustrated by specimens in the cabinet of the writer and identified by Dr. Lea. Some of them are from the original localities of the various types.

UNIO ELEGANS Lea.

Trans. Am. Philos. Soc., Vol. IV, p. 83, Pl. IX, Fig. 13, 1830–1. Described from the Ohio river.

Conchologia Iconica, Reeve, *Unio*, Plate LXXIV, Fig. 380, 1868.

Unio truncatus Rafinesque, Say in American Conchology, Pl. 67.

The only Arkansas locality where this form has been found is the St. Francis river, at Wittsburg. It is there a very common shell, preferring rather muddy bottoms. The illustration given by Reeve is a fairly good one, but presents certain artistic effects that are not to be seen in the shell itself. It is a member of a group of which *Unio donaciformis* Lea may be considered a leading term.

UNIO GIBBOSUS Barnes.

Am. Jour. Sci. and Arts, 1st series, Vol. VI, Pl. XI, Fig. 12, 1823.

Unio arctior Lea. Trans. Am. Philos. Soc., Vol. VI, p. 10, Pl. IV, Fig. 10, 1834; Conchologia Iconica, Reeve, *Unio* Plate LXXXV, Fig. 454, 1868.

Unio dilatatus Rafinesque, so Conrad in Monograph, Plate XXI, 1838.

Unio stonensis Lea. Trans. Am. Philos. Soc., Vol. VIII, p. 195, Pl. VIII, Fig. 5, 1840; Conchologia Iconica, Reeve, *Unio* Plate LXXXV, Fig. 453, 1868.

Unio gibbosus Barnes, so Reeve in Conchologia Iconica, Pl. LXXIII, Fig. 377.

The figures of all these forms, as given by Reeve, are poor and do not well represent the shells. *U. stonensis* Lea is from Stone river, Tennessee, from which original locality the writer has specimens, and these are part of the original lot, identified by Mr. Lea, and still with the name in his handwriting. They formerly belonged to Dr. Troost, of Nashville, and were donated by Dr. J. Berrien Lindsley, into whose hands many of the shells of the Troost collection passed. There is no question that the form from the Ohio, which Mr. Lea called *Unio arctior*, is a white-nacred variety of *gibbosus*, a form which is commonly marked by a purple nacre. The white-nacred form, or *arctior*, is common in the Saline river, at Benton; it is abundant also in the Piney river, Missouri. Typical *gibbosus* was obtained in the St. Francis, at Wittsburg.

The geographical range of this form is from western New York to Minnesota and Kansas, south to Texas, and east to Georgia. In the Mississippi and Cumberland rivers it is both abundant and variable. There are few shells among the *Unionidæ* that present so great a range of variation as this one.

UNIO GLANS Lea.

Trans. Am. Philos. Soc., Vol. IV, 1830, p. 82, Pl. VIII, Fig. 12. From the Ohio river; Conrad's Monograph, Pl. IX, Fig. 2, 1836.

Unio pullus Conrad. Monograph of Unio, 1838, p. 100, Pl. LIV, Fig 2. From the Wateree river, South Carolina.

Unio granulatus Lea. 1861. Jour. Acad. Nat. Sci. Phila., Vol. VI, 2d series, 1866, p. 48, Pl. XVI, Fig. 46. Big Prairie creek, Alabama.

Unio germanus Lea. 1861. Jour. Acad. Nat. Sci. Phila., Vol. VI, 1866, p. 49, Pl. XIX, Fig. 54. From Coosa river, Alabama.

Unio cromwellii Lea. 1865. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. VI, 1868, p. 258, Pl. XXXI, Fig. 73. From Kiokee creek, Albany, Georgia.

Unio cylindrellus Lea. Jour. Acad. Nat. Sci. Phila. 1868, 2d series, Vol. VI, p. 308, Pl. XLVIII, Fig. 121. From Tennessee, north Georgia, and north Alabama.

Unio corvunculus Lea. Jour. Acad. Nat. Sci. Phila., 2d series, 1868, Vol. VI, p. 314, Pl. L, Fig. 127. From Swamp creek, Whitfield county, Georgia.

The localities at which this species has occurred, in collecting in Arkansas, are all in Carroll county, and presumably from the same portions of the White river. The three specimens submitted were kindly furnished by Mr. F. A. Sampson, of Sedalia, Missouri, by whom they were collected. The synonymy indicated above is based upon very large series of specimens which comprise materials from every one of Lea's localities. The species was also figured by Reeve, in 1868, *Unio* Plate XXXVI, Fig. 190. The specimen figured by him shows the emarginate character of the female, which sex he had before him. The shell is usually abundant in warm, shallow water,

near the margin, and on gravelly bars ; it also occurs commonly in muddy stations having the habit of *Unio parvus* Barnes which heads the group of which *Unio glans* is a member. *Unio ellipsiformis*, Conrad (Monograph of *Unio* Plate 34, Fig. 1, p. 60), 1838, described from Michigan, is also a synonym.

Unio gracilis Barnes.

Described in the Am. Jour. Sci. and Arts, 1st series, Vol. VI, 1823.

Unio fragilis Rafinesque, so Conrad, in Monograph of Unio, Plate XXX, 1836.

Unio dolosus Lea. 1860. Jour. Acad. Nat. Sci. Phila., Vol. V, 1861, p. 75, Pl. IX, Fig. 224. Also Conchologia Iconica, Reeve, *Unio* Plate XLI, Fig. 228. This is a poor figure of an immature specimen.

Unio gracilis Barnes. Reeve, Conchologia Iconica, 1868, *Unio* Plate XXXIX, Fig. 215. This is a figure of an old specimen but does not show the characteristic alation of the dorsal margin.

This species has occurred to us in the Saline river, at Benton, and in the St. Francis river, at Wittsburg. It does not differ in any material respect from the forms found so abundantly in the sloughs along the Mississippi river farther to the north, and in all the larger streams which are tributary to it, except, perhaps, the Missouri river alone. Lea's *dolosus* is very abundant in the Coosa river at Wetumpka, and in the Alabama at Selma. It was also found in numbers in the Cahaba, at Lily Shoals, in Bibb county. There can be no doubt of its identity with the older form described by Barnes.

The typical form of the group that it heads, this species ranges from the Ottawa river, Canada, to Minnesota, Iowa, and Kansas, and south to Central Alabama and to Texas.

Unio grandidens Lea.

Jour. Acad. Nat. Sci. Phila., 2d series, 1862, Vol. V, p. 205, Pl. XXX, Fig. 274. Also Reeve, in Conchologia Iconica, 1868, *Unio* Plate LXXXIII, Fig. 439.

This species has not been found by us in Arkansas nor do we know of the existence of any specimens other than

the types. It was collected by Dr. Byrd Powell, near Hot Springs, Arkansas, and was described from two unmatched valves belonging to old individuals. Reeve gives a very good figure, probably copied from Lea, but is hopelessly confused on the relations of the form. He does not recognize the name of Lea, save as a synonym, but places it under *Unio nodulosus* Wood. He suggests that it has an aspect very much like that exhibited by certain Chinese shells, and thinks that both "may prove to be the *Chama plumbea* of Chemnitz." It is hardly necessary to say that there is no relation to *Chama*, and no question but that the shell is properly credited to Arkansas. It is a member of the pustulate group and is not far removed from *Unio cooperianus*, which it closely resembles.

Unio irroratus Lea.

Trans. Am. Philos. Soc., Vol. III, 1827, p. 269, Pl. V, Fig 5. Described from Ohio.

Unio irroratus Lea, Reeve, in Conchologia Iconica, *Unio* Pl. XII, Fig. 44, female. 1868.

Unio stegarius Rafinesque, so Conrad, in Monograph of Unio, p. 83, Pl. XLVI, Fig. 1, 1838. Also Reeve, in Conchologia Iconica, *Unio* Plate XII, Fig. 45, male. 1868.

This species occurred in the St. Francis river, at Wittsburg, and in the Saline, at Benton. In the first mentioned locality it is very abundant and specimens of all ages were found. The very young have the outline of *Unio elegans*, but they are somewhat longer than the young of that species at a corresponding age. The resemblance of very many of the young to the form described by Conrad as *Unio aberti* is also marked. The triangular outline is lost with age, and the circular form becomes more and more marked. Closely allied to it is the common *Unio dromas* Lea, of the Cumberland river.

Unio hydianus Lea.

Trans. Am. Philos. Soc., 2nd series, Vol. VI, 1834, p. 14, Pl. VI, Fig. 14.

This species was described from the Bayou Teche, Louis-

iana; it occurs abundantly in the St. Francis river, at Wittsburg, and in the Saline river at Benton. It is a synonym of *Unio luteolus* Lamarck, to which the reader is referred.

UNIO LACHRYMOSUS Lea.

Transactions Am. Philos. Soc., 2nd series, 1827, p. 272, Pl. VI, Fig. 8. Described from Ohio. Also Reeve, in Conchologia Iconica, 1864, *Unio* Pl. IX, Fig. 33.

Unio asperrimus Lea. Trans. Am. Philos. Soc., 2d series, Vol. IV, p. 71, Pl. V, Fig. 3. 1830–1.

Unio quadrulus Rafinesque, so Say, in Am. Conch., Pl. 53, 1834.

Unio quadratus, Rafinesque, so Reeve, in Conchologia Iconica, *Unio* Plate VI, Fig. 24, 1864.

Unio lunulatus, Pratt. Proc. Davenport Acad. Sci., Vol. I, Pl. XXXI, Fig. 1, (1870?).

Obtained by us in the St. Francis river, at Wittsburg, and in the Saline river, at Benton. *Unio lachrymosus* was described from a small and immature specimen; *Unio asperrimus* from an old and well-worn shell. Yet the resemblances are so close that one might easily have recognized their identity. From the Little Arkansas river, Kansas, come the largest and finest specimens of this species that we have ever seen. In geographic range the form extends from western New York to Kansas and Minnesota, and south to Texas and Alabama.

UNIO LÆVISSIMUS Lea.

Trans. Am. Philos. Soc., Vol. III, Pl. XIII, pp. 444–445.

Specimens of this form were taken by Dr. J. C. Branner, in the Little Red river, at Fulton. The shell is somewhat more globose than the same form reported from other localities; the specimens have a slight tendency to vary toward *Unio hermannii* Lea, described originally from Texas. The types of Lea's *Unio lævissimus* came from the Ohio, in which stream it is by no means uncommon. The range of this form is from Western or middle Ohio to Kansas and Nebraska; southward it ranges to Trinity river, Texas. It is a member of the bi-alate group, the leading term of which is *Unio alatus* Say.

UNIO LIGAMENTINUS Lamarck.

Plate XXI.

Animaux sans Vertebres, Ed. 1838, Vol. VI, p. 533.

Described as follows:—

U. testa ovali tumida, sub epiderme candida; ligamento subduplici: unico externo detecto; allero intra natem et cardinem obtecto.

"*Habite la riviere de l' Ohio. A. Michaud. La coquille a sur chaque valve un angle obtus au cote anterieur. Son test est tres blanc. Son corselet est un peu eleve en carene. Dent cardinale fort epaisse. Largeur, 77 millimetres.*"

It is quite possible that the very extensive synonymy that is exhibited by this species is due largely to the incomplete description which Lamarck gave to this form. It is widely distributed over the United States from western New York to Michigan, Minnesota, Dakota, and Kansas; south to Texas, Louisiana, Alabama, and Tennessee. In this vast range, throughout which it is common or abundant, it has a wonderfully diversified environment. Its home may be in sluggish and muddy bayous, where it delights to dwell in mud and sand; in rapidly flowing mountain streams, like the upper Cumberland and the Holston rivers, where it may be found on gravel bars or wedged in between the larger rocks in the middle of the channels; in the muddy or gravelly rivers of the western prairie States, as in Iowa and Illinois, where it dwells indifferently in mud or gravel. It follows therefore, that these great differences in environment will be influential in determining its coloration and its form. So it is among the most variable, in minor details, of any of the common river-mussels of the western States, sharing in this regard the changes in form incident to *Unio luteolus* Lamarck and *Unio complanatus* Solander, the last named being a form which has never yet been found in any stream west of the Appalachians, outside the drainage of the Great Lakes. These very variable shells have been described many times by those who look for differences rather than resemblances, and so the great burden of synonymy has arisen. A partial list of the most

evident synonyms is given below, a list which does not exhaust, by any means, this fruitful mine.

Unio crassus Say. Nich. Encyc. Am. Ed., Article Conchology, Plate I, Fig. 8, 1816; American Conchology, Pl. VIII, 1831; Reeve, in Conchologia Iconica, *Unio* Plate XCV, Fig. 520, 1868. This is a fine figure of a well-rayed female.

Unio carinatus Barnes. Am. Jour. of Sci. and Arts, 1st series, Vol. VI, 1823, pp. 126 and 259, Fig. 10, Plate 11. From Fox river, Illinois.

Unio ellipticus Barnes. Am. Jour. Sci. and Arts, 1st series, Vol. VI, 1823, Pl. 13, Fig. 19, in outline only. From Fox river, Illinois.

Unio crassus Say, so Conrad, in Monograph of Unio, 1836, Pl. XVI; Reeve, in Conchologia Iconica, *Unio* Plate XL, Fig. 220, 1866. This is a fine figure of a large male specimen.

Unio fasciatus Rafinesque, so Conrad, in Monograph of Unio, 1836, Plate I, p. 3.

Unio powellii Lea. Trans. Am. Philos. Soc., 2d series, Vol. X, Pl. XIX, Fig. 25, p. 270, 1852. From the Saline river, Arkansas, where the writer obtained it in large numbers, in 1891.

Unio pinguis Lea. Jour. Acad. Nat. Sci., 2d series, Vol. IV, 1858, p. 78, Pl. XV, Fig. 58. This is a deformed specimen of *Unio ligamentinus* from the St. Peter's, Minnesota, river. The species was based on a single specimen found in the cabinet of Dr. Budd; no other specimens are known.

Unio upsoni Marsh. Ms. Described in a paper read before the Mercer county, Illinois, Historical Society. The types came from Kishwaukee river, Winnebago county, Illinois. The author of the species thinks he has also recognized it from the White river, Indiana. Having seen the original types, no hesitation is felt regarding this disposition of the form.

Additional to these references little will be needed to understand this species. It may be better understood, however, if a full description of the form be given, and such description

follows, drawn from a large series of specimens from the Des Moines river, Iowa, and supplemented by very large numbers from nearly every considerable stream within the geographic range of this form.

Shell large, elliptical, compressed, rounded before, subbiangulate behind, smooth or striate, thickened anteriorly, thin and iridescent posteriorly; epidermis yellowish-straw color, rayed with numerous, broad, green rays, extending from the umbones ventrad; the rays are indistinct or wanting anteriorly; lines of growth numerous and often, especially in old specimens, raised into ridges which are concentric with the ventral margin; ligament long, thick, black, nearly straight; umbones scarcely prominent, approximating, with many very fine, concentric folds, apparent only in young specimens with perfect epidermis; from the posterior edge of the umbones an obtuse angle extends over the disk posteriorly to the margin where it is apparent at one of the angles which renders the outline biangulate; cardinal teeth double in the left, and disposed to be double in the right valve, triangular, crenulate, roughened; lateral teeth long, lamellar, slightly curved ventrad, crenulate; plate between cardinal and lateral teeth incrassate, arched, smooth; anterior cicatrices large, deeply impressed, distinct; posterior cicatrices large, slightly impressed, confluent, that of the *retractor pedis* muscle impressed at the extreme end of the lateral teeth; dorsal cicatrices in the cavity of the umbones as deep pits disposed in a straight line, which ends near the margin of the plate; pallial cicatrix crenulate, deeply impressed anteriorly; nacre pure white, iridescent, in many specimens with a blush of pink or with decided pink coloration.

Length, 125 mm.; height, 75 mm.; breadth, 52 mm.

The measurements given are those of a large specimen from the Des Moines river, at Des Moines. The species often exceeds these dimensions but is commonly found smaller. In the female the posterior margin is much more rounded than in the male, and the biangulate character quite disappears. The general outline is more flowingly rounded, and the transverse measurements somewhat greater, in the female than in the male shell.

Say's description of *Unio crassus* does not agree with his figure, as has already been pointed out by Dr. Lea. He says his species has waves, while the figure, which shows the interior of the shell only, does not give any hint of that character. It is doubtful that the description and figure were made from the same species. Moreover, it will be noticed, from the dates assigned to these several forms in the synonymy, that Say's species was described long before Lamarck framed his description. But there had already been described from Europe, by Retzius, 1788, a species with the name Say employed. Say's name, therefore, falls into synonymy. This shell is often received from correspondents under the name of *Unio luteolus* Lamarck, which form it very closely, in some respects, resembles.

The Arkansas localities, whence the species has been obtained, are the St. Francis river, at Wittsburg; Ouachita river, at Malvern; and Saline river, at Benton. The last named stream is the original one for the shells which Lea described under the name of *Unio powellii*, the female of which is well figured by Reeve in the volume cited. His specimen was a fair exhibition of the Arkansas form.

UNIO LUTEOLUS Lamarck.

Plate III.

Animaux sans Vertebres, 1818, Vol. VI, p. 79; also, same, edition of 1838, Vol. VI, p. 544.

Unio luteolus Lamarck, Reeve, in Conchologia Iconica, *Unio* Plate LVIII, Fig. 239, female; 239b, female, 1867; also, in same, Plate LXI, Fig. 306, as *Unio multiradiatus* Lea, corrected in *errata*. This is a good figure of the female.

Unio siliquoideus Barnes. Am. Jour. Sci. and Arts, 1st series, Vol. VI, p. 269, Fig. 15, 1823. This is female *luteolus*.

Unio inflatus Barnes. Am. Jour. of Sci. and Arts, 1st series, Vol. VI, 1823, p. 266.

Unio hydianus Lea. Trans. Am. Philos. Soc., Vol. VI. p. 14, Pl. VI, Fig., 14, 1834; Reeve, in Conchologia Iconica, *Unio* Plate XXXVII, Fig. 203, female, 1866.

Unio haleianus Lea. Trans. Am. Philos. Soc., Vol. VIII, p. 247, Pl. XXVII, Fig. 63, 1842. Also a form said to be this is figured by Reeve, *Unio* Plate XXIV, Fig. 116, 1865, in Conchologia Iconica. There is no resemblance to Lea's form.

Unio approximus Lea. Trans. Am. Philos. Soc., Vol. X, Pl. V, Fig. 13, p. 74. Described in 1845 from the Red river, Louisiana; published as above in 1848.

Unio distans Anthony. Am. Jour. of Conchology, Vol. I, p. 156, 1865.

Unio affinis Lea. Trans. Am. Philos. Soc., Vol. X, p. 271, Pl. XIX, Fig. 26; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate LXI, Fig. 307, 1868. Described from Alexandria, Louisiana.

Obtained by us in the St. Francis river, at Wittsburg; and in the Saline river, at Benton. The Benton form is *Unio hydianus* Lea and is a very abundant one in the Saline.

The original description of Lamarck was as follows:—

"*U testa oblongo-ovata, tenui subpellucida, luteo-virente, radiata; latere antico majore, latiore, rotundato.*

"*Habite la riviere Susquehana et celle Mohancks, dans les Etats Unis. * * * La ligament passe entre le crochet et la charniere. Largeur 69 millimetres.*"

This short and imperfect description was not known to the earlier students of American mollusca, and there is little wonder that considerable synonymy has been established on this shell. It has a very wide range, extending from Winnipeg and Slave Lakes and the Saskatchewan river, British America, to central New York, south to Georgia, Alabama, Texas; west to Kansas, Montana and Dakota. In all this range it is abundant in favorable localities and often attains a great size. Lamarck's original specimens did not approach the maximum dimensions which this shell sometimes reaches.

A very beautiful and somewhat depauperate form occurs in the lakes of northern Indiana. It was a specimen of this sort that constituted the basis of Anthony's description of *Unio distans*. Though sometimes confounded with *Unio ligamentinus* Lamarck there is really no excuse for the confusion of the two forms, since they are more dissimilar than alike. The

beaks of the young, and this statement is true as well of old and perfect specimens, are beautifully marked with ridges that are concentric, or better, perhaps, angulated, with the very obtuse angle pointing toward the tip of the umbones. In *Unio ligamentinus* this character is not so marked and differs in the degree of fineness of these ridges.

The following description is based upon a series of shells taken from the Des Moines river, in central Iowa :—

Shell large, elongate, somewhat inflated, rather thin, circularly rounded before, elliptically rounded behind, the male often somewhat pointed posteriorly, female more tumid posteriorly, emarginate ventrally; epidermis light horn color, polished and shining, usually abundantly rayed with narrow, bright, green, crenulate, somewhat curved rays which depart from the beaks and cover more or less closely the posterior three-fourths of the disk, these are often wanting, especially in old specimens; lunule long, narrow; ligament long, thin, light horn color; hinge margin nearly straight or very slightly arcuate; umbones prominent, approximate, concentrically wrinkled, the wrinkles being angulate and the apices of each pointing toward apex of the umbone, light, nearly white, in color when the epidermis is perfect; cardinal teeth double in both valves, equal only in the left valve, rather small, thin, acutely serrate, all directed anteriorly; lateral teeth long, thin, lamellar, striate, nearly or quite straight; dorsal plate smooth, short, rounded, thin; anterior cicatrices distinct, that of the adductor rather deep, large, striate, irregularly impressed, that of the *protractor pedis* well impressed but not deep; posterior cicatrices confluent, very slightly impressed, smooth, iridescent; pallial cicatrix well impressed before, broad and shallow, or scarcely impressed, behind; dorsal cicatrices numerous, impressed as deep pits in an irregular row in the center of the cavity of the beaks; cavity of the beaks rather shallow; nacre pure white, sometimes somewhat iridescent posteriorly.

The swollen outline of the full grown female apparently led to the description of this form under the name of *Unio siliquoideus* by Dr. Barnes. This variety in the Mississippi and its larger tributaries, especially those which enter it from the

west, is not only abundant, but is frequently the only form found. It is usually, also, of a darker color, and inhabits muddy portions of the river beds. The female shells are usually found in greater abundance than the male forms, but occasionally the latter are most numerous. The female appears to have formed the basis of nearly every described species that has been erected, and which appears in the synonymy given herewith.

UNIO METANEVRUS Rafinesque.

Plate X.

Obliquaria metanevra Rafinesque, Annales Generales des Sciences Physique, Bruxelles, September, 1820, p. 305, Pl. LXXXI, Figs. 15 et 16. Described from Kentucky.

Unio metanevra Rafinesque, so Reeve, in Conchologia Iconica, *Unio* Plate VII, Fig. 25, 1864. A good figure of outside character.

Unio nodosus Barnes, Am. Jour. Sci. and Arts, 1st series, Vol. VI, 1823, Pl. VI, Figs. 7a and 7b, p. 124. Described from Wisconsin; Hildreth in Am. Jour. Sci. and Arts, 1st series, Vol. XIV, p. 281, Fig. 10, 1828.

Unio rugosus Barnes, Am. Jour. Sci. and Arts, 1st series, Vol. VI, 1823, p. 126, Fig. 9. Described from Ohio; Hildreth in Am. Jour. Sci. and Arts, Vol. XIV, 1st series, p. 282, Fig. 12, 1828.

Our Arkansas specimens came from the St. Francis, at Wittsburg; the Ouachita, at Malvern; the Saline, at Benton.

A small number of related forms, constituting a natural group, are headed by this earliest described member; among them are *Unio tuberosus* Lea; *Unio wardii* Lea, and *Unio cylindricus* Say. The type of the group has a wide distribution from Ohio, south to the Coosa and Alabama rivers, Alabama; Louisiana and Texas; west to the Neosho and Elk rivers, Kansas; and north to Dresbach, Minnesota.

This species is exceedingly variable. In the Alabama, Tennessee, Cumberland, and Mississippi rivers it is usually

short, thick, and nodulous, and often exhibits a pinkish tinge within. In the Meramec, White, St. Francis, Saline, and Colorado rivers it is larger, flatter, thinner, less nodulous, or the nodules are less numerous, but the individual ones are much larger and smoother. It is such a shell as this, with absolutely perfect beaks and epidermis, that forms the basis of the figure in the plate. It was collected by Prof. B. W. Everman, in the White river, Indiana, and is among the most perfect full-grown specimens known. The arrow-shaped, green markings are well exhibited in the specimen.

Conrad, in his Monograph, Plate V, Fig. 2, gives a fine figure of this species.

UNIO MULTIPLICATUS Lea.

Trans. Am. Philos. Soc., 2d series, Vol. IV, 1830–31, p. 106, Pl. IV, Fig. 2. Reeve, in Conchologia Iconica, *Unio* Plate II, Fig. 8, as *Unio heros* Say; Lea figures the animal of his species in Jour. Acad. Nat. Sci. Phila., 2d series, Vol. IV, Pl. 30, Fig. 105.

Unio heros Say. New Harmony Disseminator, Vol. II, p. 291, 1829; Conrad in Monograph of Unio, Pl. LIX.

Unio undulatus Say. American Conchology, 1831, Pl. XVI, figured from the Fox river, Illinois. This is not the *Unio undulatus* Barnes, but Say abandoned his *heros* for the name of Barnes thinking the totally dissimilar forms to be identical.

Unio boykinianus Lea. Trans. Am. Philos. Soc., 2d series, Vol. VIII, 1840, p. 208, Pl. XIII, Fig. 22; Reeve, in Conchologia Iconica, *Unio* Plate I, Fig. 1, 1868. Described from the Chattahoochee river, Georgia.

Unio elliottii Lea. Jour. Acad. Nat. Sci. Phila., Vol. IV, 2d series, 1858, p. 54, Pl. VII, Fig. 37. Described in 1856 from Othcalooga creek, Gordon county, Georgia.

Unio eightsii Lea. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. IV, 1860, Plate LXIV, Fig. 192, p. 367, described from Texas and Mexico.

This is the most ponderous *Unio* found in American waters. It sometimes attains, as in the Ohio river, at Evansville and Louisville, the Cumberland, at Nashville, the Alabama, at

Selma, and the Red river, at Shrevesport, very great development. From all these localities we have seen large examples, some of which are believed to be unrivaled elsewhere.

Though Say's name of *heros* has strict priority, it cannot be used for the following reasons: it was poorly described in the beginning; it was abandoned by its author for the name of *undulatus* which had been given to another and distinct species by Barnes, from which procedure it is clear that Say had no clearly defined view concerning this form. Lea's name and description being the first that was accompanied with figures, and being the first clearly to indicate the limits of the species, must be adopted, and his name is now in common use. Say himself said, in his description of Plate XVI, American Conchology: "I formerly considered this species, with much doubt, as distinct from the *undulatus* of Barnes, and gave to it the name of *heros*, but notwithstanding some differences, I have concluded, after a more mature examination and comparison, that it may be with propriety referred to that species. Barnes drew his description and figure from a specimen then unique, * * * which was so eroded as not to exhibit the ornamental tubercles of the umbo and beak." To all who have seen the perfect forms of *undulatus* Barnes and *multiplicatus* Lea the marked differences in the characters of the beaks will be clear. Say abandoned his name for this form, and another student renamed it.

This shell has occurred to us only in the St. Francis river, so far as collections have been made in Arkansas.

I have not seen a specimen of *Unio gigas* Swainson, but a specimen in the Museum Taylor, England, is figured by Reeve as coming from the Ohio river. *Vide Unio* Plate LVI, Fig. 287, Conchologia Iconica, Vol. XVI, 1867. There can be no question that this is also *Unio multiplicatus* Lea, and that it should be placed under the above synonymy.

Reeve describes and figures a shell under the name of *Unio perplicatus* Conrad, in Conchologia Iconica, Vol. XVI, *Unio* Plate IX, Fig. 35, which had been labeled by J. G. Anthony, but which is most certainly a specimen of *Unio multiplicatus* Lea. The specimen was then in the Museum Cuming.

UNIO OBLIQUUS Lamarck.

Plate IV.

Historie Naturelle des Animaux sans Vertebres, 1818, Vol. VI, p. 72; also same, edition of 1838, Vol. VI, p. 534.

Unio undatus Barnes, *in partim*. Am. Jour. of Sci. and Arts, 1st series, Vol. VI, 1823, p. 121, Fig. 4. From the Wisconsin and Fox rivers.

Unio cordatus Rafinesque, so Conrad, in Monograph of Unio, p. 48, Pl. XXV, 1836; also Reeve, *Unio* Plate LXXIII, Fig. 376, 1868.

Unio obliquus Lamarck, so Conrad Monograph Pl. XLIII, Fig. 2, 1838. Conrad is in error in making *ebenus* Lea a synonym of this form.

Much confusion exists regarding this species, which is a highly characteristic one. Very much more extensive collecting than has hitherto been done by any person or organization throughout the range of the form will be needed to place it properly. Whether *Unio pyramidatus* Lea and *Unio mytiloides* Rafinesque may not also fall under it as synonyms could not now be gainsaid.

Lamarck's original description was as follows:—

"*U. testa sublongitudinali, ovato-rotundata, obliqua, sub epiderme candida; ligamento subduplici; dente cardinali crasso, sulcato, bipartito.*

"* * * *Habite la riviere de l'Ohio. A. Michaud. Distincte de la precedente par sa forme: elle est renflee vers les crochets, deprimee vers l'autre extremite, bisillonnee sur le cote anterieur. Longueur apparente, 61 millimetres.*"

The following description is based upon specimens taken from the Cumberland river, at Nashville, Tennessee, where the species is very abundant, and attains a very large size:—

Shell heavy, sulcate, thick, large, triangularly cordate, wrinkled parallel with the lines of growth, compressed on the posterior umbonal slope, turgid or swollen at the umbones, very solid and thick anteriorly; epidermis rather thick, striate, especially at the margins, black or reddish corneous, olivaceous in the young, eradiate; lines of growth numerous, well impressed, crowded confusedly; dorso-posterior margin

arcuate, almost circular in old specimens; posterior umbonal slope rounded, much produced in old specimens, with rather marked angle at junction with posterior margin; ventral margin disposed to be sulcate; anterior margin rounded, scarcely produced, not as far forward as the umbonal tips; umbones large, very thick, turgid, somewhat produced beyond the anterior margin, approximating in perfect specimens, minutely undulated at tips; ligament large, thick, long, black, curved parallel to the dorsal margin; lunule large, cordate, black; cardinal teeth large, heavy, short, bifid in the left and disposed to be trifid in the right valve, rough, striate-crenulate, all segments departing at varying angles from a point immediately under the apex of the umbones, the dorsal division in the left valve the largest and heaviest, and parallel to the cardinal teeth; plate joining cardinal teeth with the laterals short, thick, smooth dorsally, but striate ventrally, margin somewhat crenulate; lateral teeth long, thick, slightly curved ventrad, striate-crenulate, rough; anterior cicatrices deep, rough-pitted, distinct, outline of the adductor somewhat triangular, that of the *protractor pedis* elliptical, behind rather than under the adductor; posterior cicatrices distinct, well and deeply impressed, the adductor concentrically striate; the *retractor pedis* circular, pit-like, impressed just below the ends of the lateral teeth; pallial cicatrix broad, crenulate, well impressed throughout, but not deeply impressed anteriorly; dorsal cicatrices not impressed in the cavity of the beaks, but as a broad row on the posterior margin of plate formed by the cardinal teeth, numerous and rough; nacre white, in some specimens with occasional brownish blotches, iridescent posteriorly; dimensions of average mature specimen: length, 95.56 mm.; breadth, 45.00 mm.; height, 77.40 mm.

The only locality in Arkansas which is represented by this form, so far as our collections extend, is the Ouachita river, at Arkadelphia. A single specimen only was secured, but it compares well with typical specimens from the Cumberland river. Not far removed from the forms which we believe will properly group with this as synonyms are other forms such as *Unio plenus* Lea and *Unio solidus* Lea, the relationships of which are yet somewhat problematical.

UNIO OCCIDENTALIS Conrad.

Monograph of Unio, 1836, p. 64, Pl. XXXVI, Fig. 1.

This is an abundant species in central Arkansas, particularly in the Little Red river, Van Buren county; found also in the White river, Carroll county; Saline river, Benton, Saline county.

There is no other form with which this species will be easily confused. It groups with *Unio phaseolus* Hildreth, but is quite distinct from that form; it is commonly much smaller. It was described originally from the Current river, Arkansas, and is not yet known to occur outside of the State.

UNIO OZARKENSIS Call.

Plate XVIII.

Proc. U. S. Nat'l Mus., Vol. X, p. 498, Pl. XXVII, 1887.

The original description of this species follows: —

Shell smooth, elliptical, somewhat compressed laterally, inequilateral, thick, but thickest anteriorly; epidermis thin, striate toward the margins, yellowish-brown, or olivaceous, marked with numerous, obscure, narrow, green rays disposed regularly over the central portion of the disk; lines of growth rather numerous, dark, well marked; dorso-posterior margin curved; posterior umbonal slopes always eradiate, more or less biangulate, which angulations continued posteriorly mark the siphonal area and render the posterior margin biangular; umbones small, triangular, scarcely prominent, approximating, marked — in non-eroded specimens — by two or three rather coarse undulations; ligament short, thick, light brown; cardinal teeth disposed to be double in both valves, short, oblique, thick, unequally bifid, striated, the posterior division generally thickest and heaviest; lateral teeth rather short, slender, slightly curved, crenulate at extremities, in general direction forming nearly a right angle with a line drawn through the tip of the umbo and the anterior division of the cardinal tooth; anterior cicatrices deep, pit-like, striate, confluent, though in occasional specimens the *protractor-pedis* impression is distinct from the adductors and deep; posterior cicatrices distinct, that of the *adductor* muscle being usually well impressed, that

of the *retractor-pedis* muscle circular, pit-like, impressed at extreme end of lateral tooth; pallial cicatrix well impressed throughout, but especially marked anteriorly; dorsal cicatrices irregularly crowded and placed near the inferior edge of the plate, which connects the lateral and cardinal teeth; nacre usually silvery white, occasionally salmon, or warm pink, iridescent posteriorly. Length, 54.50 mm.; breadth, 15.28 mm.; height, 32.76 mm.

The original localities are the White and Current rivers of Arkansas and Missouri; and Jack's Fork of the Current river, Missouri. A single specimen referable to this form has been seen from the Little Red river, at Clinton.

UNIO PARVUS Barnes.

Am. Jour. of Sci. and Arts, 1st series, Vol. VI, 1823, p. 274, Fig. 18; Lea figures the animal in Jour. Phila. Acad. Nat. Sci., 2d series, Vol. IV, Pl. XXIX, Figs. 102, 102a; Conrad, Monography of Unio, 1836, Pl. IX, Fig. I; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate XXXV, Fig. 186, a very poor figure from a specimen in the Museum Cuming.

Unio paulus Lea. Trans. Am. Philos. Soc., Vol. VIII, 1840, p. 213, Pl. XV, Fig. 29. From the Chattahoochee river, Georgia.

Unio minor Lea. Trans. Am. Philos. Soc., Vol. IX, 1843, p. 276, Pl. XXXIX, Fig. 3. From Lakes Monroe and George, Florida.

Unio marginis Lea. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. VI, p. 255, 1868, Pl. XXXI, Fig. 69. From Dougherty county Georgia.

Unio corvinus Lea. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. VI, 1868, p. 310, Pl. XLVIII, Fig. 123. From Flint river, Georgia, and Neuse river, North Carolina.

Unio vesicularis Lea. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. VIII, 1874, p. 37, Pl. XII, Fig. 34. From Lake Ocheechobee, Florida.

The Arkansas localities for this form are the St. Francis river, at Wittsburg; Ouachita river, at Arkadelphia; Saline

river, at Benton. It no doubt occurs in abundance in many other streams in the State. It is usually a very abundant shell, preferring the muddy banks of bayous and sluggishly flowing portions of streams, where it may be found most commonly buried in the mud. There is but the minute opening leading from the siphons to indicate its presence.

So few animals of the *Unionidæ* have been described that it may not be amiss to insert at this place a description of the animal of *Unio parvus* based upon the examination of specimens taken in the Des Moines river, in central Iowa.

Animal of *Unio parvus.* Color of the mass whitish; tentacular portion of mantle dark brown, ending in a caruncle; labial palps large, white, triangular, united at base and partially so over the posterior margin; external ctenidium smaller than the internal, thicker and larger at the posterior extremity, which is rounded, and on the margin, which is marked by a double row of minute, white papillæ; ctenidia united above throughout their entire length; free below; internal ctenidium white, ovate.

The mass of the animal within the cavity of the beaks is light brown owing to the color of the large liver which shows through the thin tissues separating it from the cavity of the branchiæ.

The chief anatomical peculiarity is the presence of the caruncle in the female; this is somewhat separated from the main tentacular mass and is supported by a slender pedicel.

Unio phaseolus Hildreth.

Am. Jour. Sci. and Arts, 1st series, Vol. XIV, 1828, p. 283, Fig. 14; Say, in American Conchology, 1830, Plate 22; Reeve, in Conchologia Iconica *Unio* Plate LXXIII, Fig. 378, 1868; Lea figures splendidly the soft parts in Jour. Acad. Nat. Sci. Phila., 2d series, Vol. IV, Plate XXIX, Fig. 101.

Unio planulatus Lea. Trans. Am. Philos. Soc., Vol. III, 1829, p. 431, Pl. IX, Fig. 13.

Unio camelus Lea. Trans. Am. Philos. Soc., Vol. V, 1834, p. 102, Pl. XV, Fig. 45. Reeve, in Conchologia

Iconica, *Unio* Plate LV, Fig. 283, 1867. Both Reeve and Dr. Lea had before them, for drawing and description, large and well-worn, very old, specimens.

This form has occurred to us in the Ouachita, at Malvern, and the Saline river, at Benton. From the last named place large and fine examples that would readily pass under the name of *Unio camelus* Lea were obtained. The range of the species is from western New York west to Kansas and south to Texas. It attains a very great size in the Cumberland river, Tennessee, where it is exceedingly abundant. Specimens collected by amateurs have been received under the name of *Unio arctior* Lea.

Unio plenus Lea.

Trans. Am. Philos. Soc., Vol. VIII, 1840, p. 211, Pl. XIV, Fig. 26; Reeve, Conchologia Iconica, *Unio* Plate LXI, Fig. 305, Vol. XVI.

The westernmost range for this form has been determined thus far to be eastern Kansas in the Neosha river. In Arkansas it has occurred to us in collections made in the Ouachita river, at Malvern, and in the St. Francis river, at Wittsburg. It is a very abundant shell in the first named stream. See remarks under *Unio obliquus* Lamarck.

Unio plicatus Lesueur.

Name adopted by Lea from ms name given by Lesueur. *Vide* Trans. Am. Philos. Soc., Vol. III, 1829, p. 409.

Unio rariplicata Lamarck. Historie Naturelle des Animaux sans Vertebres, edition 1818, Tome VI, p. 71. From the Ohio.

Unio hippopœus Lea. Trans. Am. Philos. Soc., 2d series, Vol. X, Pl. I, p. 67, Pl. I, Fig. 1, 1845. From Lake Erie. Reeve, in Conchologia Iconica, Vol. XVI, *Unio* Plate XI, Fig. 40, 1864. This is a depauperate form of *Unio plicatus*.

Unio neislerii Lea. Jour. Acad. Nat. Sci., Phila., Vol. IV, 1859, p. 212, Pl. XXVI, Fig. 93. From the Flint river, Georgia.

Unio brazosensis Lea. Jour. Acad. Nat. Sci. Phila., 2d

series, Vol. VI, 1868, Pl. 48, Fig. 122, p. 309. Based upon a young specimen from the Brazos river, Texas.

Unio lincecumii Lea. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. VI, 1868, p. 312, Pl. 49, Fig. 125. Species based upon three specimens from the Brazos river, Texas.

Unio perplicatus Conrad. Jour. Acad. Nat. Sci., Phila., 2d series, Vol. VIII, p. 178.

Unio pauciplicatus Lea. Jour. Phila. Acad. Nat. Sci., 2d series, Vol. VIII, 1874, p. 29, Pl. 9, Fig. 26. Described from specimens obtained in the Colorado river, Austin, Texas.

Reeve also figures, under the MS name of *Unio perlensis* Conrad, with the habitat "North America", a shell contributed to the Museum Cuming by John G. Anthony, which appears to be an abnormal form of this species. *Vide* Conchologia Iconica, Vol. XVI, *Unio* Plate XI, Fig. 42.

This *Unio* occurs in great numbers in the St. Francis river, at Wittsburg, rivaling all others, save, perhaps, *Unio trapezoides* Lea. The form is the short and somewhat ventricose one, which Mr. Conrad called *perplicatus*. It also occurred in some abundance in the Saline river, at Benton.

The form which Mr. Lea called *Unio hippopœus*, from Lake Erie, is without question a depauperate *plicatus* and is not entitled even to varietal distinction. Throughout the great geographical range of this species almost every possible variety of environment is to be found, and it would be strange indeed if the shells did not in some measure respond to these factors. It is usually abundant, wherever it occurs at all. In central Iowa it is rare, but in the Mississippi river, on the eastern border of that State, it is both common and large. In the Cumberland river it is a very abundant shell; and is, in short, to be reckoned among the most common of our Unios. In Arkansas, aside from the localities named above, the shell is said to be abundant in the Little Red river, though we have not seen specimens that came from that stream. From the Cedar river, Iowa, was obtained a specimen which presented the following dimensions: length, 135 mm.; height, 98 mm.; breadth, 59 mm.

UNIO PURPURATUS Lamarck.

Plate V.

Animaux sans Vertebres, 2d Ed., Vol. VI, p. 533, 1838. Described from the Mississippi; Reeve, in Conchologia Iconica, Vol. XVI, *Unio* Plate XXIV, Fig. 115, 1865.

Unio ater Lea. Trans. Am. Philos. Soc., Vol. III, 1829, Pl. VII, Fig. 9, p. 426. This is the female and was described from specimens taken in the Mississippi river, below Natchez.

Unio lugubris Say. American Conchology, 1832, Plate XLIII. Described from the Bayou Teche, Louisiana. This name was proposed by Say for Lea's species, he doubtless thinking that Nilsson's name had priority.

Unio poulsonii Conrad. New Fresh Water Shells of the United States, 1834, pp. 25–26, Pl. I; Reeve, in Conchologia Iconica, Vol. XVI, 1866, *Unio* Plate LI, Fig. 270. Conrad described his form from the Black Warrior river, Alabama.

Unio coloradoensis Lea. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. III, 1857, p. 314, Pl. XXXI, Fig. 29. Described in 1856, from specimens obtained in the Colorado river of Texas.

This species is among the most ponderous of North American *Uniones*. Chiefly confined to the streams of the southern United States it yet ranges as far north as middle Kansas, and eastwardly to north Alabama and Georgia. In Mississippi, Louisiana, Arkansas, and Texas it is both common and large, but does not rival the giant forms which have come to our cabinet from the Little Arkansas river, near Wichita, Kansas. Two specimens from that locality, and those not the largest, form the basis of the figures which are given herewith.

Lamarck's description, but not his original one, is given herewith, the bibliographic reference to which appears in the above synonymy.

"*U. testa ovato elliptica, tumida, anterius subbiplicata, intus viridi-violaceo purpureoque tincta; dente laterali crenulato.* * * * *Habite le Mississipi* * * * *Je la crois des grandes rivieres de l'Afrique.* * * * *Belle et grande*

coquille a nacre pourpree avec des taches irregulieres d'un vert violatre, sur-tout sous les crochets. Largeur de mon exemplaire, 139 millimetres. La dent cardinale est epaisse mais de taille mediocre. L'autre dent est tres finement crenelee.''

The reference of this form to the rivers of Africa is, of course, entirely incorrect; its general resemblance to *Pleiodon* may have caused the statement.

Lea's *Unio ater* is the female of this species, while his *Unio coloradoensis* is based upon a large male. Conrad's *Unio poulsonii* is also a male. Again Say described, for his form, the female.

The shell may be described as follows from the appearances presented by mature and large specimens taken in the Little Arkansas river, Kansas, by Mr. J. R. Mead.

Shell large, heavy, smooth, striate, posteriorly elliptical, convex, thick, very thick anteriorly, rounded before, obtusely biangulate behind; epidermis thick, black, striate towards the margin, and on the posterio-dorsal slope, umbonal slope shining, eradiate or obscurely rayed, the rays seen only on the thin margins of the old specimens, in the young as many capillary lines over the whole disk of the umbones; lines of growth conspicuous, numerous and crowded, in old specimens forming slightly raised ridges, which are parallel to the margins but which, posteriorly, form imbrications, these are often broken and give the shell an exceedingly rough appearance; dorso-posterior margin slightly curved; posterior, umbonal slope marked by two carinæ, one of which is very prominent, the other but slightly indicated, these, at the posterior margin, indicate the positions of the incurrent and excurrent orifices and render the margin biangulate; umbones large, prominent, rounded, always so eroded in the old shell as not to disclose the character of the undulations, but nearly perfect, young specimens present indications of apiculate folds; ligament long, thick, black, scarious, rough; cardinal teeth single in the right and double in the left valve, of young specimens, but disposed to be trifid in the right valve, in large and old specimens, erect, dentate, rough, triangular, the anterior portion, in the left valve, the larger; lateral teeth long, straight, thick-lamellar, smooth, but often slightly crenulate on the margin, separated

entirely from the cardinals, there being no connecting plate, forming an angle of 130° with a line drawn through the tips of the umbones to the tip of the anterior division of the cardinals; anterior cicatrices distinct, very large, and very deeply impressed, striate, sometimes roughened, deepest close to the base of the cardinal teeth; pallial cicatrix very deep anteriorly, crenulate, and lightly impressed behind; posterior cicatrices large, confluent, not at all impressed, concentrically striate, the *retractor pedis* impression neither on nor very near the end of the lamellar laterals; dorsal cicatrices disposed variously, and always irregularly, in the cavity of the beaks, sometimes quite central; nacre always rich purple, commonly roughened with numerous small pear-like masses studding the body cavity.

Dimensions of large male: length, 165.00 mm.; breadth, 66.00 mm.; height, 116.50 mm. Dimensions of large female: length, 141.50 mm.; breadth, 68.15 mm.; height, 96.76 mm.

UNIO PUSTULATUS Lea.

Trans. Am. Philos. Soc., Vol. IV, 1830, p. 79, Pl. VII, Fig. 9. Described from the Ohio.

Unio nodulatus Rafinesque. So Conrad, Monography of Unio, Pl. XLV, Fig. 1, 1838; Reeve, in Conchologia Iconica, Vol. XVI, *Unio* Plate XIII, Fig. 51, 1864.

This form is easily distinguished from the related species which follows, by the fewer pustules which are larger than in *Unio pustulosus* Lea, and are besides differently disposed over the disk. Moreover, its quadrate outline is dissimilar to that presented by any other of the pustulate Uniones.

In the St. Francis river, at Wittsburg, the species occurs in very great numbers, and is well developed and perfect; it was also found, sparingly, at Benton, in Saline river. It is so well marked that very few synonyms have been made from this shell, a fact that few other species will illustrate.

UNIO PUSTULOSUS Lea.

Plates XIII–XV.

Trans. Am. Philos. Soc., Vol. IV, 1830, p. 64, Pl. VIII, Fig. 7, from the Ohio and Alabama rivers; Reeve, in

Conchologia Iconica, Vol. XVI, *Unio* Plate XII, Fig. 43, as *Unio bullatus*, Rafinesque, 1864; *Unio bullatus* Rafinesque; so Conrad, in Monograph of Unio, Pl. XL, Fig. 2, 1838. This is probably the form intended by Hildreth as his *Unio verrucosa alba*. *Vide* Am. Jour. Sci. and Arts, 1st series, 1828, Vol. XIV, p. 289.

Unio schoolcraftensis Lea. Trans. Am. Philos. Soc., Vol. V, 1832, p. 37, Pl. III, Fig. 9, from Fox river, Wisconsin. This name, for grammatical reasons, was subsequently changed to *schoolcraftii*. Reeve also figures this form, Conchologia Iconica, Vol. XVI, *Unio* Plate I, Fig. 3, 1868. Plates XIII, XIV, Figs. 1–4, herein.

Unio prasinus Conrad. New Fresh Water Shells of the United States, 1834, p. 44, Pl. III, Fig. 1. An immature shell from Fox river, Wisconsin. Reeve, Conchologia Iconica, Vol. XIV, *Unio* Plate VII, Figs. 26a, 26b, 1864; these two figures are excellent, and are taken from specimens presented to the Museum Cuming by John G. Anthony.

Unio turgidus Lea. Trans. Am. Philos. Soc., Vol. VI, 1834, p. 11, Pl. V, Fig. 11; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate III, Fig. 10, 1864. Described from near New Orleans, Louisiana.

Unio dorfeuillianus Lea. Trans. Am. Philos. Soc., Vol. VI, 1836, p. 73, Pl. XVII, Fig. 54; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate X, Fig. 38, 1864. A poor figure. Described from the Ohio river, at Cincinnati. Plate XV, Figs. 1–2, herein.

Unio mortoni Conrad. Monograph of Unio, p. 11, Plate VI, Fig. I, 1836. Described from the Bayou Teche, Louisiana. This is Lea's *Unio turgidus*.

Unio pernodosus Lea. Trans. Am. Philos. Soc., Vol. X, 1845, p. 71, Pl. III, Fig. 8; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate XII, Fig. 46, 1864. Described from North Carolina.

Unio asperatus Lea. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. V, 1861, p. 68, Pl. VII, Fig. 218; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate LXXXV,

Fig. 450, 1868. Described from the Alabama river, at Claiborne.

Unio vallatus Lea. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. VI, 1868, p. 315, Pl. L, Fig. 128. Described from Alabama.

Unio refulgens Lea. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. VI. 1868, p. 317, Pl. LI, Fig. 130. Described from Lauderdale county, Mississippi. Plate XV, Figs. 3–4, herein.

Unio sphæricus Lea. Jour. Acad. Nat. Sci. Phila., 2d series, 1868, Vol. VI, p. 319, Pl. LI, Fig. 132. Described from the Pearl river, Mississippi.

Unio cahabensis Lea. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. VIII, 1874, p. 17, Pl.V, Fig. 14. Described in 1871 from the Cahaba river, Alabama.

This is an abundant form in the St. Francis, at Wittsburg, and a common one in the Saline, at Benton. It is, no doubt, quite generally distributed over the State, and the various names above listed are represented by many of the varying forms which the species exhibits. It will be noticed, in the above synonymy, that several of the so-called species come from the same stream or drainage area, and their descriptions are separated from one another by the interval of a few years. Specimens of every form listed in this synonomy, Lea's species all having been named by himself, have been seen and studied in the course of the past ten years. With the exception of *Unio turgidus* Lea examples of every species is before the writer at this time. No hesitation is felt in regarding this series of forms as one species, varying only in those trivial matters which should not, at most, constitute varietal value and which are the expression of different geographic factors.

The plates given herein show certain of the forms of this widely distributed shell, in some of its most marked phases. Recently, from Louisiana comes a form of *pustulosus* that is very like *sphæricus*, as it is found in Texas ; from the Ouachita, at Arkadelphia, come excellent specimens of *refulgens* which, in large series, approach the Louisiana forms. The St. Francis river presents the typical specific form, and with it *sphæricus*

and *dorfeuillianus*, all intergrading in so marked a manner that identity must be regarded as established. From the Little Arkansas, at Wichita, Kansas, come numbers of magnificent examples of *schoolcraftii*, some entirely covered with pustules, others absolutely devoid of even a semblance of one; indeed, the writer's collection contains some fifty examples from that stream, exhibiting every phase of nodulation from absolutely smooth specimens to those showing great numbers of small pustules. The characters of the cardinal teeth alone would have sufficed, in the hands of species mongers, to make a dozen "extremely characteristic" species.

The Des Moines river, in central Iowa, presents only the form to which Mr. Lea gave the name of *Unio schoolcraftii*. From this form of the shell a number of the figures given have been made. As in typical *pustulosus* so here there is every degree of nodulation and even of rotundity of form. *Unio vallatus* from Alabama, which was collected by the writer in great numbers in Alabama a few years ago, much resembles the form from Iowa even in the numbers and disposition of the pustules. The female is often somewhat emarginate, but does not approach *Unio pustulatus* Lea in that respect. In *refulgens* the truncated posterior is the most marked differential feature. Plates XII to XIV represent *schoolcraftii* in its various phases.

Unio rectus Lamarck.

Plate VII, (male in outline.)

Historie Naturelle des Animaux sans Vertebres, 1819, Vol. VI, p. 74; described from Lake Erie. Same, 2d edition, Vol. VI, p. 537, 1838; Reeve, in Conchologia Iconica, Vol. XVI, *Unio* Plate XIX, Fig. 86, 1865, the figure is that of a large and old male; Conrad, Monograph of Unio, Pl. XV, 1836.

Unio prælongus Barnes. Am. Jour. of Sci. and Arts, 1st series, Vol. VI, No. 1, p. 261, Fig. 11, 1823.

Unio sageri Conrad. Monograph of Unio, 1836, p. 53, Pl. XXIX, from the Detroit river.

Unio leprosus Miles. Annual Report of the Geological

Survey of Michigan, 1861, p. 240. From the Huron river.

Arkansas specimens have been seen only from the St. Francis, at Wittsburg, and the Saline, at Benton. It doubtless occurs in nearly all the large streams in that State.

Lamarck's description of *Unio rectus* runs as follows:—

"*U. testa transversim elongata, angusta, convexa, anterius, subangulata; latere antico striis longitudinalibus obliquis, remotis obsoletis. * * * Habite le lac Erie, Michaud. Elle a presque la forme du mytilus lithophagus, Son test est blanc, recouvert d' un epiderme brun noiratre. Largeur, 100 millimetres.*"

The figures here given in the plate are of shells collected in the Des Moines river, and upon similar shells the description of the species, given below, is based: —

Shell large, smooth, elongate, compressed laterally, thick, very thick anteriorly, rounded before, pointed posteriorly, epidermis thick black, or reddish corneous, shining, obscurely rayed with dark green, the broad rays not very apparent in old specimens, lines of growth numerous, well marked, imbricated posteriorly, and often so on ventral margin; dorso-posterior margin straight, or nearly so; posterior umbonal slopes gently rounded, becoming more angular near the beaks, much imbricated towards posterior margin; umbones small, scarcely approximating, marked, in non-eroded specimens, by many minute, fine, concentric crenulations or folds; ligament long, thick, black, sometimes dark brown; cardinal teeth double in the left, and disposed to be double in the right valve, the larger portion erect, sometimes sharp, sometimes blunt, and commonly gently posteriorly recurved, the characters of the double portion in left valve various, sometimes sharp, often blunt, or smooth rounded; lateral teeth long, lamellar, straight, finely crenulate on margins; anterior cicatrices very large, deep, striate, distinct, that of the *protractor pedis* impression considerably above the lower margin of the large and deep adductor cicatrix; posterior cicatrices not deeply impressed, confluent, very large, pallial cicatrix very deep anteriorly, irregularly impressed throughout, crenulate; dorsal cicatrices impressed deeply in the center of the cavity of the

beaks, large, often pit-like, in old shells exhibiting two or three large scars, circular in outline, and as deep as the *protractor pedis* impression, though the posterior one is commonly oval; plate connecting the cardinal and lateral teeth not well developed; nacre usually dark purple, often pink, white, or salmon; frequently the coloration is confined to the region of the cardinal and lateral teeth, the remainder of the interior being pure white.

Length, 171 mm.; breadth, 60 mm.; height, 70 mm.

These are the dimensions of very large shells collected in the Cedar river, Iowa.

This species ranges from New York to Minnesota, Nebraska, Kansas, Indian Territory and Texas, to Georgia, and is common throughout all that vast area.

UNIO RETUSUS Lamarck.

Plate VIII.

Historie Naturelle des Animaux sans Vertebres, 1819, Vol. VI, p. 72; also, 2d edition, 1838, Vol. VI, p. 534. Described as from Nova Scotia. Reeve, in Conchologia Iconica, Vol. XVI, *Unio* Plate LXXI, Figs. 363a, 363b, 1868.

Unio torsa Rafinesque. Annales Generales des Sciences Physiques, Bruxelles, 1820, Vol. V, p. 311, Plate LXXXII, Figs. 1, 2 et 3. Described from the Ohio. See also Conrad, in Monograph of Unio, Plate VIII, 1836, p. 19.

Unio obtusa Say. So Deshayes, in Cuvier's Regne Animal, *teste* Lea. I have been able to find no work in which Say uses this name for any *Unio*.

Lamarck described this shell in the following terms:—

"*U. testa rotundata, tumida, intus violacea; natibus retusis, erosis; dente laterali breviusculo.* * * *

Habite les rivieres de la Nouvelle-Ecosse. A. Michaud. Test epais; epiderme d' un vert jaunatre; dent cardinale grossiere, sillonnee, divisee en deux. Longueur apparente, 47 millimetres."

The range of this species is rather more restricted than is

common for Unios of this type. It has been found only in the drainage of the Ohio, and the Mississippi river itself, but is not yet known from streams beyond. South it ranges to the Holston river, in east Tennessee, and to the Cumberland, at Nashville. It is there quite abundant. There is certainly an error in assigning to this species the distant habitat of Nova Scotia, as was done by Lamarck in originally describing it. The great traveler and naturalist, Michaud, had secured this form, with numerous others, during his visit to the New World, and from material furnished by him Lamarck drew his description. The localities were either confused by Lamarck, or what would be more natural under the circumstances, had been confounded by the collector. However this may be, the original shells were most certainly obtained elsewhere than in the region named by Lamarck.

From specimens furnished by Professor Barton W. Evermann, and taken in the White river, Indiana, the following description is drawn:—

Shell rotund, large, smooth, convex, heavy, rounded before, circular behind; epidermis rather thin, polished, striate, disposed to imbrication towards the margins, olivaceous, lines of growth numerous, crowded, darker; dorso-posterior margin curved and rounded; postero-dorsal umbonal slope lighter horn-colored, with numerous capillary rays of green, which are especially marked near the beaks, this slope is separated from the lateral umbonal slope by a rather well marked angle, it has also two slightly marked carinæ; umbones large, prominent, approximating closely, curved anteriorly, and projecting slightly beyond the antero-ventral margin, smooth; ligament short, thick, curved with dorsal margin, light horn-color; lunule large, cordate, scarious; cardinal teeth single in the right, double in the left valve, multi-tuberculate, striate, crenulate, the folds all originating at a common point immediately under the tip of the umbone, as a whole the segments are triangular, massive, thick, short; lateral teeth long, curved, commencing well toward the dorsal margin, and nearly on a line with the anterior portion of the cardinals, lamellar, somewhat thick, double in both valves, crenulate on the margins; the plate connecting the cardinal with the laterals

has several folds or plications, rather thin; anterior cicatrices distinct, deep and pit-like, not very large, the adductor roughened, the *protractor pedis* striate; posterior cicatrices deeply impressed, large, confluent, that of the *retractor pedis* at the tip of lamellae of lateral teeth; dorsal cicatrices numerous, pit-like, often confluent, placed on the plate formed by the base of the cardinal teeth; pallial cicatrix well impressed throughout, but deepest and most crenulate anteriorly; nacre rich purple, lighter to white on the margins, beyond the pallial line.

Length of a mature specimen, 70.75 mm.; breadth, 43.50 mm.; height, 74.56 mm.

The species has not yet been found, to our knowledge, in Arkansas; the conditions which obtain in the bayous along the Mississippi are such, however, that it may reasonably be expected to occur since it is common in the Mississippi river farther to the north.

UNIO ROTUNDATUS Lamarck.

Plate IX.

Animaux sans Vertebres, in Historie Naturelle, 1819, Vol. VI, p. 75; also, same, edition of 1838, Vol. VI, p. 538. From unknown locality.

Unio suborbiculatus Lamarck, Historie Naturelle Animaux sans Vertebres, Vol. VI, p. 81; also 2d edition, 1838, Vol. VI, p. 546. From locality unknown.

Unio glebulus Say. Transylvania Journal of Medicine, Vol. IV, p. 526, 1831; also American Conchology, 1832, Plate 34, female; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate LXXIV, Fig. 384, young and not characteristic female. Described from the Bayou Teche, Louisiana.

Unio subglobosus Lea. Trans. Am. Philos. Soc., Vol. V, 1837, p. 30, Pl. II, Fig. 3; Reeve, Conchologia Iconica, Vol. XVI, Plate *Unio* LXIV, Fig. 321, 1868. Described from the Bayou Teche, Louisiana. Reeve's figure is that of an old male.

Reeve also figures, as this form, a shell on Plate XXIII, Vol. XVI, figure 106, which is certainly some other species. Correcting the error in the addendum to *Unio* he quotes Conrad, who thinks that the shell may be *Unio kienerianus* Lea. It is certainly much like it.

This is a rare species, and will probably always be so considered. It has not occurred to any collector outside of Louisiana, though it has been found in other than the original locality. There is a fine specimen in my collection which was recently obtained in Crass Lake near Shrevesport, Louisiana, by Mr. Wayland Vaughan, that is very characteristic indeed. Besides, there is before us a suite of three specimens that formerly belonged to Dr. Gerard Troost, of Nashville, Tenn., a warm personal friend of Thomas Say, and a member, for a time, of the singular community which sprang up at New Harmony, Indiana. To him Say gave these examples of his *glebulus*, the original label of which is still treasured with the specimens. They came into my hands through the kind liberality of Dr. J. Berrien Lindsley, of Nashville, who became the owner of Troost's collection, or of most of it. The history is complete, and there is no question that this lot has passed nnder the inspection of the great naturalist who described it as new. The suite is from the Bayou Teche, Louisiana.

Lamarck described this shell in the following terms:—

"*U. testa elliptico-rotundata, inferne ventricosa, sub epiderme splendide margaritacea; cardine arcuato. Habite* * * * . *Coquille rare, d'une forme singuliere pour le genre, et dont la nacre est argentee, legerement teinte de rose, irisee et tres brillante. Largeur, 78 millimetres. Elle a un pli sur le cote anterieur.*"

The "silvery nacre" indicated by Lamarck has been exhibited by but one specimen which has come to our notice. The original description of *Unio suborbiculatus* Lamarck comes nearer to the conditions exhibited by this shell, but the example must have been a very large one. To connect the two better, in the mind of the reader, it is only necessary to add that Lamarck himself gives Say's *glebulus* as a synonym, that is to say, this has been done by Deshayes, who edited the second edition of the Animaux sans Vertebres. Lea, who saw the original example of *Unio rotundatus*, in the collec-

tion of the Baron de Ferussac, surrendered his species to Lamarck.

From the examples in our cabinet, formerly belonging to Troost, the following description is made: —

Shell subcircular in outline, globose, convex, the longitudinal about twice the lateral diameter, the male somewhat compressed, rounded before, and angular behind, the female somewhat emarginate posteriorly; epidermis thin, olivaceous, greener over the umbones, eradiate, striate towards the margin, velvety; lines of growth numerous, and crowded, especially so near the region of the margin, often broad and darker colored; posterior-umbonal slope separated from the lateral slope by a well-marked angulation, with two rather faint carinæ; umbones small, scarcely rounded, depressed, without undulations; ligament short, rather thin, scarious, light brown, curved with the dorsal margin; cardinal teeth short, thick, erect, slightly inclined forwards, double in the left, and disposed to be trifid in the right valve, the central mass of the right tooth far the largest; the plate connecting the cardinals with the laterals is poorly developed, thin, rounded, smooth; lateral teeth short, distant from the cardinals, straight, single in the right and double in the left valve, crenulate, rather thin; naterior cicatrices distinct, deep, and pit-like, roughened, somewhat excavated under the plate formed by the cardinal teeth; pallial cicatrix faintly impressed throughout; posterior cicatrices very large, confluent, that of the *retractor pedis* at extreme tip of lateral teeth; dorsal cicatrices small, arranged in a more or less regularly disposed row within the cavity of the beaks, pit-like and deep; nacre purplish or rose-tinted, — this coloration is most marked on the teeth and extends as a mere blush of pink or rose over the balance of the shell. One specimen, from Shreveport, is pure white except a portion of the lateral teeth and the tips of the cardinals, approaching most nearly Lamarck's description of the silvery nacre. Dimensions of mature male: length, 61.60 mm.; breadth, 31.32 mm.; height, 45.58 mm.; of mature female: length, 54.20 mm.; breadth, 32.70 mm.; height, 41.02 mm.

This species will doubtless yet be found in southeastern Arkansas, in muddy bayous. Its close resemblance to a

Cyrena or to a *Cyprina* in color, and general character of the epidermis, will serve to readily distinguish it from all related forms.

Unio securis Lea.

Trans. Am. Philos. Soc., Vol. III, 1829, p. 437, Pl. XI, Fig. 17; embryo figured in Jour. Acad. Nat. Sci. Phila., 2d series, Vol. IV, p. 47, Pl. V, Fig. 6, 1858; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate LXI, Fig. 304, 1868. Described from the Ohio.

Unio lineolatus Rafinesque. So Say, in American Conchology, Plate XLVIII. This part, VII, is undated and was published by Mr. T. A. Conrad, after Mr. Say's death.

The only occurrence to us, in Arkansas, of this shell was in the St. Francis river, at Wittsburg, where it is commonly found on the muddy bottoms in great numbers and of large size. Its cuneiform shape separates it readily from all others likely to be found in Arkansas.

Unio speciosus Lea.

Jour. Acad. Nat. Sci. Phila., 2d series, Vol. V, p. 207, Pl. 31, Fig. 276; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate LXXXIV, Fig. 447, 1868. Described and figured from Texas.

This shell has not been found by us in Arkansas nor have we seen more than one specimen, said to have been taken in the Ouachita river, near the Indian Territory boundary. If this is its real habitat it properly belongs in this list and will, besides, be found at other localities within the State of Arkansas.

Unio subgibbosus Lea.

Jour. Acad. Nat. Sci. Phila., 2d series, Vol. IV, 1858, Pl. VI, Fig. 36, p. 53. Described from the Oostanaula and Etowah rivers, Floyd county, Georgia.

In the remarks accompanying this form's characterization Mr. Lea says that he has specimens received from Dr. Hale, from the Red river, Arkansas. On this statement the shell is

listed in this register. Recently a large set of some twenty specimens was received from Carney Bayou, Claiborne Parish, Louisiana, rendering it very likely that the shell will yet be found abundantly in favorable localities in Arkansas. Some years since the writer collected it, in large numbers, in Piney river, Texas county, Missouri. It groups with Barnes form, along with *Unio sublatus* Lea, though the specific value of all the forms is doubtful, the point cannot be settled now. The specimens from Louisiana and Missouri have been compared with large suites from the Oostanaula river, collected in 1881. They differ in no respect.

UNIO SUBROSTRATUS Say.

New Harmony Disseminator of Useful Knowledge, January 15, 1831; reprint by Say, p. 6. From the Wabash river. The shell which Reeve figures for this species, Conchologia Iconica, Vol. XVI, *Unio* Plate XVII, Fig. 78, is *Unio iris*, and was drawn from a specimen communicated by John G. Anthony, who, evidently, did not know the species.

Unio nashvillianus Lea. Trans. Am. Philos. Soc., Vol. V, 1834, p. 100, Pl. XIV, Fig. 43; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate XXX, Fig. 158. Described from specimens communicated by Dr. G. Troost from the Cumberland river, at Nashville. See below.

Unio mississippiensis Conrad. Jour. Acad. Nat. Sci. Phila., 2d series, 1850, p. 277, Pl. XXXVIII, Fig. 11; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate XIX, Fig. 85. Described from the lower Mississippi.

Unio nigerrimus Lea. Trans. Am. Philos. Soc., Vol. X, 1852, p. 268, Pl. XVIII, Fig. 23. From Alexandria, Louisiana.

Unio rutersvillensis Lea. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. IV, 1860, p. 356, Pl. LX, Fig. 181. Described from Rutersville, Fayette county, Texas.

Unio topekaensis Lea. Jour. Acad. Nat. Sci., 2d series, Vol. VI, 1868, p. 313, Pl. XLIX, Fig. 126. Described from near Topeka, Kansas.

Specimens were secured from the White river, Carroll

county; the St. Francis river, at Wittsburg; the Ouachita, at Arkadelphia; the Saline, at Benton.

A specimen of this shell was reported on by Dr. Lea in the Proceedings of the Philadelphia Academy of Natural Sciences for 1860, page 51, to which was assigned the indefinite locality of "Arkansas." It was reported under the name of *Unio nasutus* Say, a species which does not occur west of the Appalachians, outside of the drainage of the Great Lakes. It was peculiar in that the teeth were reversed, being single in the left and double in the right valve.

In some MS notes left by Dr. G. Troost in his copy of Volume I of Observations on the Genus Unio, now in the library of Dr. J. Berrien Lindsley, of Nashville, the statement is made that the shell which Lea called *Unio nashvillianus* was not originally found in the Cumberland river, but in the Harpeth river, some miles further south. The original locality will, therefore, be the latter river. The original specimen, with Lea's name in MS is now in my possession. The writer has, however, found the species in the Cumberland, at Nashville.

UNIO TETRALASMUS Say.

Plates XIX, XX.

American Conchology, Plate XXIII, 1830. Described from the Bayou St. John, Louisiana. This plate is copied in Plate XX herein, figures 4, 5.

Unio declivis Say. Transylvania Journal of Medicine, Vol. IV, 1831, p. 527; American Conchology, Plate XXXV, 1832; Conrad, Monograph of Unio, p. 45, Pl. XXIII, Fig. 1, 1836. Described from the Bayou Teche, Louisiana.

Unio camptodon Say. American Conchology, 1832, Pl. XLII, Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate LXX, Fig. 356. From near New Orleans, Louisiana.

Unio geometricus Lea. Trans. Am. Philos. Soc., Vol. V, 1832, p. 38, Pl. IV, Fig. 10. Described from the Bayou Teche, Louisiana.

Unio excultus Conrad. Monograph of Unio, 1836,

pp. 99–100, Pl. LV, Fig. 1. Described from near New Orleans, Louisiana. A copy of this figure is given herewith, Plate XX, Figs. 1–3.

Unio sayii Ward. So Tappan in Am. Jour. Sci. and Arts, 1st series, Vol. XXXV, 1839, p. 268, Pl. III, Fig. 1; Conrad, Monograph Plate LVI, Fig. 2, as *Unio sayanus* Ward. These figures are produced herewith, on Plate XIX, figures 3–5. Described from Circleville, Ohio.

Unio symmetricus Lea. Trans. Am. Philos. Soc., Vol. X, 1845, p. 73, Pl. IV, Fig. 11. From the Red river, Alexandria, Louisiana.

Unio subcroceus Conrad. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. II, p. 297, 1854, Pl. XXVI, Fig. 1. Described from a stream in Arkansas, tributary to the Canadian fork of Red river.

Unio manubrius Gould. Proc. Bost. Soc. Nat. Hist. Vol. V, 1855, p. 229. From Chihuahua, Mexico.

Unio jamesianus Lea. Jour. Acad. Nat. Sci. Phila., 2d series, 1858, Vol. IV, p. 52, Pl. VI, Fig. 35. Described from a single specimen obtained at Jackson, Mississippi, and then in the cabinet of U. P. James, of Cincinnati. The specimen is a pathologic representative of *Unio tetralasmus* Say.

This widely distributed species occurs from Ohio, south to central Alabama and through Texas into Mexico. Its most northern and western locality thus far is central Kansas, not far from Wichita. It preserves its specific characters so generally that it is a matter of great surprise that so many synonyms should fall under it. The study of the figures, descriptions, and localities above indicated, will furnish convincing evidence of identity. Of the total number listed, seven came from Louisiana and contiguous territory; of these seven, five are from the same State, and of these five, two are from the same bayou. The pathologic *Unio jamesianus* is not the first shell or the only one which has been projected into specific distinction; the small *Unio liebii* Lea and the *Unio hippopæus* Lea, both from Lake Erie, are further illustrations.

This species occurs in Arkansas in the White and the Black rivers, and in the Red river, near the Louisiana boundary.

UNIO TRAPEZOIDES Lea.

Trans. Am. Philos. Soc., Vol. IV, 1830, p. 69, Pl. III, Fig. 1; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate V, Fig. 17, 1864. Described from Lake St. Joseph, Louisiana.

Unio interruptus Say. Transylvania Journal of Medicine, Vol. IV, p. 525, 1831; also American Conchology, 1832, Pl. XXXIII. From Bayou Teche, Louisiana.

Unio atromarginatus Lea. Trans. Am. Philos. Soc., Vol. VIII, 1840, p. 207, Pl. XIII, Fig. 21. From the Chattahoochee river, Georgia. Evidently a junior.

Unio sloatianus Lea. Trans. Am. Philos. Soc., Vol. VIII, 1840, p. 217, Pl. XVI, Fig. 33. From the Chattahoochee river, Georgia.

This is an abundant shell in the St. Francis river, at Wittsburg, at which point very large and fine specimens were secured. It also occurred in the White river, at Augusta, where a single valve was found on the bank; in the Saline, at Benton; and in the Ouachita, at Malvern.

I am not sure that Lea's *atromarginatus* falls into the synonymy of his *trapezoides* but it appears to do so judging from the only specimens which have come to notice. From Louisiana come very numerous and fine specimens of this species, but they do not attain the great dimensions reached by the shells from the St. Francis. The species is a mud-loving one, and delights in sluggishly flowing water. The general transverse form, and the peculiar folds or plications on the posterior margin and slope, will serve to distinguish this species from all others.

UNIO TRIGONUS Lea.

Trans. Am. Philos. Soc.,Vol. IV, 1831, p. 110, Pl. XVI, Fig. 40; so, also, Reeve, Concholgia Iconica, Vol. XVI, *Unio* Plate LXXXVI, Fig, 459. From the Ohio river.

Unio chunii Lea. Jour. Acad. Nat. Sci. Phila., Vol. V, 1862, p. 196, Pl. XXVII, Fig. 265. From Dallas, Texas.

Unio riddellii Lea. Jour. Acad. Nat. Sci. Phila., Vol. V, 1862, pp. 197–8, Pl. XXVII, Fig. 267; Reeve, Con-

chologia Iconica, Vol. XVI, *Unio*, Plate LXXXIII, Fig. 442. From Dallas, Texas.

The geographic range of this heavy and well marked shell is very wide, extending from western New York to Minnesota, and Iowa, and Kansas; to Texas, east to Mississippi and Tennessee. In Arkansas it has been found in the St. Francis river at Wittsburg.

UNIO TUBERCULATUS Barnes.

Am. Jour. Sci. and Arts, last series, 1823, Vol. VI, p. 125, Pl. VII, Figs. 8a, 8b; also, figured as *Unio verrucosus* Rafinesque, in Poulson's translation of "Monograph of the Bivalve Shells of the river Ohio", 1832, frontispiece; same, in Chenu, Bibliotheque Conchyliologique, 1845, p. 17, Pl. II, Figs. 10–12; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate 1, Fig. 4; the figure is that of a fine old male.

The range of this form is very great; specimens have been found from western New York to Minnesota, Iowa, and Nebraska; to Kansas, and central Texas; to Georgia, and Alabama. It is commonly abundant wherever found. In the Cahaba river, Alabama, where the shell is very abundant, more than half of those taken have purple nacre. The nacre is usually white, though, in large specimens, it is often blotched with irregularly distributed, brownish spots.

In Arkansas specimens have been taken in the Saline river, at Benton; in the St. Francis, at Wittsburg. Its great length, nodulous anterior portion, striate, posterior slopes, bi-angulate and compressed posterior, will serve to easily separate it from its congeners. The species was originally described from Wisconsin.

UNIO TUMESCENS Lea.

Trans. Am. Philos. Soc., 2d series, Vol X, 1845, p. 71, Pl. III, Fig. 7. Described from Alexandria, Louisiana.

This species was erected on one perfect shell, and one valve of a second specimen. The only locality in Arkansas, from which specimens were secured, is the Ouachita river, at Arkadelphia. It appears to be very rare. It is also credited to

the Tennessee drainage of north Alabama and east Tennessee. It is a very tumid shell and bears some points of resemblance to *Unio trigonus* Lea, but is abundantly rayed over the whole disk, and is of a honey yellow color.

UNIO UNDULATUS Barnes.

Am. Jour. Sci. and Arts, 1st series, Vol. VI, p. 120, Fig. 2, 1823; Reeve, Conchologia Iconica, Vol. XVI, Pl. IV, Fig. 16, as *Unio costatus* Rafinesque. Described from Ohio.

Unio latecostatus Lea. Trans. Am. Philos Soc., Vol. X, 1845, p. 68, Pl. I, Fig. 2. Described from the Black Warrior river, at Tuscaloosa, Alabama.

Unio atrocostatus Lea. Trans. Am. Philos. Soc., Vol. X, 1845, p. 70, Pl. II, Fig. 5; Reeves figure 404, Conchologia Iconica Vol. XVI, *Unio* Plate LXXVII is of *plicatus* and not of this shell at all.

Unio quintardii Cragin. Bull. Washburn Coll. Lab'y of Nat. Hist. Vol. II, p, 6, 1887. From Salt Creek. Indian Territory, Sac and Fox Reservation.

Unio pilsbryi Marsh. Nautilus, Vol. V. May, 1891, p. 1; illustrated in The Nautilus, Vol. VII, No. 1, May, 1893, Pl. I, Figs. 7 and 8. Described from the Little Red river, Arkansas. Inspection both of the types, and the published figures confirms this disposition of the form.

Specimens were observed on the bars of the Saline river, at Benton. It occurs commonly in the Little Red river, near Clinton, Van Buren county, from which locality came the shells that were characterized by the name of *Unio pilsbryi*. The species is of wide distribution, ranging from New York to Kansas, Nebraska, Dakota, and to west Central Texas; east to Georgia, Alabama, and intermediate States. It is flatter than *Unio plicatus*, and the undulations are differently disposed; they are commonly more numerous than in Lesueuer's species, and often are interrupted or broken; not infrequently specimens are found in which the undulations cover the entire disk, at other times they are few in number, and almost entirely confined to the posterior slope. This is one of the most

common Unios in North America. Conrad figures this shell as *Unio costatus* Rafinesque, on Plate VII of his Monograph.

UNIO VENUSTUS Lea.

Trans. Am. Philos. Soc., Vol VI, 1834, p. 4, Pl. II, Fig. 4; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate LXIV, Fig. 326. Described from Potosi, Missouri.

Unio pleasii Marsh. The Nautilus, Vol. V, No. 1, p. 2, May, 1891. Described from the Little Red river, Van Buren county, Arkansas.

Specimens have been seen from the Little Red river — the lot forming the types of Marsh's supposed new form, and from the White river, Carroll county. While the species does present some features, like those of the young of *Unio ligamentinus* Lamarck, it is entirely distinct from that shell; the comparison was not fortunate, for very many characters that are not allied to those of the Lamarckian form are exhibited; among them may be mentioned the capillary character of the rays, their wavy outlines, their crowding, also the character of the teeth, which are unlike those of young *ligamentinus*, the beaks, which are more elevated, the emarginate character of the female, which is not like the outline of the female *ligamentinus*. The shell which most nearly represents this one is *Unio spatulatus* Lea, but it appears to be distinct from it. Having seen and compared the types of *Unio pleasii* with the real *venustus* there is no hesitation in uniting them.

UNIO VENTRICOSUS Barnes.

Am. Jour. of Sci. and Arts, Vol. VI, 1st series, 1823, p. 267, Figs. 14a, 14b, 14c; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate XLIII, Fig. 235; American Conchology, Say, Plate XXXII. Described from the Wisconsin and Mississippi rivers.

Unio occidens Lea. Trans. Am. Philos. Soc., Vol. III, 1829; p. 435, Pl. X, Fig. 16. Described from the Ohio river.

Unio cardium Rafinesque. So Conrad, in Monograph of Unio, 1834, p. 7.

Unio satur Lea. Trans. Am. Philos. Soc., 2d series, Vol. X, 1852, p. 265, Pl. XVII, Fig. 19; Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate XCII, Fig. 501. Described from Alexandria, Louisiana.

Unio canadensis Lea. Jour. Acad. Nat. Sci. Phila., Vol. IV, 1859, p. 268, Pl. XLIV, Fig. 148. Described in 1857, from the St. Lawrence river, at Montreal.

Unio subovatus Lea, of Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate LXXXV, Fig. 456. This is not the true *subovatus* Lea.

Specimens were obtained only in the Saline river, at Benton. The form is very widely distributed, and presents variant features in all its different habitats. Commonly abundant wherever it occurs at all, when perfect specimens are obtainable it constitutes one of the most beautiful of Uniones. It is the type of a great natural group, which includes *Unio ovatus* Say, *Unio subovatus* Lea, *Unio capax* Green *Unio lineatus* Lea, and others. Specimens of the last named, from the original locality in Georgia, indicate that it too must pass into the list of synonyms.

MARGARITANA COMPLANATA Barnes.

Plate XVI.

Alasmodonta complanata Barnes, Am. Jour. Science and Arts, 1st series, Vol. VI, p. 278, Pl. XIII, Figs. 17a, 17b, 1823.

Symphynota complanata Lea. Trans. Am. Philos. Soc., 1829, Vol. III, p. 448. Transferred from *Unio*.

Unio complanatus Lea. So Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate L, Fig. 266.

This species is rarely found in the St. Francis, at Wittsburg. While it has a wide range it appears to be most abundant in western Illinois, in the Mississippi river, and throughout Iowa. The last named State may, indeed, be said to be its metropolis. The figure is made from a young individual taken in the Des Moines river, and is designed to show the characters of the beaks, which are peculiar to this form.

MARGARITANA CONFRAGOSA Say.

New Harmony Disseminator of Useful Knowledge, Vol. II, No. 22, 1829, p. 339; American Conchology, Plate XXI, 1830. Described from the Wabash river, Indiana.

Unio confragosus Say. So Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate LX, Fig. 299. A fine figure of the external view of the shell.

This species has occurred only in the St. Francis river, so far as present information extends. It is a form which loves to dwell in the soft mud of sluggishly flowing streams. Just over the Louisiana boundary line, in Claiborne Parish, this shell occurs in numbers. It is not without reason, therefore, that it may be expected to occur in other portions of the State of Arkansas than the one listed.

MARGARITANA RUGOSA Barnes.

Alasmodonta rugosa Barnes. Am. Jour. of Sci. and Arts, 1st series, Vol. VI, 1823, p. 278, Pl. XIII, Figs. 21a, 21b; DeKay Natural History of New York, Vol. V, Mollusca, p. 196, Pl. XIV, Fig. 226. 1843.

Unio rugosus Barnes. So Reeve, Conchologia Iconica, Vol. XVI, *Unio* Plate LX, Fig. 302, 1867. Reeve says this is equivalent to *Unio abducta* Say, a species which we have been unable to find that Say ever characterized.

Specimens were obtained in the White river, Carroll county; and in the Saline, at Benton, where the form appears to be abundant. This shell has a wide range from New England, to west central Kansas, Texas, Louisiana, Alabama, and Georgia; the northernmost range, that is authoritatively known, is the Rideau and Ottawa rivers, Canada.

ANODONTA EDENTULA Say.

Alasmodonta edentula Say. New Harmony Disseminator of Useful Knowledge, Vol. II, No. 22, 1829, p. 340; described from the Wabash river.

Anodonta edentula Say. DeKay Nat. Hist. N. Y., Pt. V, 1843, p. 201, Pl. XVI, Fig. 231; Lea, Trans. Am. Philos. Soc., Vol. IV, 1858, p. 50, Pl. VI, Fig. 37.

Anodonta ferruginea Lea. Trans. Am. Philos. Soc., 2d series, Vol. VIII, 1840, p. 289, Pl. XIX, Fig. 43. Described from Simon's Creek, Indiana.

Anodonta tetragona Lea. Trans. Am. Philos. Soc., 2d series, Vol. X, 1845, Pl. VIII, Fig. 25, p. 82; described from Alexandria, Louisiana.

Anodonta shafferiana Lea. Trans. Am. Philos. Soc., 2d series, 1852, Vol. X, Pl. XXVI, Fig. 50, p. 288; described from Horn Lake creek, Tennessee, and Flat Rock creek, Indiana; Reeve, *Anodon* Plate XXXV, Fig. 143, Conchologia Iconica, Vol. XVII.

Anodonta arkansasensis Lea. Trans. Am. Philos. Soc., 2d series, Vol. X, 1852, p. 293, Pl. XXIX, Fig. 56. Described from Kansas.

Alasmodonta rhombica Anthony. Am. Jour. Conchology, Vol. I, 1865, p. 158.

Anodon annulatus Sowerby. Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate XVIII, Fig. 67. This figure and description are based upon a specimen in the Museum Cuming, from an unknown habitat; it shows the characters of the beaks of *edentula*, and is without question that form.

This is the most common and abundant *Anodonta* in the west. The characters of the dorsal margin are such that it is often mistaken for a *Margaritana* as, indeed, was the case when originally described. Subjected to a vast variety of environmental conditions, it is not surprising that very many names have been applied to its differing forms. It is not easily separated, at times, from the form called *Anodonta undulata* Say, which is supposed to be entirely confined to the regions east of the Appalachians, or to waters draining into the Great Lakes.

Reeve's Fig. 60, Vol. XVII, Conchologia Iconica, Plate XVII, is not *Anodonta edentula*, but is something else.

The species has occurred in collections made in the St. Francis river, at Wittsburg, and in the Saline, at Benton; a single imperfect specimen was picked up in a small stream, without a name, in the southeastern part of Craighead county.

ANODONTA GRANDIS Say.

New Harmony Disseminator, Vol. II, 1829, No. 22, p. 341; Reeve, Conchologia Iconica, Vol. XVII, Plate *Anodon* I, Fig. 1, 1870. Described from the Fox river, and the Upper Mississippi river.

Anodonta stewartiana Lea. Trans. Am. Philos. Soc., 2d series, 1834, Vol. V, p. 47, Pl. VII, Fig. 17; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate XXXIII, Fig. 133. Described from the Bayou Teche, Louisiana.

Anodonta plana Lea. Trans. Am. Philos. Soc., 2d series, 1834, Vol. V, p. 48, Pl. VII, Fig. 18, as *palna* in typographic error; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate XXIV, Fig. 94. Described from Bear Grass creek, near Louisville, Kentucky.

Anodonta declivis Conrad. Am. Jour. Sci. and Arts, Vol. XXV, 1st series, p. 341, Pl. I, Fig. 11, 1834. Described from the Flint river, Morgan county, Alabama,

Anodonta corpulenta Cooper. Appendix to "Narrative of an Expedition through the Upper Mississippi to Itasca Lake, etc., under the direction of Henry B. Schoolcraft," p. 153; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate XXXII, Fig. 129. Described from the Lake of the Woods, and the Upper Mississippi.

Anodonta decora Lea. Trans. Am. Philos. Soc., 2d series, Vol. VI, 1836, p. 64, Pl. XX, Fig. 63; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate XXI, Fig. 83, 1869. Described from the Ohio river.

Anodonta gigantea Lea. Trans. Am. Philos. Soc., 2d series, Vol. VI, 1838, p. 1, Pl. I, Fig. 1; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate XXXVII, Fig. 152. Described from Port Gibson, Mississippi.

Anodonta ovata Lea. Trans. Am. Philos. Soc., 2d series, Vol. VI, 1838, p. 2, Pl. II, Fig. 2; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate XXII, Fig. 85, 1869. Described from Marietta, Ohio. Reeve's figure, which is that of a shell without decortication of the beaks, shows well the undulate-apiculate character of the tips.

Anodonta harpethensis Lea. Trans. Am. Philos. Soc., 2d series, Vol. VIII, p. 224, Pl. XIX, Fig. 42; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate XXI, Fig. 82, 1869. Described from the Harpeth river, Tennessee.

Anodonta linnæana Lea. Trans. Am. Philos. Soc., 2d series, Vol. X, 1852, p. 289, Pl. XXVII, Fig. 51; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate XXXV, Fig. 144. Described from Lake Concordia, Louisiana.

Anodonta virens Lea. Trans. Am. Philos. Soc., 2d series, Vol. X, 1852, p. 290, Pl. XXVIII, Fig. 53; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate XXXIV, Fig. 138. This form was described from the Red river, near Alexandria, Louisiana. Through some curious blunder Reeve says "River Euphrates."

Anodonta gesneri Lea. Jour. Acad. Nat. Sci. Phila., 2d series, 1859, p. 231, Pl. XXXI, Fig. 109; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate VII, Fig. 15. Described from the Uphaupee creek, Macon County, Georgia.

Anodonta inornata Anthony. Am. Jour. of Conchology, Vol. II, 1866, p. 145. *Teste* Lea.

This is, without doubt, the most abused American *Anodonta*. Of wide distribution it is one of the most polymorphous shells found on the continent. A number of years ago attention was called to this variant shell, and some of the synonymy here indicated definitely was there hinted at.* There is scarcely a stream in all the great Mississippi Valley but that in it some form of this abundant shell occurs. In outline every one of the forms given above may be found in every lot which numbers forty or fifty specimens, and if the old and the young are taken and compared, all the forms from *gigantea* to *ovata* and *virens* may be obtained. It has fared rather better than the European *Anodonta cygnea*, of which over one hundred and twenty synonyms are known, but by the time it has had attention equal to that of its European congener, it may fare as badly.

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* American Naturalist, Vol. XIV, 1880, pp. 529–530.

The group has received too little attention, and too much reliance has been placed upon authority to fully and correctly understand this shell. Those who collect *Unionidæ* by proxy, and whose acquaintance with streams and lakes is confined to the views from passing train or from study window, will continue to see many species in this polymorphous form.

Specimens were obtained in the St. Francis river, at Wittsburg, and in the Saline, at Benton. It will doubtless be found, in numbers, in the old river beds of all the larger streams, and in most ponds and lakes throughout the State of Arkansas. It ranges to western New York and to central Texas, and north to British America.

ANODONTA IMBECILLIS Say.

New Harmony Disseminator of Useful Knowledge, 1829, Vol. II, No. 23, p. 355; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate XXVII, Fig. 102, as of Lea. Described from the Wabash river.

Anodonta incerta Lea. Trans. Am. Philos. Soc., Vol. V, 1832, p. 45, Pl. VI, Fig. 16; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Plate XVII, Fig. 59. Described from the Ohio river.

Anodonta hordea Gould. Proc. Bost. Soc. Nat. Hist., Vol. V, 1855, p. 229; Reeve, Conchologia Iconica, Vol. XVII, *Anodon* Pl. XVIII, Fig. 66, as *Anodon hordeum* Gould. Lea says this is Say's *Anodonta imbecillis;* it must be confessed that Reeve's figure bears no resemblance to it as it is generally understood on this side of the Atlantic.

There is no *Anodonta* in American waters so easily determined as this one, and so little likely to be confounded with any other species. It is commonly of a bright green color, and is of very thin texture, resembling nothing else in our waters. In Arkansas it has been found only in the St. Francis river, at Wittsburg, but doubtless occurs elsewhere. We have it from various localities in Louisiana and Texas, whence it ranges to western New York and Canada.

ANODONTA OPACA Lea.

Trans. Am. Philos. Soc., 2d series, Vol. X, p. 285, Pl. XXV, Fig. 46. Described from near New Orleans, and from near Little Rock, Arkansas.

This is a member of the *grandis* group and it is not sure but that it should have been placed under the synonymy of that species. It has not been seen by us in any collection from Arkansas, and is admitted to this list on the strength of the original description, which credits it to this State.

There have been listed in the foregoing pages fifty-nine species of *Unionidæ*, illustrating the three common North American genera. Had there been recognized the great number of synonymous forms, with which mere collectors seek to enrich their cabinets, the list might have been greatly extended. At present we know, from Arkansas, 52 species of *Unio*, 3 species of *Margaritana*, and 4 species of *Anodonta*.

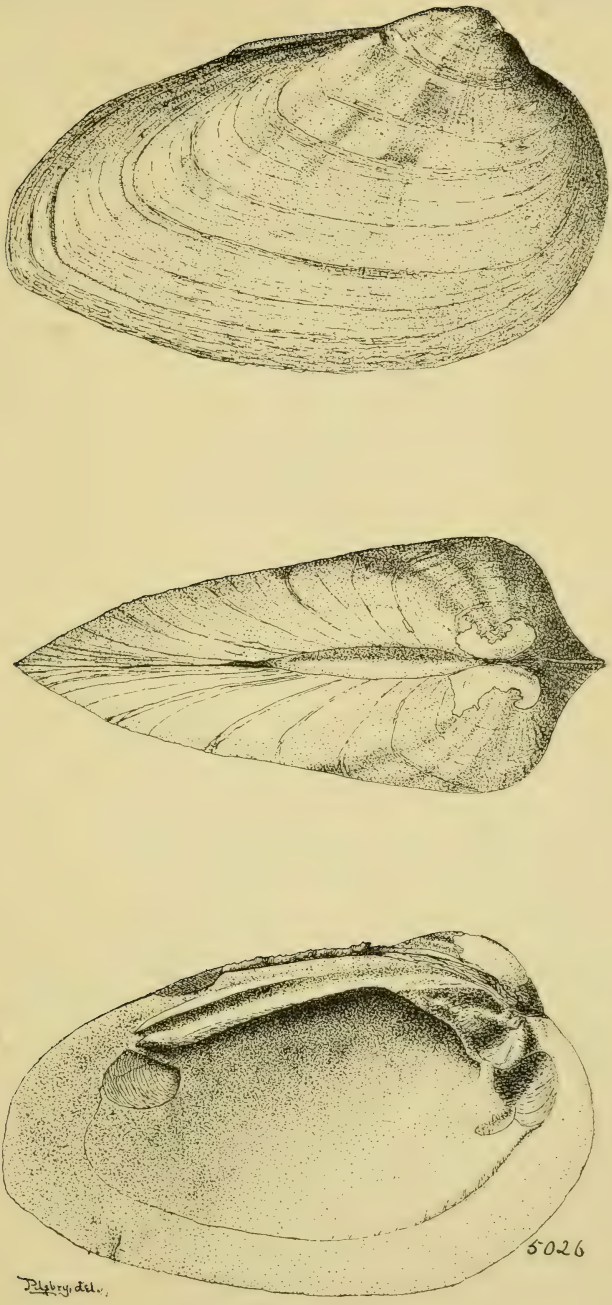
The *Unionidæ* abound in the streams of Arkansas; varieties or species may be relatively few, but individuals are very abundant. They are to be sought in every conceivable condition of bottom, and other factors of environment. Often certain forms affect stated or well-known sorts of stations in cold and clear, or warm and muddy waters; others will be found on gravelly or sandy bars, ordee ply buried in mud, close to the river's margin. Careful search rarely fails to reveal some form of interest.

LOUISVILLE, KENTUCKY, Nov. 16, 1893.

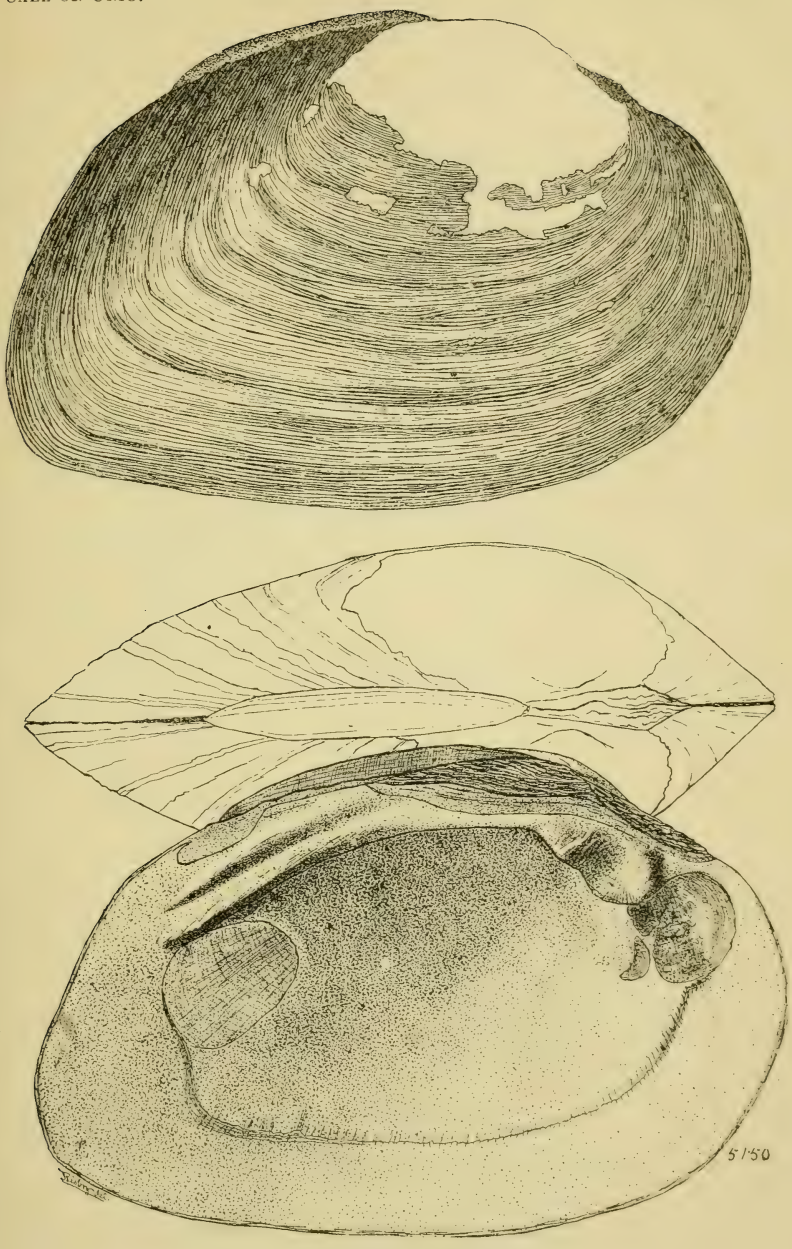
Issued January 3d, 1895.

LIST OF PLATES.

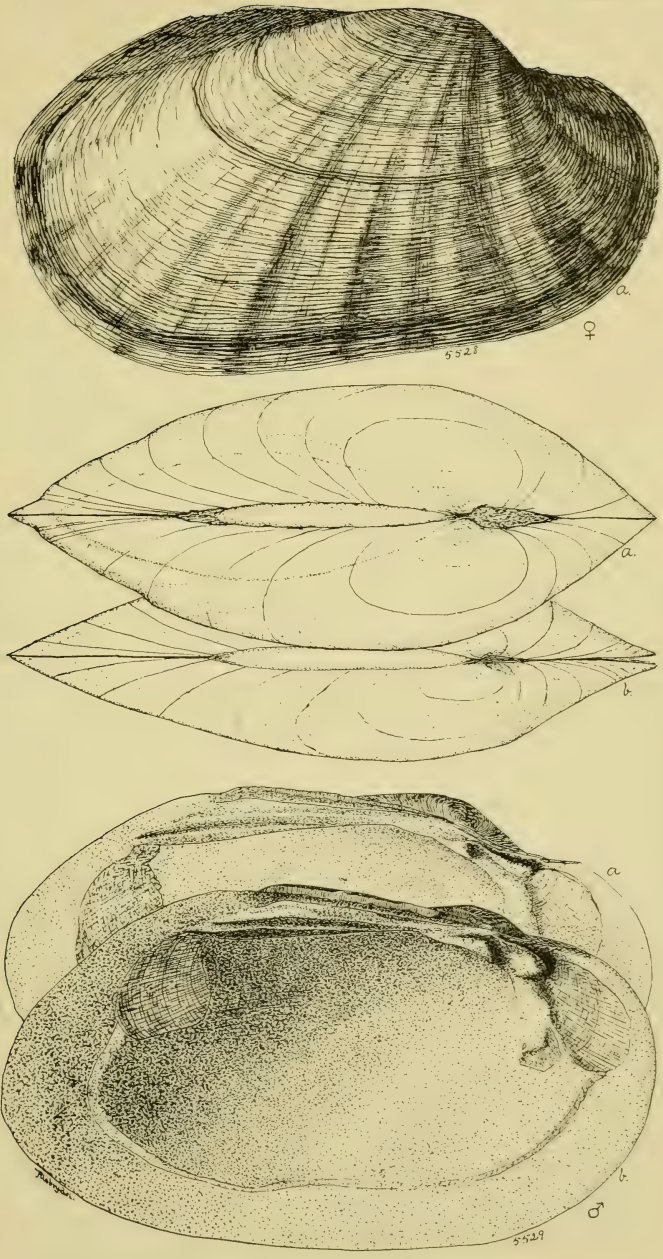
PLATE I. Unio clavus Lamarck.
II. Unio crassidens Lamarck.
III. Unio luteolus Lamarck.
IV. Unio obliquus Lamarck.
V. Unio purpuratus Lamarck. Male and female
VI. Unio purpuratus Lamarck. Female.
VII. Unio rectus Lamarck.
VIII. Unio retusus Lamarck.
IX. Unio rotundatus Lamarck.
X. Unio metanevrus Rafinesque.
XI. Unio cylindricus Say.
XII. Unio schoolcraftii Lea.
XIII. Unio schoolcraftii Lea. Varieties.
XIV. Unio schoolcraftii Lea. Figures 1–4.
Unio pustulosus Lea. Figures 5–6.
XV. Unio dorfeuillianus Lea. Figures 1–2.
Unio refulgens Lea. Figures 3–4.
XVI. Margaritana complanata Barnes.
XVII. Unio breviculus Call. From U. S. Nat. Museum.
XVIII. Unio ozarkensis Call. From U. S. Nat. Museum
XIX. Unio sayii Ward. Figures 1–2.
Unio sayanus Conrad. Figures 3–5.
XX. Unio excultus Conrad. Figures 1–3.
Unio tetralasmus Say. Figures 4–5.
XXI. Unio ligamentinus Lamarck.



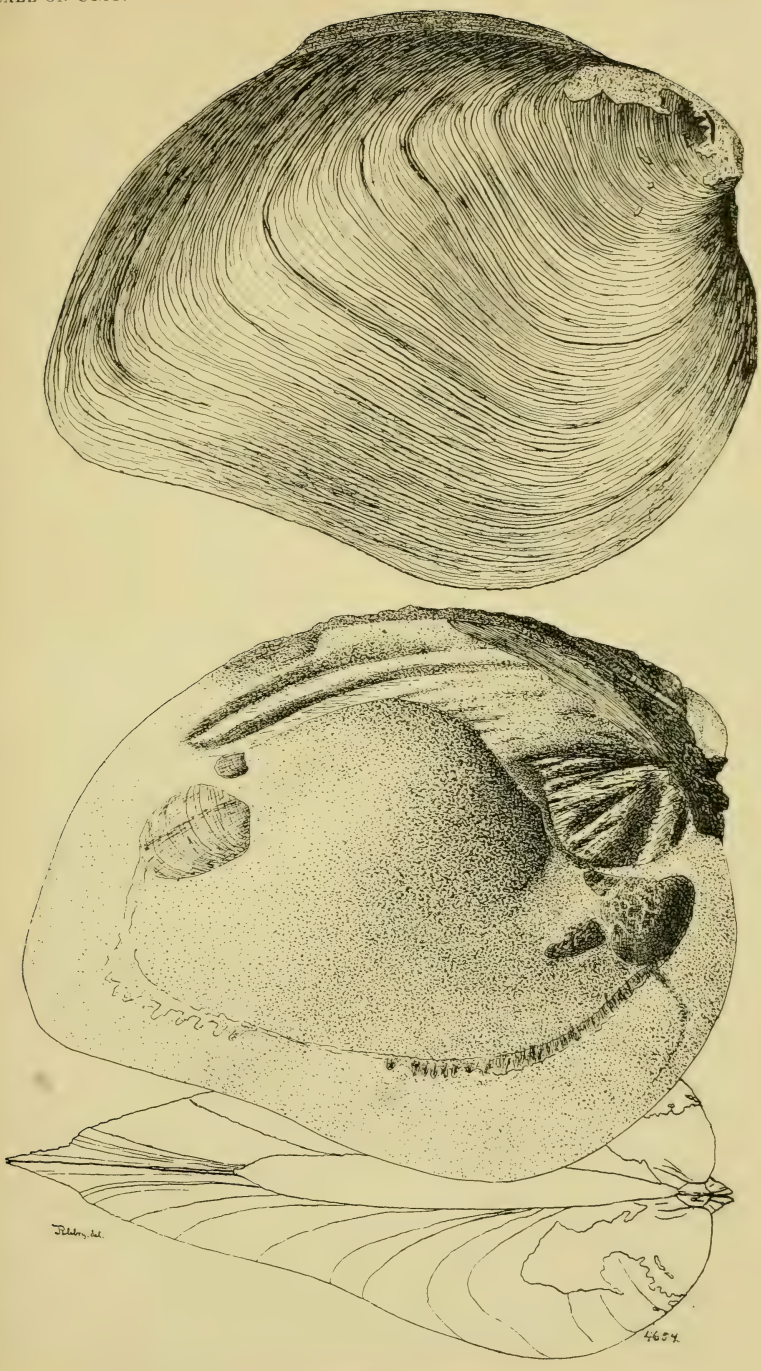
Unio clavus Lamarck.



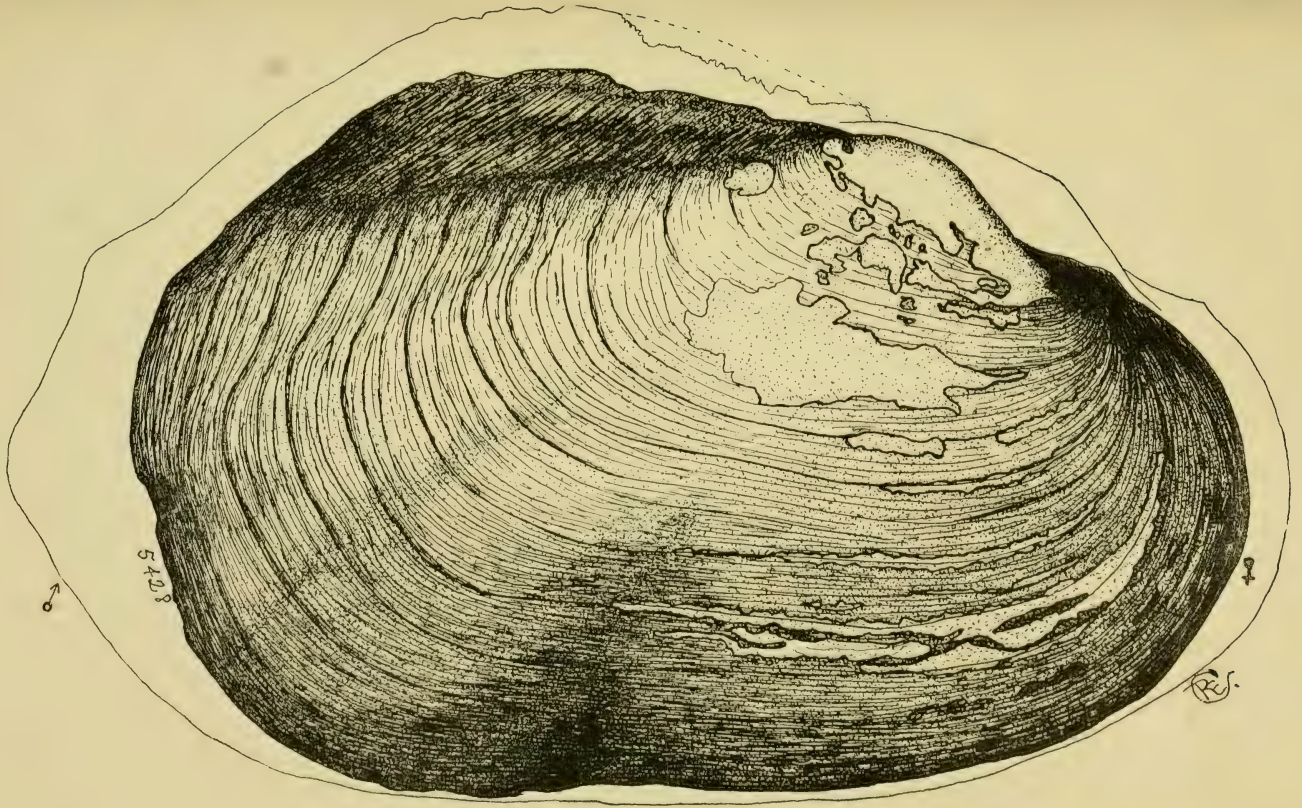
Unio crassidens. Lamarck.



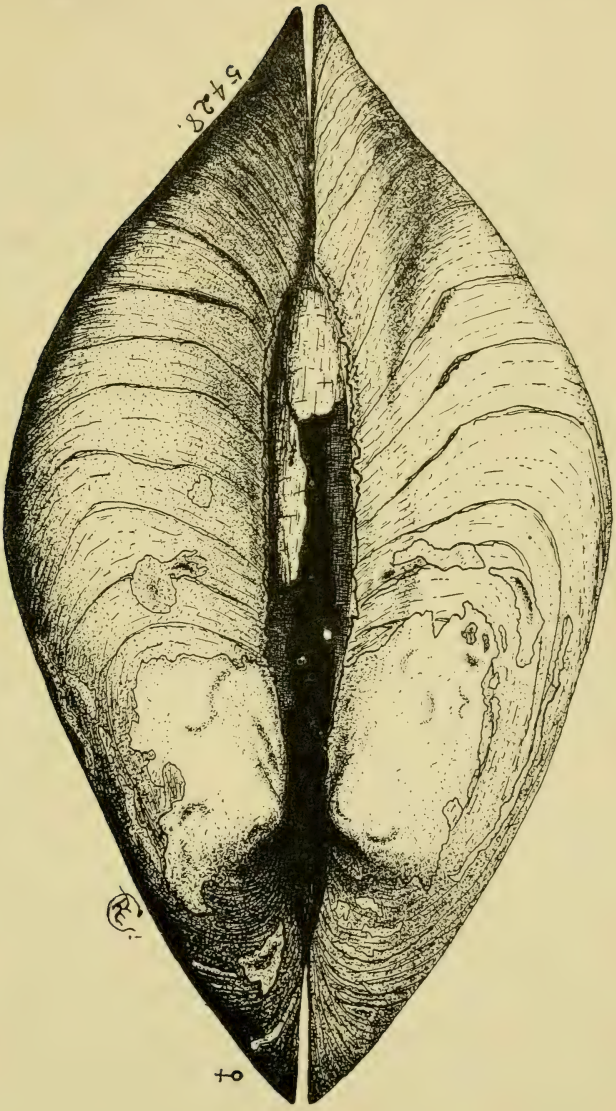
Unio luteo'us Lamarck.



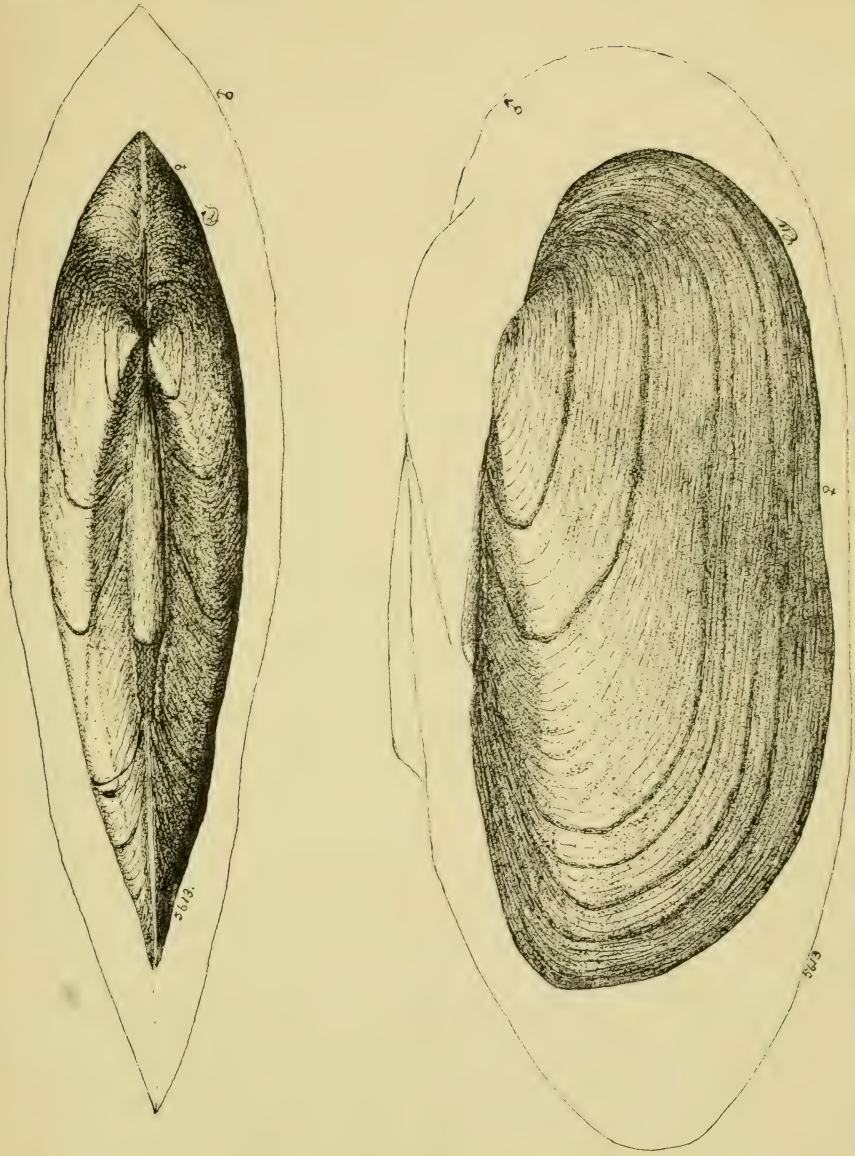
Unio obliquus Lamarck.



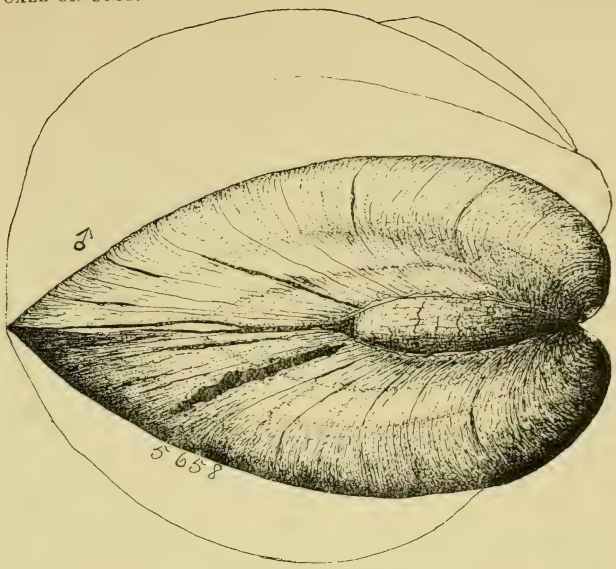
Unio purpuratus Lamarck.

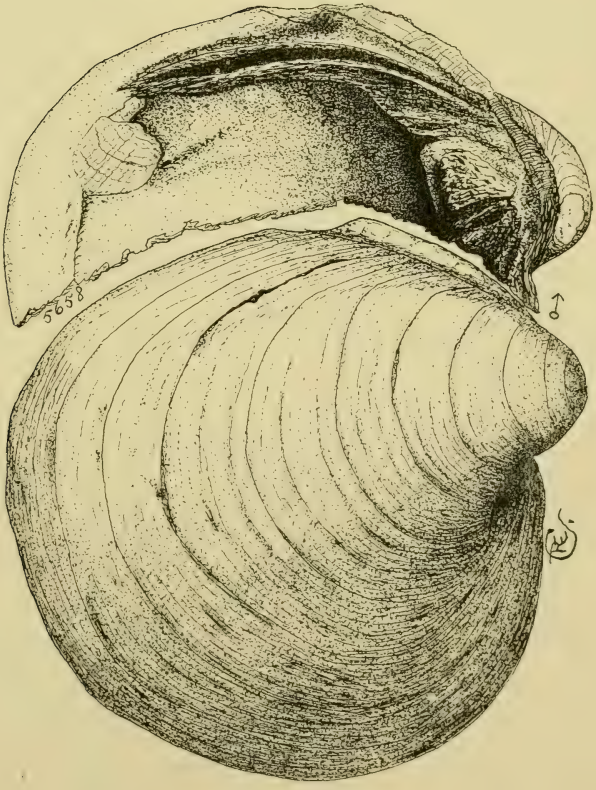


Unio purpuratus Lamarck.

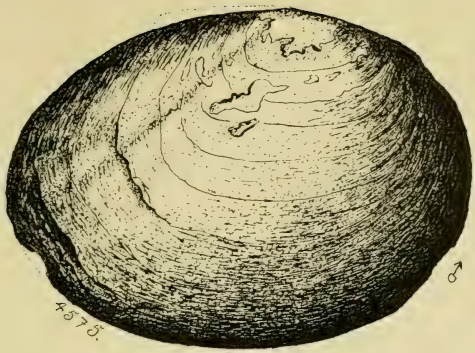


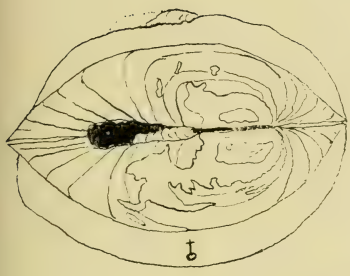
Unio rectus Lamarck.

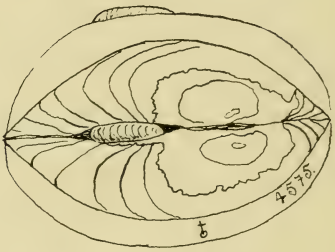


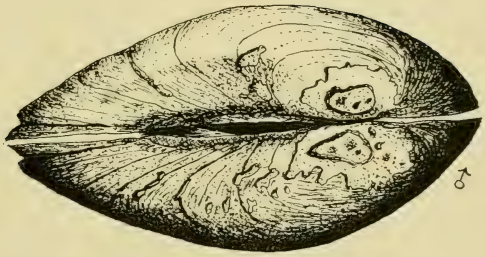


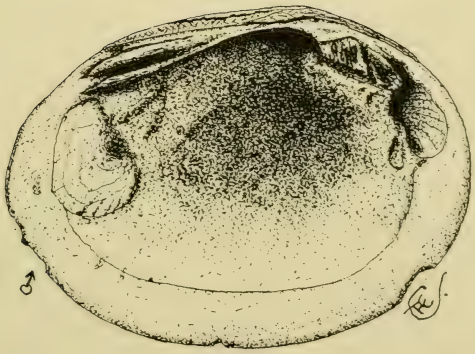
Unio retusus Lamarck.



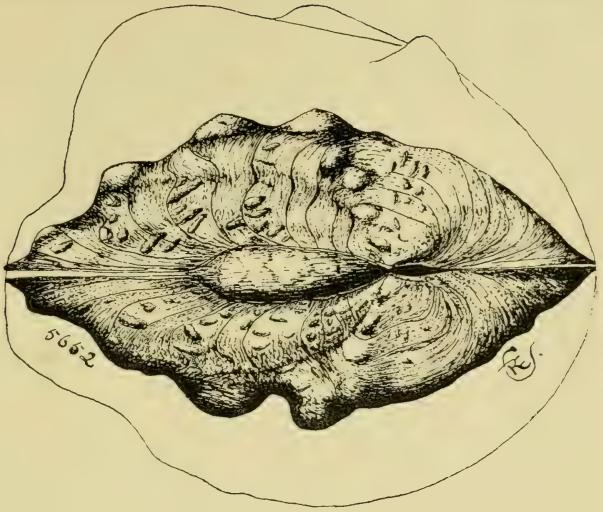


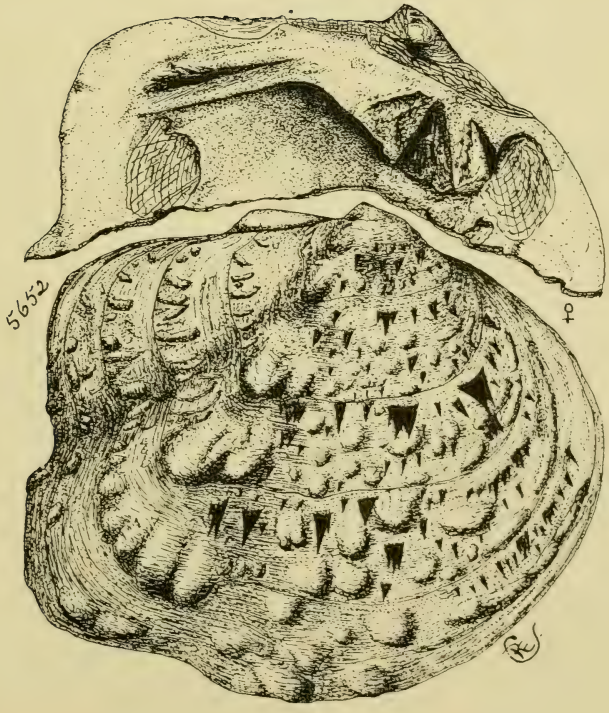




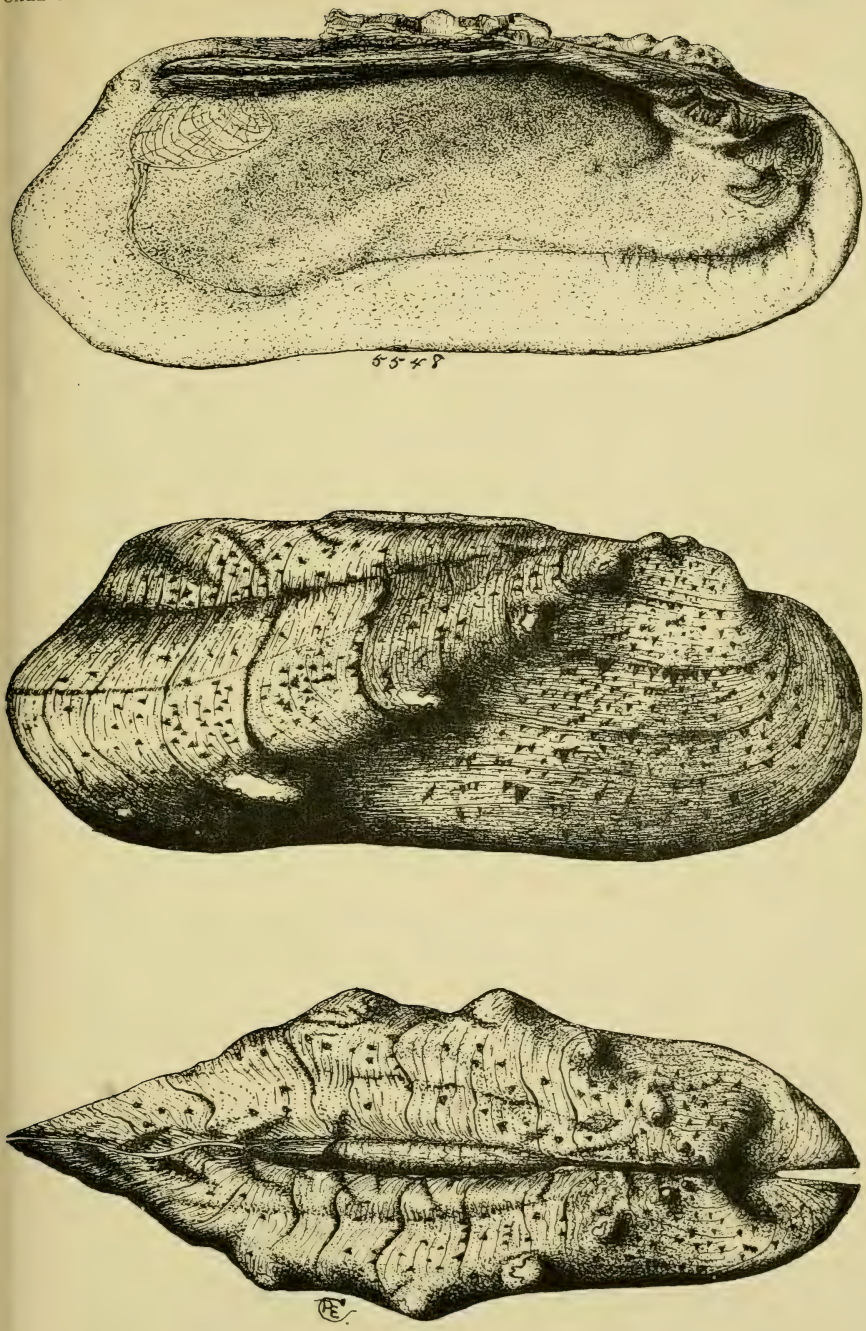


Unio rotundatus Lamarck.





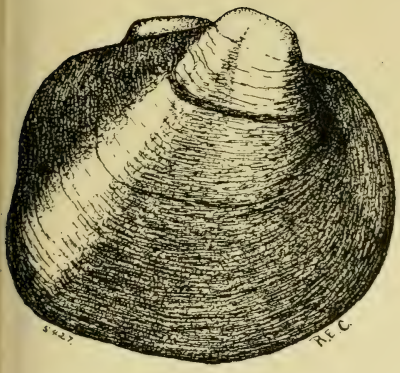
Unio metanevrus Rafinesque.

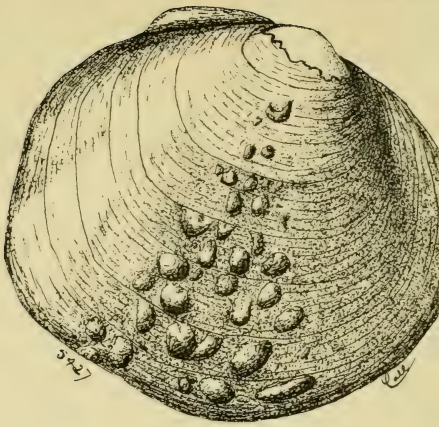


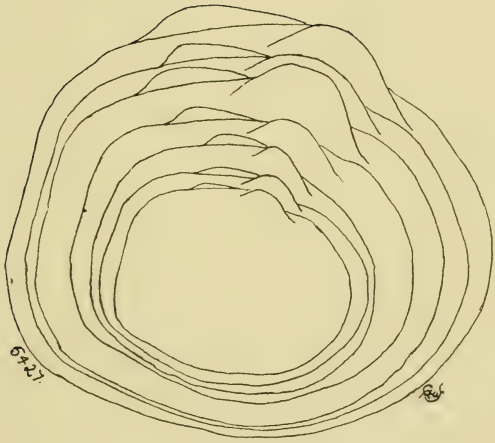
Unio cylindricus Say.

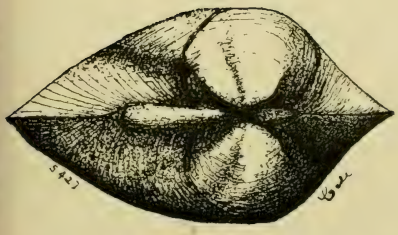
Unio schoolcraftii Lea.

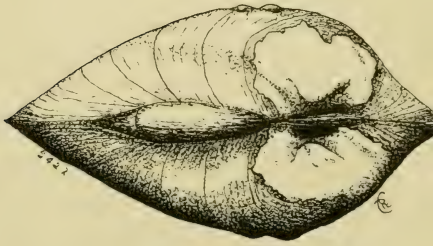
(REDUCED.)





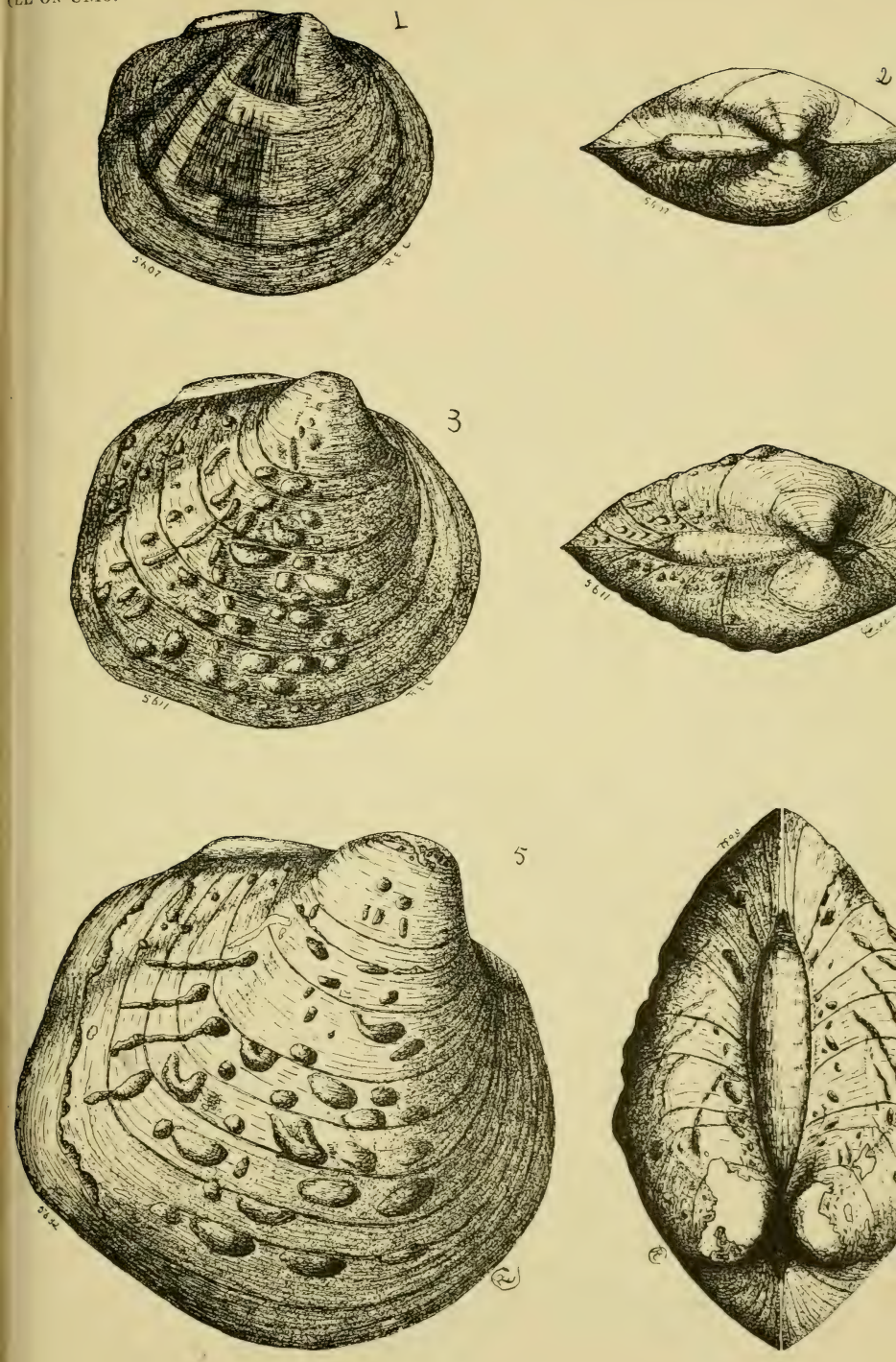




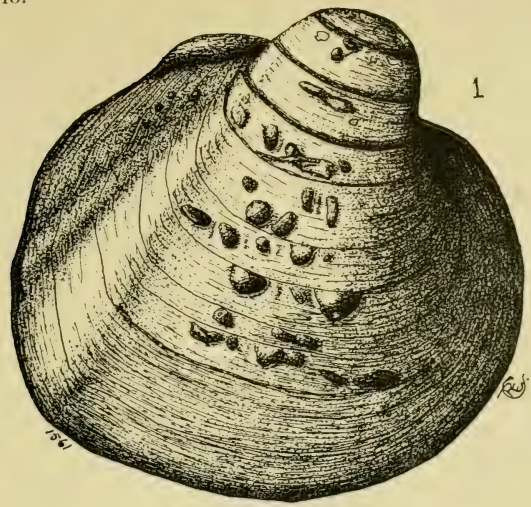


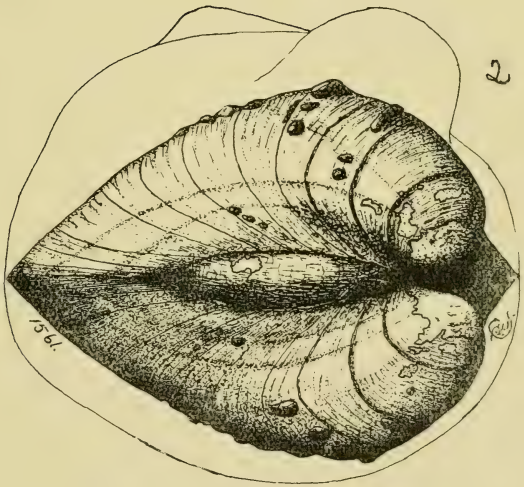
Unio schoolcraftii Lea.

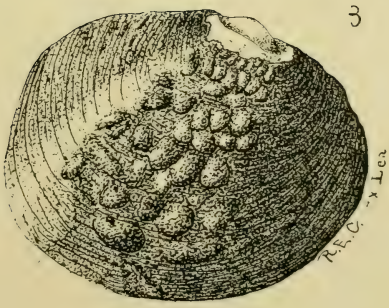
(VARIETIES.)

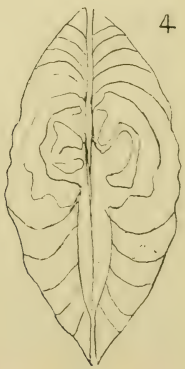


Figs. 1–4. Unio schoolcraftii Lea.
Figs. 5–6. Unio pustulosus, Lea.



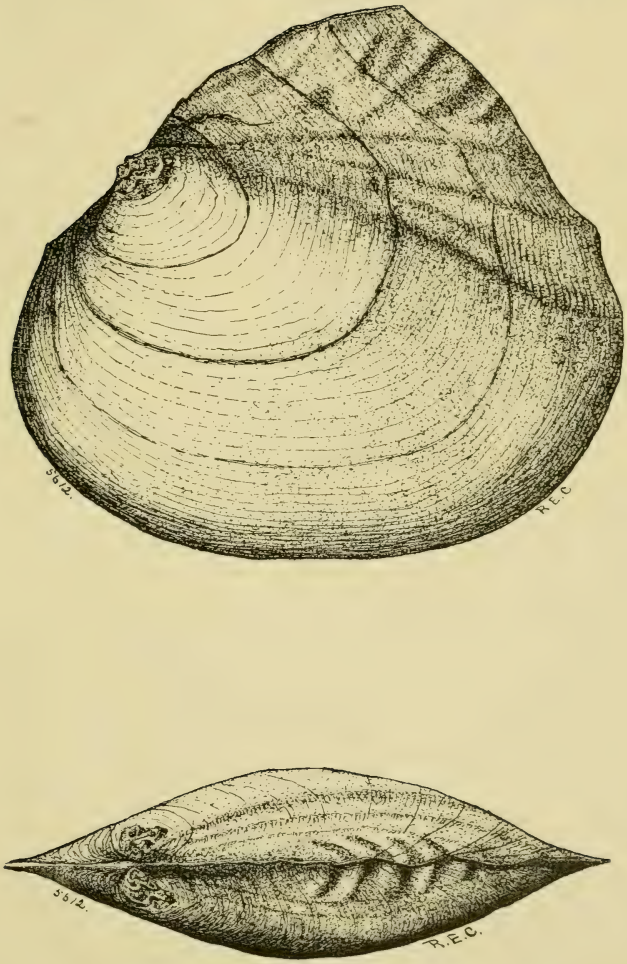




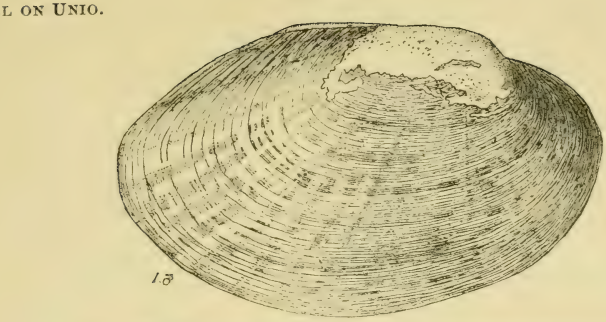


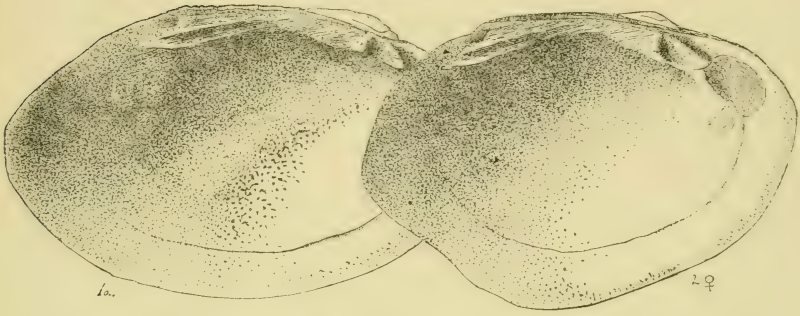
Figs. 1–2. Unio dorfeuillianus Lea.
Figs. 3–4. Unio refulgens Lea.

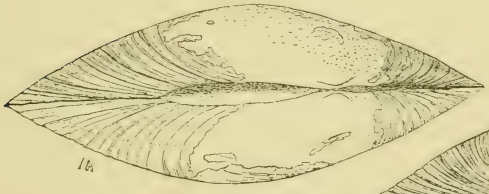
CALL ON UNIO. PLATE XVI.

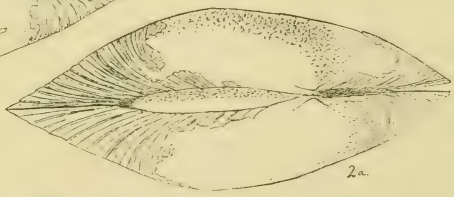


Margaritana complanata, Barnes.



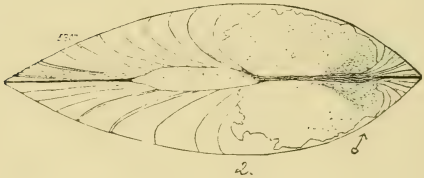






Unio breviculus Call.

1.



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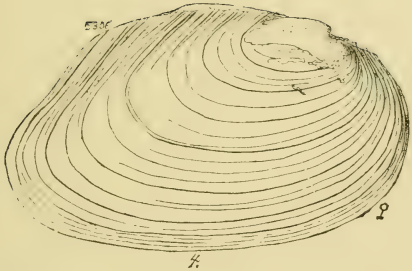

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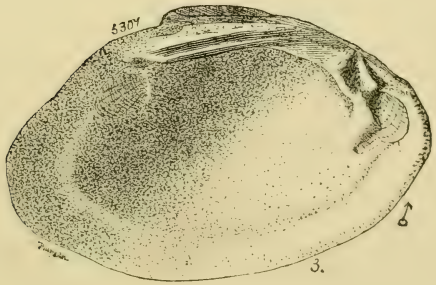
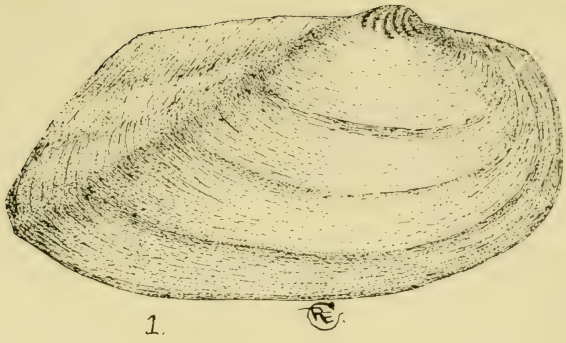


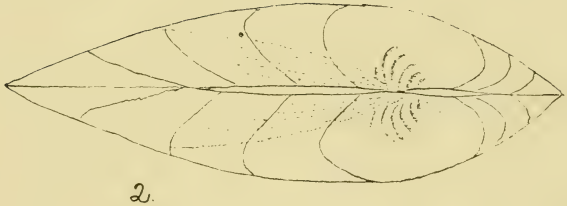
3.

Unio ozarkensis Call.

CALL ON UNIO. PLATE XIX.



1.



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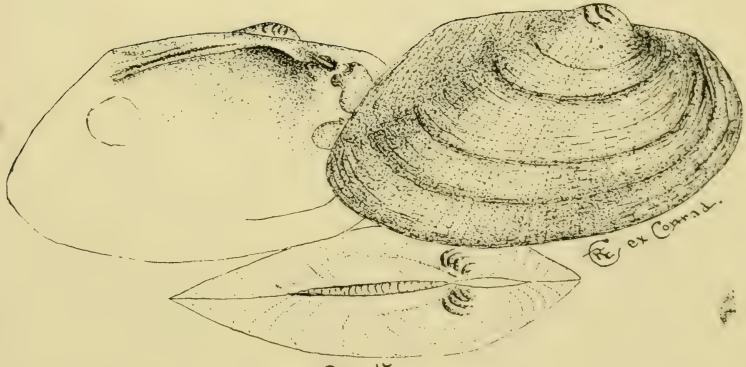
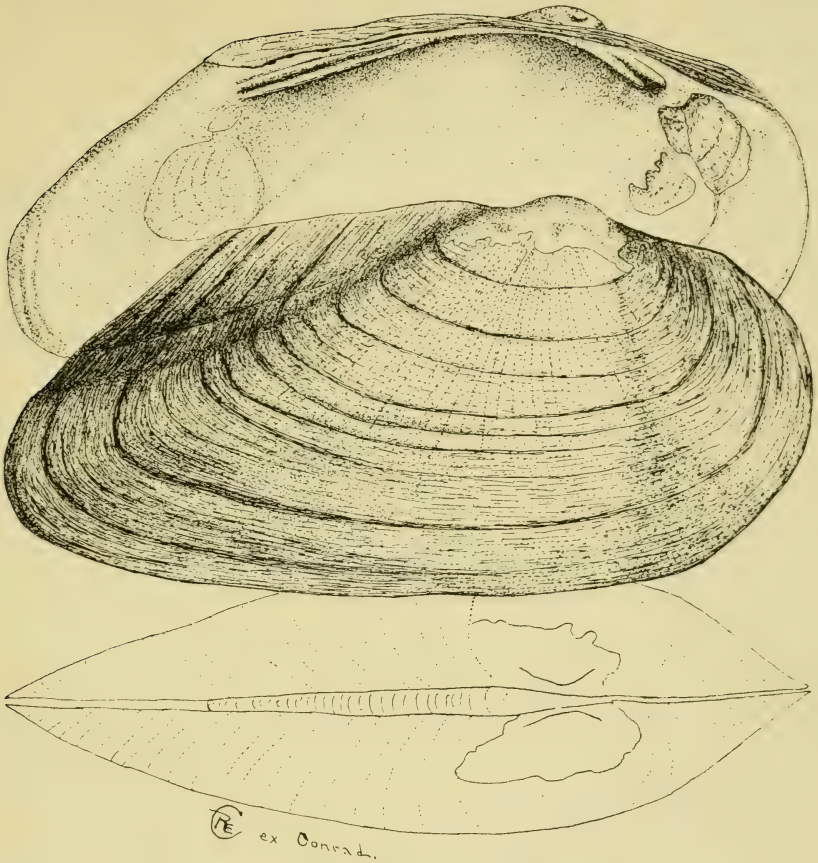
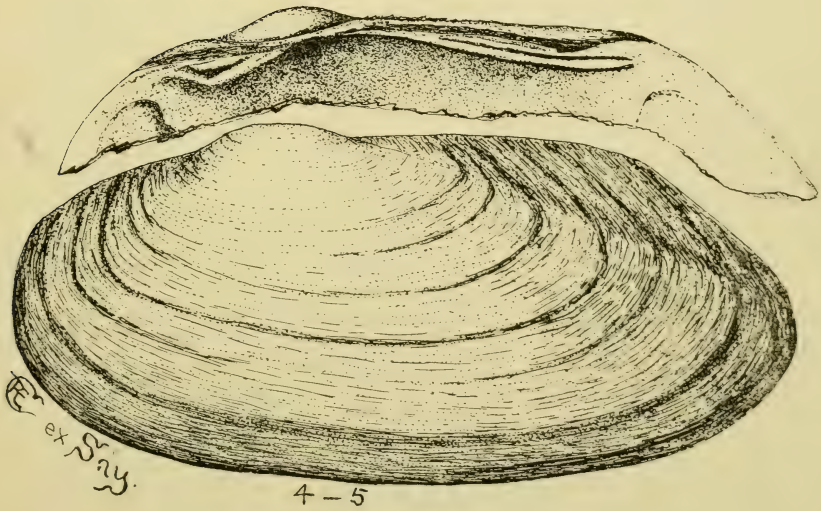


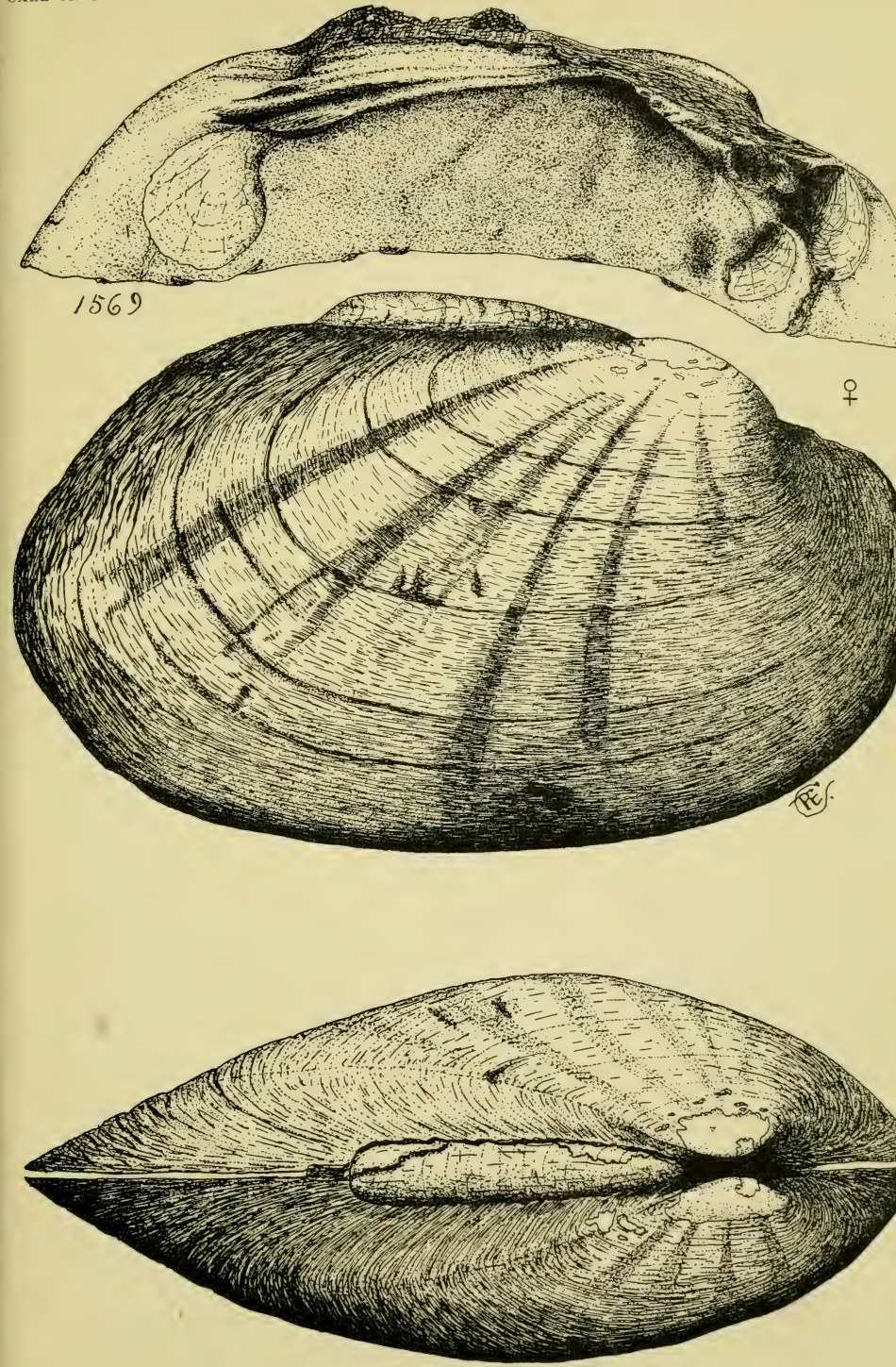
3–5.

Figs. 1–2. Unio sayii Ward.
Figs. 3–5. Unio sayanus Conrad.





Figs. 1–3. Unio excultus Conrad.
Figs. 4–5. Unio tetralasmus Say.



Unio ligamentinus Lamarck.

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By

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