

UNIVERSITY OF MICHIGAN  
MUSEUM OF ZOOLOGY

**Miscellaneous Publications No. 12**

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# The Genus *Gyrotoma*

BY

CALVIN GOODRICH

Published in Co-operation with the Geological Survey of Alabama

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ANN ARBOR, MICHIGAN  
PUBLISHED BY THE UNIVERSITY  
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ALEXANDER G. RUTHVEN,  
Director of the Museum of Zoology,  
University of Michigan.

## THE GENUS GYROTOMA

By CALVIN GOODRICH

The genus *Gyrotoma* has received no systematic treatment in fifty years. Since 1873, when Tryon's monograph was published, three collectors, T. H. Aldrich, A. A. Hinkley and H. H. Smith have taken many hundred times more specimens than were available for study by the naturalists who described the species. For the present inquiry I have examined material from several sources. The collection made by Mr. Smith and now in the Alabama Museum of Natural History is unrivaled, and, because of the water-power development in the Coosa River, flooding the shoals in which *Gyrotomae* live, it can probably never be duplicated. Acknowledgments are due to the Alabama Museum, the U. S. National Museum, Dr. Bryant Walker and Miss Mina Winslow. Without their aid this work could not even have been attempted.

### THE RECORD

Dr. Isaac Lea was the first descriptive naturalist to receive specimens of *Gyrotoma*. These he described as *Melania excisa* and *Anculosa incisa*, suggesting at the same time the generic term *Schizostoma*. When later he found the name already in use for a fossil he changed it to *Schizochilus*. In the meanwhile Shuttleworth had defined his genus. The fossil *Schizostoma* as well as the *Schizostoma* of Lea finally were forced into the synonymy. The good doctor, one of whose picturesque qualities was tenacity of purpose coupled with a certain fervid plausibility, sought to dig his original name out of its grave. The canons of nomenclature do not allow for cases of resurrection, and *Gyrotoma* has had to stand as the true generic designation.

Lea's specimens were sent to him by Dr. B. W. Budd. Because these shells were few in numbers, the condition of many of them that of drift material, their place of origin confused, and because Dr. Budd was himself interested in conchology and hardly likely to take ten or twenty shells where he might have gathered thousands, it is improbable that he was the collector. About the same period, *Gyrotomae* came to Mighels and apparently from the same correspondent. This was 1841, possibly 1842, to 1845. All the forms were of the Wetumpka aspect. In July, 1845, Shuttleworth described two species. His specimens had been collected by Rugel, who apparently visited the Coosa River at Greensport or thereabouts and may have gone as far down as Childersburg. It was not until 1904, when Mr. H. H. Smith began to explore the Coosa systematically, that Shuttleworth's one "good" species was found by an American collector. This history is an illustration of the casual, one might say accidental, collecting of early-day zoology in America.

About fifteen years after Dr. Budd's sendings, Gyrotomae, from the reaches between the Yellowleaf Creek of Shelby County and Fort William Shoals, Talladega County, were taken by Dr. Schowalter of Uniontown, Alabama. It would seem that Dr. William Spillman of Columbus, Mississippi, visited the Coosa River in the same places and at about the same time, and it is possibly fair to infer that the two were together. Lea and Anthony erected eighteen species from this new material and Reeve described still others under names supplied by Anthony.

Reeve's monograph of Melatoma appeared in 1860-61. Swainson had established Melatoma as a subgenus of Melanopsis Lam. Reeve believed it to be the same as Gyrotoma. Tryon says that Melatoma "is actually an exotic marine shell." The connection of Anthony's name with Melatoma was an error. Reeve's illustrations are excellent and in most instances the species can be recognized from these pictures. But the descriptions, written by Reeve, convey little information of value. In two of the descriptions no mention is made of the fissure, the distinctive character of Gyrotoma. In the case of one species the slit is described as "small, almost obsolete"; in one as "slightly channelled"; in two, "moderate"; in two, "broad"; in ten, "deep"; in two, "rather deep"; in one, "very deep." The reader of Reeve is reminded of the childhood question, "How deep is a well and how long is a string?"

The Anthony types described in this monograph are in the Museum of Comparative Zoology at Cambridge, Massachusetts. Reeve's own types are in the British Museum and these were examined by Dr. Bryant Walker and compared with material taken by Mr. Smith.

In 1862 Brot issued a "Catalogue Systematique des Especies qui Composent la Famille des Melaniens." He spoke about the genus Gyrotoma being little known in Europe and of the sparse distribution of examples among the collections. He indicated a suspicion that these shells might be variations or mutations of "certain species of the group of *M. Haysiana*, which live in the same locality." A very just criticism was made of authors who pictured their species in the conventional manner and failed thereby to show the "characteristic notch." Lacking a sufficient number of specimens and illustrations more decisive Brot declined to pass upon the validity of the genus. It is this catalogue I have mentioned later in the text as the Brot list.

In 1869, Dr. James Lewis (4) made a list of the Gyrotomae as part of a catalogue of mollusks of the Coosa River. Tryon's (10) study of the genus appeared in 1873. For half a century it has been a guide for the collector of Pleuroceridae. It erred in the synonymy. The classification was artificial. Too many species were recognized as valid. But when it is remembered that thirteen species of Gyrotoma had been erected from just thirteen specimens and that comparatively few additional shells were available for Tryon's study, that Shuttleworth's species were unknown in this country and Mighels' types had been destroyed by fire, any sharp criticism of Tryon's work with the genus would be unfair.

The next writing upon the subject was by Mr. A. A. Hinkley, whose paper (2) appeared in 1904. He had collected the year before in the

Coosa at Fort William Shoals, Wilsonville and Wetumpka. He distributed a great number of specimens, many of which I have had the opportunity to examine.

Hannibal (2, p. 179) recognized *Gyrotoma* as a genus and set down *Goniobasis* as a subgenus. Under the name *Gyrotoma olivula excisa* (Lea) he threw together all the forms that are mentioned in Tryon as being deep-fissured, eighteen species in all. Twenty-two, described as having short or shallow fissures, suffered telescoping under the designation *Gyrotoma laeta incisa* (Lea). Mr. Hannibal was bold, but not without a few misgivings. Preparatory to a prodigious scrambling of the Pleuroceridae he wrote, "It is not anticipated that this treatment will meet with general approval in every instance."

The Alabama Museum collection of *Gyrotomae* is, of course, unparalleled. It contains thousands of specimens carefully labelled and so painstakingly cleaned that color and sculpture can be made out quickly and with certainty. Notes by Mr. Smith upon his labels and observations he made in his correspondence with Dr. Walker have been invaluable in this study.

#### THE ENVIRONMENT

The genus is confined to the Coosa River. It has not been found even within the mouths of creeks flowing into the river. The nature of the habitat supplies the explanation. Mr. Smith repeatedly wrote of *Gyrotomae* as living in rapid heavy currents. Speaking of the genus at Wetumpka he said that it was "almost confined to swift water, and those specimens in pools do not look healthy and are apt to be deformed." A permanent habitat of this kind is rarer among Pleuroceridae than is generally supposed. *Io* and *Anculosa* do occupy the swifter parts of rivers, the old as well as the young, but most species of Pleurocera are to be found in quiet water. *Pleurocera uncialis* (Hald.), a characteristic east Tennessee species, is in the main part of streams only while partly grown. The adults seek the pools and banks. I have noticed the same thing of *Goniobasis livescens* (Menke) in Ohio, Michigan and Indiana. Colonies of *livescens* are found upon wave-beaten rocks in Lake Erie, but far larger colonies inhabit places much more protected. The ordinary bulbous form of *livescens* lives plentifully in rapids of the upper Wabash River. A depauperate form of the species was collected by Hinkley under stones in the lower part of the river. Such a site, corresponding to that in which *Gyrotoma* flourishes, was an unhealthy one for a species probably the most adaptive of all *Goniobases*.

#### DISTRIBUTION

*Gyrotoma* first appears in the Coosa at Lock 2, St. Clair County. The only species there and about as far down as the mouth of Yellowleaf Creek of Shelby County is *pyramidatum*. In the short distance between this point and the foot of Peckerwood Shoals, Talladega County, occur five species which are confined to these reaches, namely, *amplum*, *cariniferum*, *spillmanii*, *lewisii* and *hendersoni*. The second and the last of these five are known from Fort William Shoals only. *Alabamensis* is first met with sparingly

on Peckerwood Shoals and disappears below Duncan's Riffle, Chilton County. *Walkerii* has a somewhat shorter range, Weduska Shoals, Shelby County, to Butting Ram Shoals, Coosa County. Five species occur at Wetumpka. Their up-river range from this point is: *Excisum*, to Three-Island Shoals, Talladega County; *laciniatum*, to Fort William Shoals; *incisum* and *pumilum* to Weduska Shoals; *pagoda*, to The Bar, Chilton County.

The localities for *Gyrotoma* mentioned in this paper are here set down in their order, up-stream to down-stream, the county designations being given as upon Mr. Smith's labels, though the river in most of these places is the border between counties:

Lock 2, St. Clair County.  
 Ten-Island Shoals, St. Clair County.  
 Lock 4, St. Clair County.  
 Riverside, St. Clair County.  
 Truss Shoals, St. Clair County.  
 Clarence Shoals, St. Clair County.  
 Hall's Island, Talladega County.  
 Yellowleaf Creek (upper), Shelby County.  
 Three-Island Shoals, Talladega County.  
 Fort William Shoals, Talladega County.  
 Peckerwood Shoals, Talladega County.  
 Weduska Shoals, Shelby County.  
 Cedar Island, Chilton County.  
 Adam's Ferry, Chilton County.  
 Yellowleaf Creek (lower), Chilton County.  
 Butting Ram Shoals, Coosa County.  
 Higgin's Ferry, Chilton County.  
 Wetumpka, Elmore County.

#### RELATIONSHIPS AND GENERAL CHARACTERS

The affinities of *Gyrotoma* are with certain *Goniobases* which should be separated from that genus. These mollusks are characterized by large shells and large opercula. They have the same wide aperture of *Gyrotoma* and the same microscopic sculpture. The group has not been carefully studied, but these species unquestionably belong to it: *Goniobasis impressa* Lea, *laeta* Jay, *showalterii* Lea (1860), *lewisii* Lea, *bellula* Lea and *ovalis* Lea. Probably others are *gratiosa* Lea and *lachryma* Anthony, which Tryon (10, pp. 342, 343) assigned to *Eurycaelon*. Occasionally all these species develop incipient fissures. Mr. Smith collected several specimens with fissures nearly as large as in *pyramidatum* and *incisum* and yet, in other regards, retaining their usual *Goniobasic* features. Every one has a deposit of callus at the top of the columella. This is found in typical *Gyrotoma*. One specimen of *Goniobasis showalterii*, in addition to having a very small fissure, has a girdle for about 5 mm. upon the body whorl.

After a little study it becomes apparent that *Gyrotoma* is not a compact genus whose members can be traced with certainty to a common origin. It differentiates into five natural groups. *Pyramidatum* and *spillmanii* form one of these groups. A second consists of *pagoda*, *pumilum*, *alabamensis* and *cariniferum*. These two groups would appear to have developed from *Goniobasis laeta* or some other species very like it. *Lewisii* and *hender-*



*soni* constitute a third group whose relations with *Goniobasis impressa* are quite plain. *Incisum*, *walkeri* and *amplum*, though not always easily to be distinguished from one another, manifestly differ from the other species of *Gyrotoma*. The fifth group is made up of *excisum* and *laciniatum*. Their well-fixed characters and their long range in the river justify the belief that they are the oldest species of the genus. I have been unable to find in *Goniobasis* any species definitely ancestral to the *excisum* and *incisum* groups.

The specific value of some of the races of *Gyrotoma*, I recognize, is open to question. It requires considerable familiarity with them, and perhaps the habit of mind which goes with studying a family of extreme complexity, to be altogether confident as to the identifications of certain forms, *incisum* and *amplum* for example. Characters overlap. Characters sometimes prominent in one locality fade nearly to invisibility in another. It might possibly be doubted whether variations in the depth of the fissure, being largely a matter of size, warrant recognition beyond subspecific rank.

But difficulties arise in attempting a wholesale lumping of the *Gyrotomae*. One would have to ignore distinct differences in many of the young and these differences point to ancestral distinctions. The derivation of one group is clearly not the derivation of two other groups. A fourth and a fifth group cannot be traced to any known form. Lumping would consolidate forms independently developed, adding confusion instead of achieving simplicity.

A possibly important question in connection with *Gyrotoma* is whether it is a genus in course of developing or disappearing. J. C. Willis (11, p. 166) recites three explanations for endemism which he chooses to consider rivals: "(1) That endemics are very specialized species (and genera) suited only to the areas upon which they have been found; (2) that they are old species (and genera) which have been driven into quiet nooks or left in odd corners by the competition of better adapted species; and (3) \* \* \* that in general they are young beginners, descended from the 'wides'." Willis' argument is largely devoted to the advocacy of the third explanation as the one for the majority of cases. I see no reason why all three hypotheses may not apply with almost equal force. The *Vitrinizonites* of the southern Appalachians may be examples of highly specialized forms narrowly confined to particular localities. An illustration of one form of a relict race is given by Ortmann (7, p. 3-6). *Margaritana margaritifera* (L.) occurs in the headwaters of the Schuylkill River, and in no other place in Pennsylvania. The shells are confined to cold trout streams and in the parts of these that are 800 to 1200 feet above sea level. "The Pennsylvanian area of this species is not only the most southern extension of its range in eastern North America, but it also has the peculiarity of being the only one to the south of the Terminal Moraine. Thus it may be regarded as a part of the Glacial Preserve (refugium) of this species." The great numbers in which *Gyrotomae* occur in the Coosa River, their variability which is so characteristic of a genus that has not yet become "fixed" and their failure, for all their numbers and apparent vigor, to get beyond a restricted habitat, convince me that they represent "young beginners descended from the 'wides'."

The observations of skilled zoologists with a great deal of field experience have been warnings against giving hastily the emphasis of specific names to the thirteen species herein recognized. Ortmann (6, p. 512) says, "Isolation is, in my opinion, a necessary factor in the differentiation of species and I do not think that a case ever will be discovered where two closely allied species possess precisely the same distribution." Jordan's law (3, p. 547) lays it down that, "Given any species in any region the nearest related species is not likely to be found in the same region nor in a remote region, but in a neighboring district separated from the first by a barrier of some sort." More briefly Ruthven (9, p. 192) declares that "directly related forms on any line of descent occupy neighboring environments."

Several of the closely allied species of *Gyrotoma* do appear to have exactly the same distribution to all intents and purposes. Unfortunately I have not all the details of Mr. Smith's collecting experiences. But the impression is obtained from his letters and from the notes accompanying the labels that a given reef of a series of shoals is not occupied by a heterogeneous assemblage of mollusks, but by some particular form of the genus, each such colony being cut off from other colonies of the genus by deep water, quiet water, rolling gravel, by mud or by rocks that in dry seasons are exposed to the air. Thus within a small area, too small to be especially observed by the collector not upon the lookout for it, there may be a distinct differentiation of locality, small barriers with as powerful an influence upon *Gyrotomae* as barriers quite plain to the eye—all the effects of isolation.

#### THE OPERCULA

The opercula of all *Gyrotomae* are large, leathery, dark red to dark brown. The growth lines are crowded. The surface in instances is more or less marked with microscopic wrinkles which tend to form irregular lines or bands at right angles to the growth lines. The nucleus is indented. Opercula wear down quickly and become irregular in shape so that in the cases of adults the shape is frequently quite different from that in the young. In old specimens the nucleus or area of the inner whorls is often completely eroded away.

In this study the opercula were first examined in connection with the shells. Later they were more carefully re-examined and compared with one another, species by species. There are recognizable differences, but I cannot feel that they are of great importance. The opercula of *pyramidatum*, *spillmanii*, *lewisii* and *hendersoni* are quite broad and with the inner whorls well within the operculum. *Pagoda* has a narrower, darker operculum, the apex more blunt. In *pumilum*, *alabamensis* and *cariniferum* the opercula are mostly of the *pagoda* form, but have become slightly broader and noticeably larger. The opercula of *excisum* and *laciniatum* are practically identical, being smaller than in *pyramidatum*, darker, thinner and broader than in *pagoda*. The inner whorls are tightly coiled rather than loosely. The opercula of *incisum* are thin, ragged, variable in shape. In *walkeri* and *amplum* the opercula are much the same as those of *incisum*, but in *amplum*

they appear to run decidedly larger and this is not to be explained by the size of the aperture. The nucleus of all except *pyramidatum* is quite close to the left margin and near the base.

A few opercula have been illustrated, but without any intention of accentuating differences. Many of the differences are possibly due to variations in the erosion to which this feature is subjected in strong currents. The opercula of quite young Gyrotomae are very nearly uniform.

#### GENUS GYROTOMA SHUTTLEWORTH

*Schizostoma* Lea, (non Bronn, 1835), Proc. Amer. Phil. Soc., II, 1843, p. 242; Trans. Amer. Phil. Soc., IX, 1844, p. 26; X, 1848, pp. 67, 93; I, n. s., 1852, p. 295; Proc. Acad. Nat. Sci., Phila., XII, 1860, p. 186; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, pp. 218, 243, 245, 246; VI, 1866, p. 152; Obs. Gen. Unio, IV, 1848, pp. 26, 67, 93; V, 1852, p. 51; IX, 1863, pp. 40, 65, 67, 68; XI, 1867, p. 108; Tryon, Amer. Journ. Conchol., I, 1865, pp. 114-116, 131; II, 1866, p. 134; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, pp. xxiii-xxvii, xxxiii, xxxv, xxxix, xlvi, 351; Hinkley, Nautilus, XVIII, 1904, p. 40, 41.

*Gyrotoma* Shuttleworth, Mittheil. der Nat.-forsch. Gesellsch. in Bern., July 22, 1845, p. 88; H. & A. Adams, Genera, I, 1854, p. 305; Gray, Guide to Mollusca, I, 1857, p. 103; Chenu, Man. de Conchyl., I, 1859, p. 293; Anthony, Proc. Acad. Nat. Sci., Phila., XII, 1860, p. 53; Binney, Check List, 1860; Brot, List, 1862, p. 27; Tryon, Monog. Strepom., 1873, pp. xv, xviii, xxiii, xxiv-xxvii; Paetel, Cat., 1888, p. 361; Pilsbry, Proc. Acad. Nat. Sci., Phila., 1896, p. 497; Hannibal, Proc. Malacol. Soc., X, 1912, p. 179.

*Schizochilus* Lea, (non Gray, 1850), Trans. Amer. Phil. Soc., X, n. s., 1852, p. 295; Obs. Gen. Unio, V, 1852, p. 51; IX, 1863, p. 67; Proc. Acad. Nat. Sci., Phila., XII, 1860, p. 186; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 245; Tryon, Monog. Strepom., 1873, pp. xxiv, xxxiii.

Melatoma Anthony, Gray, Proc. Zool. Soc. of London, 1847, p. 153; Woodward, Manual, 1851, p. 131; Reeve, Conch. Icon., 1860.

Apella Mighels, MS., 1860.

"Shell turreted; columella incurved, thickened above by an intermarginal callus; aperture oval, somewhat spread out (effuse) at the base; lip simple, sharp, with a narrow fissure, deeply notched.

"Animal. ———; operculum corneous, spiral."—Shuttleworth.

#### GROUP OF *Gyrotoma pyramidatum*

Rather heavy, pyramidal especially in the young, sometimes nodose, smooth to striate; fissure shallow, oblique, not exceeding 8 mm. in depth; girdle not always conspicuous; aperture ovate; sinus not pronounced; bands usually four and of equal width.

#### *Gyrotoma pyramidatum* Shuttleworth

Pl. I, figs. 1, 2, and 3

*Gyrotoma pyramidata* Shuttleworth, Mittheilungen der Naturforschenden Gesellschaft in Bern, No. 50, July 22, 1845, p. 88; H. & A. Adams, Genera, I, 1858, p. 305; Binney, Check List, 1860, No. 329; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 361.

*Gyrotoma conica* Shutt. (?), Troschel, Gebiss der Schnecken, I, 1857, p. 111, pl. 8, fig. 12; Brot, List, 1862, p. 27; Tryon, Monog. Strepom., 1873, p. 380.

*Gyrotoma laeta incisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 182.

*Schizostoma pyramidatum* Shutt., Tryon, Monog. Strepom., 1873, pp. xv, 365; Lewis, Fauna of Ala., 1876, p. 23.

*Description:* Shell pyramidal, heavy, olivaceous or blackish, concentrically sulcate-costate, more often with rough knobs (nodules); banded with brown, apex eroded; whorls 5 or 6; fissure short, broad, columella thickened tuberculously above.

Length, .9; breadth of the ultimate whorl, .412-.5 of an inch. Length of aperture, .312; length of fissure, .1 of an inch.

Obs.—Somewhat resembles *Melania canaliculata*; varies as the preceding (*G. ovoidea*).

A few specimens . . . occur among others, with the upper whorls acutely carinated, ridges and furrows fewer and almost obliterated; epidermis paler and apex little eroded.—Shuttleworth.

This is the first *Gyrotoma* appearing in the river. Mr. Smith's highest station for it was Lock 2, which is at the head of Ten-Island Shoals, between St. Clair and Etowah counties. Shuttleworth in his preface states that Rugel collected in the Coosa River, near Wetumpka. But there is sound reason for believing that this is an error. The species was never taken by persons who collected from Wetumpka as far up the stream as Fort William Shoals. The nodulous character of the shells sent to Europe is a peculiarity almost entirely confined to Pleuroceridae upon and near Ten-Island Shoals. Not only are the *Gyrotomae* of this locality so marked and the so-called *Eurycaelon*, but also *Anculosae* and *Goniobases*. In a letter to Dr. Walker, Mr. Smith said that even certain *Pleurocerae* are likewise affected. The oddity is not in mollusks collected farther up the river. It tends to disappear below these shallows.

The fissure<sup>1</sup> is shallow, oblique, and is angled rather than curved or sinuous as in *incisum*, also having a short fissure. At Lock 2, the fissure has a maximum depth of 3 1-2 mm. At Hall's Island, it is as deep as 5 mm. and is not so oblique as in material from the higher locality. Obliqueness is more pronounced in young specimens than in old; in juveniles the fissure is a mere notch. The hem is only faintly marked, being of much the same color as the rest of the shell; it is to be observed in hardly more than half the shells.

The pyramidal aspect is that mostly of individuals one-half to three-fourths grown. The base is usually rounded in adults. Knobs, when present, give the shell a squared, four or five-sided appearance, and are not spaced regularly. Color<sup>2</sup> ranges from honey-yellow to raw-umber. The prevailing banding formula is four bands of equal width. The aperture is ovate. The white or bluish-white columella is smoothly rounded, slightly

<sup>1</sup>In the literature of Pleurotomariidae the fissure is spoken of as the "anal sinus" and the girdle or hem as the "sinus band". I have preferred to use the terms of the early writers upon *Gyrotoma* even if the others be more descriptive. Doubtless as in the marine mollusk the fissure of *Gyrotoma* serves a purpose for the discharge of excreta.

<sup>2</sup>The colors assigned in this study are according to "Color Standards and Color Nomenclature" of Ridgway, 1912. While a fairly large number of names have been given in order to be as exact as possible it will be remarked that the color range in this genus is rather limited.

produced at the base and has a node at the fissure. It attains full development earlier in this species than in any other of the genus. The outer lip is sinuous. The largest *pyramidatum* measured, which probably would have eight whorls if uneroded, is 21 x 11 1-2 mm.

A young specimen from Lock 2, having five whorls, is conic, carinated at the periphery of the whorls, sharply angulate of base. The whorls are flat and without folds. The columella is undeveloped. There is scarcely more than an indication of fissure. Bands are three in number.

Mr. Smith's lowest locality for *pyramidatum* is Hall's Island, Talladega County. There are two specimens in the Schowalter Collection which I judge to be this species. The locality is mouth of Yellowleaf Creek (Shelby County). This is a few miles below Hall's Island.

Dr. Walker compared specimens taken by Mr. Smith with types of *pyramidatum* and *conica* in Geneva and found them to be the same. *Conica* does not appear to have been formally described. Dr. Walker, who came upon material in the Geneva Museum so labeled, suggests that the remarks at the end of the description of *pyramidatum* might have been intended to refer to this form.

### *Gyrotoma spillmanii* (Lea)

Pl. I, figs. 4 and 5

*Schizostoma Spillmanii* Lea, Proc. Acad. Nat. Sci., Phila., XIII, 1861, p. 54; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 250, pl. 35, fig. 55; Obs. Gen. Unio, IX, p. 72, pl. 35, fig. 55.

*Schizostoma babylonicum* Lea, Tryon, Monog. Strepom., 1873, p. 369.

*Gyrotoma Spillmanii* Lea, Paetel, Cat., 1888, p. 362.

*Gyrotoma laeta incisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 182.

*Schizostoma Wheatleyi* Lea, Proc. Acad. Nat. Sci., Phila., XX, 1868, p. 153; Journ. Acad. Nat. Sci., Phila., VI, 1868, p. 342, pl. 54, fig. 27; Obs. Gen. Unio, XII, 1868, p. 342, pl. 54, fig. 27; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 169; Lewis, Fauna of Ala., 1876, p. 23.

*Description*: Shell striate, subcylindrical, rather thick, yellowish-brown, imperforate; spire obtuse, conoidal; sutures impressed; whorls six, very much banded, flattened, the last large; fissure oblique and rather short; aperture large, ovate and banded within, obtusely angular at the base; columella white, thickened above; outer lip sharp and sinuous.

Operculum ovate, spiral, rather large, dark brown with the polar point near to the left edge, about one-fifth above the basal margin.

*Habitat*: Coosa River, Alabama; Dr. F. R. Showalter.

Diameter, .48; length, .92 of an inch.—Lea.

The fissure of *spillmanii* is like that of *pyramidatum* from Hall's Island. The young, though larger, whorl for whorl, are hardly to be separated from juvenile *pyramidatum*. The types carry the resemblance because they have unusually shallow fissures for adult *spillmanii*. But this species in general is a larger, coarser race, more boldly sculptured, pyramidal only in the adolescent stage and so stepped at the suture as to suggest to Tryon that it was the same as *babylonicum* Lea. I think it can stand as a species, related closely to *pyramidatum* or springing at no great distance in time from the same ancestral form.

The fissure is 3 to 8 mm. in depth, always oblique. Of 20 specimens in one lot, 11 have a wide fissure, in 9 it is narrow. Most of these latter individuals show signs of injury or deformation at the top of the whorl. The girdle is cord-like, irregular, more or less conspicuous by reason of differing in color from the body of the shell.

*Spillmanii* is heavy, nodulous, though sometimes smooth, frequently constricted, slightly plicate upon the early whorls. Fourteen shells in the lot of 20 have stout, revolving folds, 5 have folds nearly obsolete and 1 is smooth. Growth lines are fine to coarse, the scars of rest periods being quite prominent. An adult with three remaining whorls measures 25 x 13 1-2 mm. Color varies from sulphine-yellow to buffy-citrine. Bands are four, all of the same width. This is the prevailing formula. Variations are modifications of this formula. The aperture is wide, ovate, the sinus at the base scarcely noticeable. The columella is white, thick, broadly rounded and has a heavy callous at the top. The outer lip is slightly sinuous.

A young shell of five whorls is pyramidal, obscurely plicate, subangulate at the base. The columella is small, undeveloped; the fissure a mere curving indentation. A full grown shell would have eight whorls probably if un-eroded.

The more nearly typical shells examined in the Alabama collections were taken by Dr. Schowalter and the locality given is "Coosa River, Shelby County, Ala." A smooth form, less robust and with a shallow fissure corresponding with the types, was taken by Mr. Smith in Peckerwood Shoals. No other localities are known.

The type of *wheatleyi*, save in point of size, looks very much like *spillmanii* in form, sculpture, bands and fissure. This seems to be the only shell of the kind that was collected by Schowalter. Mr. Smith found two small shells which I feel convinced are dwarfed *spillmanii*, but curiously they differ greatly from Lea's *wheatleyi*.

In his formal description, Lea mentions Dr. Schowalter as the collector from whom he received *spillmanii*. Later, under "observations," he says, "I have a number of specimens, chiefly young, from Dr. Spillman and a fine suite of different ages from Dr. Schowalter." All these shells are in the United States National Museum. Certain ones, with a label (1) pasted upon them, I have ventured to assume to be the types. They correspond to the Schowalter shells in the Alabama Museum collection. With them are two specimens of *G. pagoda* Lea and a third *Gyrotoma* broken and indeterminate. These probably are the sendings from Dr. Spillman. Three other lots under the name of *Spillmanii* agree with the Schowalter mollusks and a fifth consists again of *pagoda*.

#### GROUP OF *Gyrotoma pagoda*

Conical to globose, smooth to striate, the young carinate and more or less obscurely plicate; fissure oblique to straight, not exceeding 10 mm. in depth; girdle of varying size and color; aperture more frequently elliptical than ovate; sinus usually distinct; bands, ordinarily four and equidistant.

*Gyrotoma pagoda* (Lea)

Pl. I, figs. 6, 7, 8, and 9

*Schizostoma pagoda* Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 167; Trans. Amer. Phil. Soc., X, 1848, p. 93, pl. ix, fig. 52; Obs. Gen. Unio, IV, 1848, p. 93, pl. ix, fig. 52; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 247; Obs. Gen. Unio, IX, 1863, p. 69; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 169; Tryon, Monog. Strepom., 1873, pp. xv, 365; Lewis, Fauna of Ala., 1876, p. 23.

*Gyrotoma pagoda* Lea, Chenu, Manuel, I, 1859, fig. 2,020; H. & A. Adams, Genera, I, 1858, p. 305; Binney, Check List, 1860, No. 327; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Melatoma pagoda* Lea, Reeve, Monog. Melatoma, 1860, sp. 1.

*Schizostoma Wetumpkaensis* Lea, Proc. Acad. Nat. Sci., Phila., 1860, p. 187; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 251, pl. 35, fig. 56; Obs. Gen. Unio, IX, 1863, p. 73, pl. xxxv, fig. 56; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 169; Tryon, Monog. Strepom., 1873, p. 366; Lewis, Fauna of Ala., 1876, p. 23.

*Melatoma Wetumpkaense* Lea, Reeve, Monog. Melatoma, 1861, sp. 17.

*Melatoma ornata* Anth., MSS., Reeve, Monog. Melatoma, 1861, sp. 11.

*Gyrotoma ornata* Anth., Paetel, Cat., 1888, p. 362.

*Melatoma Anthonyi* Reeve, Monog. Melatoma, 1861, sp. 12.

*Gyrotoma Anthonyi* Reeve, Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 361.

*Schizostoma Anthonyi* Reeve, Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, p. 368; Lewis, Fauna of Ala., 1876, p. 22.

*Melatoma funiculatum* Lea, Reeve, Monog. Melatoma, 1860, sp. 5.

*Schizostoma pyramidatum* Shutt., Hinkley, Nautilus, XVIII, 1904, p. 41.

*Gyrotoma lacta incisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 182.

*Description*: Shell carinate, conical, rather thick, dark horn-color; spire rather short; sutures very much impressed; whorls six; fissure small; aperture elliptical, within whitish; columella smooth.

*Habitat*: Tuscaloosa, Alabama.

Diameter, .35; length, .75 of an inch.—Lea.

The pagoda-like form of this species is especially striking in the juvenile specimens and to such an extent, indeed, that these shells resemble *Gomobasis catenaria* Say. The carinae are very wide and turned upward at the edges. The suture is deeply channelled, the fissure a mere indentation. Embryo shells are about 1 1-4 to 2 whorls in size, unsculptured. The first two carinated whorls are scalloped by strong and regularly spaced plicae. As the animal grows larger, the carinae tend to disappear so that in many instances the shell is ventricose and smooth. The Wetumpka form is characterized by revolving folds, these disappearing in up-river specimens. Microscopical sculpture typically gyrotomoid.

Color varies from Ridgway's "old gold" to warm sepia. The proportion of banded to unbanded shells is about five to four. The prevailing banding system is four equidistant bands of the same width. The columella is rather narrow, rounded, with a slight nodulous thickening above. The outer lip is sharp-edged, slightly sinuous. A Wetumpka specimen measured 20 x 12 1-2 mm., the largest from up-river shoals, 22 1-2 x 14 mm.

The fissure is short, straight and bluntly rounded at the opening in old shells. It is seldom more than 3 mm. in depth. Compared with the fissure in *pumilum* that of *pagoda* is shorter and more flaring; apparently it is always straight.

The known range for the species is from The Bar, Chilton County, to Wetumpka, Elmore County.

Lea speaks of *wetumpkaensis* as umbilicate. This is merely an effect of erosion. Sometimes the animal leaves a chink close to the border of the columella and the opening is widened irregularly by corrosion. Three lots of *wetumpkaensis* in the Lea collection agree very well with *pagoda*, though less carinated and having color bands. *Ornata* is a young shell. The locality given, North Carolina, is apparently, as Tryon points out, a confusion with *Anculosa ornata* Anth. from that state. Dr. Walker examined the type of *anthonyi* in the British Museum and found it to be identical with *pagoda*. Lewis (5, p. 23) suggested the possibility of *wetumpkaensis* being a variety or the young of *pagoda*.

*Gyrotoma pumilum* (Lea)

Pl. I, figs. 10 and 11

*Schizostoma pumila* Lea, Proc. Acad. Nat. Sci., Phila., XII, 1860, p. 187; Journ. Acad. Nat. Sci., V, n. s., 1862, p. 252, pl. 35, fig. 57; Obs. Gen. Unio, IX, 1863, p. 74, pl. xxxv, fig. 57; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 169; Tryon, Monog. Strepom., 1873, p. 357; Lewis, Fauna of Ala., 1876, p. 23.

*Gyrotoma pumila* Lea, Binney, Check List, 1860, No. 328; Brot, List, 1862, p. 27.

*Gyrotoma olivula excisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 182.

*Melatoma Alabamense* Lea, Reeve, Monog. Melatoma, 1861, sp. 20.

*Schizostoma globosa* Lea, Proc. Acad. Nat. Sci., Phila., XII, 1860, p. 186; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 252, pl. 35, fig. 58; Obs. Gen. Unio, IX, 1863, p. 74, pl. xxxv, fig. 58; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168.

*Schizostoma excisum* Lea, Hinckley, Nautilus, XVIII, 1904, p. 41.

*Gyrotoma globosa* Lea, Binney, Check List, 1860, No. 321; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Melatoma globosum* Lea, Reeve, Monog. Melatoma, 1861, sp. 18.

*Description*: Shell striate, top-shaped; rather thin, pale horn-color, imperforate; spire very obtuse; sutures much impressed; whorls six, ventricose, the last very large; fissure straight and rather short; aperture rather small, ovate, white within, angular at the base and somewhat canaliculate; columella white, twisted and thickened below; outer lip acute and sinuous.

*Habitat*: Alabama; B. W. Budd, M. D.

Diameter, .40; length, .63 of an inch.—Lea.

The fissure of *pumilum* is "rather short" only as compared with the character in such species as *excisum*. It may be considered as moderately deep for the genus. It is narrow, usually straight, rarely slightly oblique. In Wetumpka specimens examined, this slit has a maximum depth of 7 1-2 mm., in a specimen from Higgin's Ferry, it is 9 1-4 mm. deep. The girdle is more marked in some specimens than in others, varying also in color and size. Cross sections showed the girdle to be hollow for about 3 or 4 mm. behind the fissure. Behind this hollow space it was filled with fine crystalline shell material.

The adult is ovate, with whorls slightly convex, the base rounded; often very heavy. The spire in partly grown shells is obtuse, with faint plicae, often missing. The largest Wetumpka specimen measures 18¾ x 11½ mm., the largest up-river shell, 22 x 12 mm. Ten or twelve revolving folds appear on the body whorl in Wetumpka lots, tending to disappear in colonies



farther up the Coosa. For example, at Butting Ram Shoals, half the *pumilum* are smooth. Color varies from sulphine-yellow to dark olive. About one shell in four lacks color bands. The prevailing formula is four bands, the third from the top being smaller than the others. The aperture is ovate to elliptical, white to yellowish-white. In Wetumpka shells the folds show through as broad white bands in the aperture. The columella is rounded, not wide, white to bluish-white. It is not nearly as stout as might be expected in a shell of this size. At the mouth of the fissure is a spot of white callus. The outer lip is curved outward at the top and is slightly crenulate in shells with folds.

In juveniles the spire is smooth, conic, the whorls flat, the suture not much impressed, the periphery angular. The fissure begins with the fifth whorl. Embryo shells are of about  $1\frac{1}{2}$  whorls, closely coiled and without sculpture.

The species occurs from Weduska Shoals to Wetumpka. The Weduska Shoals specimens are a dwarf form, occurring in very small numbers. The largest is 19 x 9 mm. The shell is delicate, shining, the upper whorls having low plicae, the base bearing obscure folds. The fissure in these specimens is straight to slightly oblique, 3 to 4 mm. in depth. The temptation has been to allow them a distinctive name, but the form appears to correspond with dwarf *pumilum* collected by Mr. Smith at Higgin's Ferry, The Bar and Duncan's Riffle.

A note upon one of Mr. Smith's labels for this species reads, "On rocks, in very swift water, 1-3 feet deep."

Hinkley (2, p. 41) makes *pumilum* a synonym of *excisum*. An examination of the types of the two species compels me to disagree with him.

### *Gyrotoma alabamensis* (Lea)

Pl. I, figs. 12 and 13

*Schizostoma Alabamensis* Lea, Proc. Acad. Nat. Sci., Phila., XII, 1860, p. 187; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 250, pl. 35, fig. 54; Obs. Gen. Union, IX, 1863, p. 72, pl. xxxv, fig. 54; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, p. 367; Lewis, Fauna of Ala., 1876, p. 22.

*Gyrotoma Alabamensis* Lea, Binney, Check List, 1860, No. 305; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 361.

*Gyrotoma olivula excisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 181.

*Melatoma babylonicum* Lea, Reeve, Monog. Melatoma, 1860, sp. 6.

*Description:* Shell striate, elliptical, stout, yellowish-olive, imperforate; spire obtusely conical; sutures very much impressed; whorls six, banded, rather inflated, the last very large; fissure oblique and rather short; aperture rather large, ovate, banded within and obtusely angular at the base; columella white, somewhat thickened above and below; outer lip sharp and sinuate.

*Habitat:* Alabama; B. W. Budd, M.D., and Dr. E. R. Showalter.

Diameter, .50; length, .90 of an inch.—Lea.

The description, "fissure oblique and rather short" so misled Mr. Smith that when he found *alabamensis* he was compelled to believe that he had come upon a new species. Examination of the type disclosed, however, that the shells of Lea and Smith were the same. The fissure varies from straight to oblique. Of 37 shells from The Bar, Chilton County, 16 had

straight fissures. The difference did not seem to be a matter of age. The depth of fissure is from 6 mm. in half-grown shells to 10 mm. in old. The girdle is yellow, rather wide, and is well-marked in nearly all specimens.

The species is probably the most robust of the genus. The largest specimen in the Alabama collection measures  $26\frac{1}{2} \times 13\frac{1}{2}$  mm. The base is sub-angular up to three-fourths of the growth. In adults, it is rounded. The folds are low, not always regularly-spaced, and are stoutest in young shells. Occasional smooth shells have been taken. A distinct tendency toward plication is noticeable upon the upper whorls. The nearly microscopic sculpture consists of fine growth lines, crossed by discontinuous, wavy transverse lines. The color is buckthorn-brown to deep olive. Two bands of equal width, at top and base respectively, and a third band, much wider, at the periphery constitute the commonest banding formula. In many specimens coloring matter is deposited in the base of the folds and this shows in the aperture as bands or lines. The aperture is elliptical rather than ovate. The columella is white, not very wide, thinning above the center into a bluish-white wash with a porcelainous node at the mouth of the fissure. The sinus is distinct. The outer lip is sharp-edged, crenulate, slightly sinuous.

Young shells are ovate, sub-angulated, plicate upon the post-embryo whorls; the fissure straight, not wide; the columella narrow, yellowish-white; the sinus having a shallow channel. Seven or eight whorls are indicated for the adult specimen.

The range of *alabamensis* is from Peckerwood Shoals, Talladega County, to Duncan's Riffle, Chilton County.

Peckerwood Shoals shells are wider in proportion to height than specimens from other known localities and they show, more than these others, the relationship of *alabamensis* and *cariniferum* Anth. A varietal name does not seem to be warranted in the case of this race unless other varieties, and there are several, are also so baptized. In nearly all the lots are shells close to *pumilum* in general appearance. *Pagoda* may be considered a third or fourth cousin to the southward and *cariniferum* a first or second cousin to the north.

### *Gyrotoma cariniferum* Anthony

Pl. I, figs. 14 and 15

*Gyrotoma carinifera* Anth., Proc. Acad. Nat. Sci., Phila., XII, Feb. 1860, p. 66; Binney, Check List, 1860, No. 310; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 361.

*Melatoma cariniferum* Anth., Reeve, Monog. Melatoma, 1861, sp. 13.

*Schizostoma cariniferum* Anth., Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, p. 353; Lewis, Fauna of Ala., 1876, p. 22.

*Schizochilus Showalterii* Lea. Proc. Acad. Nat. Sci., Phila., XII, March, 1860, p. 93.

*Schizostoma Showalterii* Lea, Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 246, pl. 35, fig. 49; Obs. Gen. Unio, IX, 1863, p. 68, pl. xxxv, fig. 49.

*Gyrotoma Showalterii* Lea, Binney, Check List, 1860, No. 334; Brot, List, 1862, p. 28.

*Gyrotoma olivula excisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 181.

*Description:* Shell conic, thick, dark brown; spire obtusely elevated, truncate, though not abruptly so, six whorls remaining, one or two having apparently been lost by truncation; carinations elevated, subacute and found on all the whorls, two on each of the spiral ones and three or four on the body whorl; fissure direct, broad and moderately deep, extending about one-fifth around the shell; sutures irregular, much modified by the carinae, and often concealed in part by them; aperture ovate and banded within; columella much rounded, callous at the lower part only; outer lip irregularly waved, its outline modified by the carinae on the body-whorl; no sinus.

*Habitat:* Coosa River, Alabama.

Length of shell, 7-8; breadth of shell, 1-2 of an inch. Length of aperture,  $5\frac{1}{2}$ -16 of an inch; breadth of aperture, 1-4 of an inch.—Lea.

The opportunity has been given to examine the type of *cariniferum*, which is in the Museum of Comparative Zoology. The shell is about three-fourths grown. The fissure is rather narrow as compared with the same character in several other species, is slanting and  $8\frac{1}{2}$  mm. deep. In twenty-five other specimens the fissure of seven is straight, very slightly oblique in one and noticeably oblique in seventeen. The girdle is narrow and of much the same color as the body of the shell.

Full grown specimens are not so stoutly ribbed as younger ones, and in instances the folds become almost obsolete. A few greatly resemble *G. alabamensis* Lea. The largest shell measured 24 x 15 mm. It should be said that in the cut published by Tryon (10, p. 353) the ribs are made to seem more twisted than they actually are in the type. The color is brownish olive. The banding formula, common to the group, is four bands, the third from the top being smaller than the rest. Variations occur, but they are modifications of this formula. The aperture is more often elliptical than ovate. In old specimens the columella is white, wide, continuous and with the usual node of porcelain-like callus at the top. Young shells are angulated at the base. They indicate that an uneroded adult would have eight whorls.

The only locality known for this species is Fort William Shoals. In 1914, shortly after a visit to this site, Mr. Smith wrote to Dr. Walker, "On a reef \* \* \* I struck *G. cariniferum*; the only ones I had seen before were a broken specimen in the Schowalter collection and about ten I had collected last year in a lower part of Fort William Shoals. In this new place we gathered about 200 in three hours, and I think we scraped the place nearly clean. The species occurred only in about fifteen yards of the reef and always in the swiftest water where other *Gyrotoma* cannot stick. There was one little pool under a fall which must have yielded over 100 fine ones."

Hinkley (2, p. 41) mentions *showalterii* Lea. It is not clear that he refers to the species which has had to give way to *cariniferum* by reason of the rule of priority or to the one given the same name by Lea in 1864.

#### GROUP OF *Gyrotoma lewisii*

Elongate to ventricose, the whorls almost flat, sometimes ligulate, the shell rather heavy and resembling *Goniobasis impressa* Lea in sculpture; fissure oblique, with a maximum depth of 6 mm.; girdle not pronounced; aperture narrow; the sinus distinct; bands consisting usually of many fine lines.

*Gyrotoma lewisii* (Lea)

Pl. I, figs. 16, 17, and 18

*Schizostoma Lewisii* Lea, Proc. Acad. Nat. Sci., Phila., XXI, 1869, p. 62; Journ. Acad. Nat. Sci., Phila., VIII, 1874, p. 61, pl. 21, fig. 16; Obs. Gen. Unio, XIII, 1874, p. 65, pl. xxi, fig. 16; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Lewis, Fauna of Ala., 1876, p. 23; Hinkley, Nautilus, XVIII, 1904, p. 41.

*Description*: Shell closely striate, subcylindrical, rather thin, yellowish-brown, imperforate; spire conical, folded; sutures very much impressed; whorls about seven, the last one large; fissure oblique and short; aperture large, rhomboidal, banded within; outer lip crenulate and sinuous; columella white, thickened and twisted.

*Habitat*: Coosa River, Alabama, Dr. E. R. Schowalter.

Diameter, .5; length, .9 inch.—Lea.

The fissure is oblique, shallow,  $2\frac{3}{4}$  to  $3\frac{3}{4}$  mm. in depth. There is no distinct girdle. A broadening or shouldering of the whorl immediately below the suture appears to serve the purpose of covering the fissure as growth proceeds. In young shells this shoulder does not occur though the mollusk has a well-developed fissure at this stage.

*Lewisii* is stout, ventricose to elongate and is covered with fine, sharply cut folds or riblets, closely set and varying slightly in size. Growth lines are fine, being crossed by minute discontinuous revolving lines not always distinct beneath a hand lens. A few specimens are constricted upon the body whorl though none taken by Mr. Smith is so much constricted as in the figure of Lea's type. Color usually citrine. All the ribs seem to contain more or less coloring matter. In young shells this shows through into the aperture, giving an effect of numerous bands. As shell material is deposited the finer bands or lines tend to disappear. The usually narrow and elliptical aperture has a distinct sinus at its base. The columella is broad and, in immature specimens, merely a wash of white above the center of the aperture. The node at the top is not prominent. One specimen has a reddish columella. The largest shell is  $22\frac{1}{2} \times 12\frac{1}{2}$  mm.

Half-grown specimens are conic, subangulate, slightly carinate and have a pronounced sinus. The fissure is very shallow, but well-marked.

Mr. Smith's shells, and presumably those taken by Dr. Schowalter, were collected on Fort William Shoals. Hinkley (2, p. 41) gives Wilsonville as another locality. This would seem to be on or within touch of Three-Island Shoals.

Dr. Lea remarked upon the resemblance of his species to *Goniobasis impressa* Lea. Save in regard to the fissure of *lewisii*, the two shells are exceedingly alike. The one, I believe, can be considered an offshoot of the other.

*Gyrotoma hendersoni* H. H. Smith, new species

Pl. II, figs. 19, 20, and 21

*Shell*: Subcylindrical, rather heavy, whorls almost flat, the last broadly rounded at the base. Apex eroded, only two whorls remaining. The entire shell is covered with low folds of varying size which tend to wave or break where new shell material has been deposited after rest periods. Between the folds of the penultimate whorl the fine

vertical growth lines are crossed by transverse lines, very delicate and usually discontinuous. Fissure oblique, 6 mm. in depth. The suture is covered by a narrow, cord-like, irregular girdle somewhat lighter than the general body color. In a broken place in this "hem" the suture appears as deeply impressed or channelled. Color of shell brownish-olive. The bands are deposits of coloring matter in the base of the folds, sometimes coalescing so that for the eleven folds of the body whorl six bands show in the aperture. Columella narrow, rounded from center to base, flattened above the center and having a heavy callus at the fissure; white from center to base, dull purple above. Aperture elliptical, with a distinct sinus below. Outer lip a little crenulate, firm, broadly curving outward at the top and slightly inward at the base.

*Operculum*: Leaf-like, leathery, very dark red. Apex acute, base rounded; right margin much more curved than the left. Whorls three, the first two tightly coiled and close to the left margin and about 1 mm. from the base. The region of the inner whorls is excavated or crater-like. Radiating lines are of varying strength. Altitude 8 1-2 mm.; diameter 4 1-2 mm.

*Measurements*: Altitude, 21 mm.; diameter, 12 mm. Aperture: Lowest part of fissure to base, 10 1-2 mm.; diameter, 4 1-4 mm.

*Type Locality*: Coosa River, Fort William Shoals, Talladega County, Ala.

Type in Museum of Zoology, University of Michigan; paratypes in Alabama Museum of Natural History.

The affinities of this species are with *G. lewisii* (Lea). It differs in having fewer and stouter folds, a more rounded body whorl, a deeper and less oblique fissure and less shouldered aspect. While the question may rise as to whether *lewisii* is *Goniobasis impressa* Lea with a gyrotomoid outer lip the position of *hendersoni* as a true *Gyrotoma* is not to be questioned.

The fissure varies from 3½ mm. in depth in young shells to 6 mm. in adults. As depth increases, the fissure becomes less oblique, or to put it another way, more narrow. There is little variation in form, sculpture and color. The bands are from five to ten, following no formula as in most other species of the genus. A young specimen of *hendersoni* is thin, subangulate. The fissure is shallow, the suture rather indistinct, the bands many and linear. Eight whorls are indicated for a full-grown specimen.

The only locality known for this species is Fort William Shoals. Writing from this place on July 17, 1914, Mr. Smith said: "On a reef just above we got the regularly striate form which I have been calling *G. lewisii*, though I am not at all sure. With it another which I take to be *G. babylonicum*, and a third form undescribed which I propose to name *G. hendersoni*; it is striate much like *lewisii*, but has a square and moderately deep slit." In September of the same year, Mr. Smith wrote: "The species which I propose to name *hendersoni* is one of the most beautiful of the genus and is apparently very constant."

#### GROUP OF *Gyrotoma excisum*

Quadrate, bulbous, conic or elongate; the whorls smooth or with folds, often faintly plicate; fissure ordinarily straight and as deep as 10 mm.; girdle well-marked, though sometimes absent; aperture elliptical; sinus distinct; bands: three in *excisum*, four in *lacinatedum*.

*Gyrotoma excisum* (Lea)

Pl. II, figs. 22 and 23

*Melania excisa* Lea, Proc Amer. Phil. Soc., II, 1843, p. 242; Trans. Amer. Phil. Soc., IX, 1844, pp. 25, 29; Trans. Amer. Phil. Soc., X, 1848, p. 93; Obs. Gen. Unio, IV, 1848, pp. 25, 29, 93; Jay, Cat., 4th ed., 1852, p. 273.

*Schizostoma excisa* Lea, Wheatley, Cat. Shells U. S., 1845, p. 28; Lea, Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 250; Obs. Gen. Unio, IX, 1863, p. 72; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, pp. xv, xxiii, xxv, 356; Lewis, Fauna of Ala., 1876, p. 23.

*Gyrotoma excisa* Lea, H. & A. Adams, Genera, I, 1858, p. 305; Binney, Check List, 1860, No. 317; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Gyrotoma olivula excisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 181.

*Melatoma excisum* Lea, Reeve, Monog. Melatoma, 1860, sp. 2.

*Melatoma Showalterii* Lea (prob. *excisum*), Reeve, Monog. Melatoma, 1861, sp. 23.

*Gyrotoma ovoideum* Shutt., Mittheil. Bern. Nat. Gesell., No. 50, July 22, 1845, p. 88; H. & A. Adams, Genera, I, 1858, p. 305, pl. 32, fig. 4; Paetel, Cat., 1888, p. 362.

*Schizostoma ovoideum* Shutt., Tryon, Monog. Strepom., 1873, pp. xv, 356; Lewis, Fauna of Ala., 1876, p. 23; Hinkley, Nautilus, XVIII, 1904, p. 41.

*Gyrotoma bulbosa* Anth., Proc. Acad. Nat. Sci., Phila., Feb. 1860, p. 65; Binney, Check List, 1860, No. 309; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 361.

*Melatoma bulbosum* Anth., Reeve, Monog. Melatoma, 1861, sp. 22.

*Schizostoma bulbosum* Anth., Lewis, Amer. Jour. Conchol., 1869-70, p. 168; Tryon, Monog. Strepom., 1873, p. 361; Lewis, Fauna of Ala., 1876, p. 22.

*Gyrotoma ovalis* Anth., Proc. Acad. Nat. Sci., Phila., Feb., 1860, p. 65; Binney, Check List, 1860, No. 325; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Schizostoma glans* Lea, Proc. Acad. Nat. Sci., Phila., 1860, p. 186; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 248, pl. 35, fig. 52; Obs. Gen. Unio, IX, 1863, pp. 70, 71, 74, pl. xxxv, fig. 52; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, p. 363; Lewis, Fauna of Ala., 1876, p. 23; Hinkley, Nautilus, XVIII, 1904, p. 40.

*Gyrotoma glans* Lea, Binney, Check List, 1860, No. 320; Brot, List, 1862, p. 27.

*Melatoma ellipticum* Anth., MSS., Reeve, Monog. Melatoma, 1861, sp. 21.

*Gyrotoma ellipticum* Anth., Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Schizostoma ellipticum* Anth., Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, p. 359; Lewis, Fauna of Ala., 1876, p. 23; Hinkley, Nautilus, XVIII, 1904, p. 40.

*Description*: Shell striate, subfusiform, rather thick, yellowish; spire ovately conical; sutures impressed; whorls flattened; aperture cut out above, small, elliptical, white.

*Habitat*: Alabama.

Diameter, .40; length, .64 of an inch.—Lea.

As variation goes in *Gyrotoma* this species is remarkably wanting in variability. At Wetumpka it bears folds in common with many other Pleuroceridae there and at Three-Island Shoals, the other extreme of its occurrence, it is ordinarily lighter in color and smooth. Otherwise there is little difference between the members of the two colonies. This may argue that *excisum* is the oldest of the genus, time having brought its usual uniformity, and this hypothesis is supported by the fact that the species has the longest range of all *Gyrotomae*.

The fissure is deep, up to 10 mm., in the largest adults, very narrow in the young and widening with age; ordinarily straight, but in a few shells

waving upon the lower edge. The girdle is thread-like to rounded and thick, and of slightly lighter color than the body of the shell.

Forms are quadrate, bulbous, ovate, elongate, any one colony having specimens of these shapes. Where folds occur they are low, not very conspicuous. Of 38 specimens in one lot taken at The Bar, 29 are obscurely plicate upon the upper whorls, 9 are without plicae. This ratio of sculptured shells to those lacking plicae is about the same wherever the species occurs. In general the shell is of a soft silky appearance. Color is aniline-yellow to mummy-brown. The commonest banding formula is three bands, the one at the periphery being wider than the others. The columella in the oldest specimens is heavy, broad, complete to the top and thickened at the fissure. Color is usually white, but at times yellowish-white, pink or purple. The sinus is distinct, pointed. The outer lip is slightly sinuous. Mr. Smith's largest *excisum* measured 23 x 12 mm.

The embryo is smooth, tightly coiled. Shells developed to the fifth whorl are smooth with a slight carina at the periphery; the sinus being well marked; the fissure straight, tight and about 3 mm. in depth. Partly grown individuals are not so angular at the base as in most other species. The whorls indicated for an adult are seven or eight.

Shuttleworth's shells from the Coosa River were sent to him by Rugel and this collector took *pyramidatum* not far from the northernmost known locality for *excisum*. It seems probable that the shell to which Shuttleworth gave the name *ovoideum* came from this point or very close to it. *G. ellipticum* Anth. in the Philadelphia Academy, received from Anthony himself, is the same as his *bulbosum* except that it is elongate. *Bulbosum* is *excisum* in its old age, *ovalis* in its graceful youth. The tuberculation of *glans*, cited by Tryon as if a distinguishing character, occurs rarely and seems to be without significance.

### *Gyrotoma laciniatum* (Lea)

Pl. II, figs. 24 and 25

*Schizostoma laciniatum* Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 167; Trans. Amer. Phil. Soc., X, 1848, p. 95, pl. ix, fig. 57; Obs. Gen. Unio, IV, 1848, p. 95, pl. ix, fig. 57; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 253; Obs. Gen. Unio, IX, 1863, p. 75; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, pp. xv, 359; Lewis, Fauna of Ala., 1876, p. 23.

*Gyrotoma laciniata* Lea, H. & A. Adams, Genera, I, 1858, p. 305; Binney, Check List, 1860, No. 324; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Schizostoma castanea* Lea, Proc. Acad. Nat. Sci., Phila., XII, 1860, p. 186; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 247, pl. 35, fig. 50; Obs. Gen. Unio, IX, 1863, p. 69, pl. xxxv, fig. 50; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, p. 355; Lewis, Fauna of Ala., 1876, p. 22; Hinkley, Nautilus, XVIII, 1904, p. 40.

*Gyrotoma castanea* Lea, Binney, Check List, 1860, No. 311; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 361.

*Gyrotoma olivula excisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 181.

*Description:* Shell smooth, obtusely conical, rather thick, banded, yellowish horn-color; spire obtuse; sutures excavated; whorls convex; fissure deep; aperture elliptical, whitish within; columella smooth, thickened above.

*Habitat:* Tuscaloosa, Alabama.

Diameter, .25; length, .45 of an inch.—Lea.

This is the smallest species of the genus. The largest shell examined measures 16 x 10 mm. The average size of fourteen specimens is 14.9 x 8.5 mm. The species resembles *excisum* Lea in sculpture, fissure and banding system. It occurs from Fort William Shoals, Talladega County, to Wetumpka, Elmore County. A note by Mr. Smith with *laciniatum* from Fort William Shoals reads, "Found in a few places along the eastern or Talladega County side and quite close to the banks where the water is swift; on or clinging to the lower side of stones. In one place, partly under overhanging bushes, we collected over 100 within a few yards, but generally the species is rare."

In *laciniatum* the fissure is very deep in proportion to the shell; it is narrow and hugs the body whorl. Its depth in adults is 7 to 7½ mm. The girdle is small and thin. Of 48 specimens the girdle is absent in 13.

The shell is conic, subangulated, with whorls flat to slightly convex. Upper whorls are smooth to carinate, showing a tendency to form a few obscure plicae. Commonly there are four or five low folds upon the base, seldom very distinct. Beneath the fissure are low vertical puckerings, made conspicuous by spots of coloring matter between them. Growth lines are fine, irregular, crossed on parts of the shell by revolving lines which in few instances go clear around the whorl. Color is buckthorn-brown to clove-brown. The prevailing banding formula is four bands of equal width, the two in the center approximate. These latter bands sometimes coalesce into the formula ordinarily occurring in *excisum*. The aperture is elliptical, nearly pointed at the top, more rounded at the base and having a slight sinus. The columella is small, regularly rounded, white and having a node at the fissure. In only one specimen observed was the columella developed fully above the center. The outer lip is sinuous, more angular at the top than rounded.

The embryo shell is very small, smooth, tightly coiled. Some juveniles are strongly carinate, others smooth. Irregular plicae occur. There are three bands, that at the center dividing into two. In shells of five whorls the fissure is quite deep. The adult *laciniatum* has seven or eight whorls.

A comparison of the types of *laciniatum* and *castaneum* proved them to be identical. Lea's first specimens were apparently from Wetumpka. It was not until about fifteen years later that he saw the up-river forms.

#### GROUP OF *Gyrotoma incisum*

Cylindrical to globose; whorls shouldered, often constricted, sometimes nodulous; smooth to striate; fissure usually shallow and oblique though in *amplum* as deep as 9 mm. and in instances straight; girdle stout and irregular when present; aperture ovate; sinus more noticeable in young than in adult shells; bands three.



*Gyrotoma incisum* (Lea)

Pl. II, figs. 26, 27, 28, and 29

*Anculosa incisa* Lea, Proc. Amer. Phil. Soc., II, 1843, p. 243; Trans. Amer. Phil. Soc., IX, 1844, p. 28.

*Schizostoma incisa* Lea, Wheatley, Cat. Shells U. S., 1845, p. 28; Lea, Trans. Amer. Phil. Soc., X, 1848, p. 93; Lea, Obs. Gen. Unio, IV, 1848, pp. 28, 93; Lea, Proc. Acad. Nat. Sci., Phila., XII, 1860, p. 186; Hanley, Conchol. Misc., Melania, 1854-58, pl. 5, figs. 44, 45; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, pp. xxiii, xxv, 378; Lewis, Fauna of Ala., 1876, p. 23; Hinkley, Nautilus, XVIII, 1904, pp. 40, 41.

*Melania incisa* Lea, Jay, Cat., 4th ed., 1852, p. 274.

*Leptoxis incisa* Lea, Haldeman, in Chenu's Illustrations Conchyliog., 1843-53, liv. 73, p. 2, pl. I, figs. 24-26; Binney, Check List, 1860, No. 363.

*Gyrotoma incisa* Lea, H. & A. Adams, Genera, I, 1858, p. 305; Binney, Check List, 1860, No. 323; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362; Goodrich, Anculosae Ala. Drain., 1922, p. 56.

*Gyrotoma laeta incisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 182.

*Melatoma incisum* Lea, Reeve, Monog. Melatoma, 1860, sp. 4.

*Schizostoma curta* Mighels, Bost. Proc., I, Oct. 1844, p. 189; Tryon, Monog. Strepom., 1873, pp. xv, 363; Lewis, Fauna of Ala., 1876, p. 22.

*Gyrotoma curta* Migh., H. & A. Adams, Genera, I, 1858, p. 305; Binney, Check List, 1860, No. 314.

*Gyrotoma curta* Gould, Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 361.

*Gyrotoma olivula excisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 181.

*Schizostoma Buddii* Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 167; Trans. Amer. Phil. Soc., X, 1848, p. 94, pl. ix, fig. 53; Obs. Gen. Unio, IV, 1848, p. 94, pl. ix, fig. 53; Obs. Gen. Unio, IX, 1863, p. 74; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, pp. xv, 370; Lewis, Fauna of Ala., 1876, p. 22.

*Gyrotoma Buddii* Lea, H. & A. Adams, Genera, I, 1858, p. 305; Binney, Check List, 1860, No. 308; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 361.

*Schizostoma constrictum* Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 167; Trans. Amer. Phil. Soc., X, 1848, p. 94, pl. ix, fig. 55; Obs. Gen. Unio, IV, 1848, p. 94, pl. ix, fig. 55; Proc. Acad. Nat. Sci., Phila., XII, 1860, p. 186; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 246; Obs. Gen. Unio, IX, 1863, p. 68; Journ. Acad. Nat. Sci., Phila., VI, 1866, p. 149; Obs. Gen. Unio, XI, 1867, p. 105; Lewis, Amer. Journ. Conchol., V, 1869-70; p. 168; Tryon, Monog. Strepom., 1873, pp. xv, 373, 374; Lewis, Fauna of Ala., 1876, p. 22.

*Gyrotoma constricta* Lea, H. & A. Adams, Genera, I, 1858, p. 305; Binney, Check List, 1860, No. 302; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 361.

*Schizostoma funiculatum* Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 167; Trans. Amer. Phil. Soc., X, 1848, p. 95, pl. ix, fig. 56; Obs. Gen. Unio, IV, 1848, p. 95, pl. ix, fig. 56; Tryon, Monog. Strepom., 1873, pp. xv, 371.

*Gyrotoma funiculata* Lea, H. & A. Adams, Genera, I, 1858, p. 305; Binney, Check List, 1860, No. 318; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Gyrotoma quadrata* Anthony, Proc. Acad. Nat. Sci., Phila., XII, Feb. 1860, p. 65; Binney, Check List, 1860, No. 330; Paetel, Cat., 1888, p. 362.

*Melatoma quadratum* Anth., Reeve, Monog. Melatoma, 1860, sp. 7.

*Schizostoma virens* Lea, Proc. Acad. Nat. Sci., Phila., XII, 1860, p. 187; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 253, pl. 35, fig. 59; Obs. Gen. Unio, IX, 1863, p. 75; pl. xxv, fig. 59.

*Gyrotoma virens* Lea, Binney, Check List, 1860, No. 335; Brot, List, 1862, p. 28; Paetel, Cat., 1888, p. 362.

*Gyrotoma obliqua* Anth., MSS., Tryon, Monog. Strepom., 1873, p. 378; Paetel, Cat., 1888, p. 362.

*Description*: Shell smooth, ovately gibbous, thick, yellowish-brown; spire short; whorls four, flattened; columella thickened above; aperture large, ovate, white.

*Habitat*: Alabama.

Diameter, .44; length, .64 of an inch.—Lea.

In *incisum* the fissure is shallow and oblique. It is as deep as  $7\frac{1}{2}$  mm. in specimens from Weduska Shoals. It is most shallow in specimens from Butting Ram Shoals down to Wetumpka, not exceeding  $2\frac{3}{4}$  mm. in depth. The girdle, which represents the material filling the fissure as growth proceeds, is usually well-marked when it is noticeable at all, particularly toward the end of growth of adult individuals.

The shell is heavy, broadly rounded at the shoulder, frequently with a broad constriction around the center of the whorl. Hinkley (2, p. 40) speaks of *incisum* as never nodulous. Occasional specimens do have nodes at the shoulder, but these markings appear to be without significance. The largest shell observed measures  $22 \times 14\frac{1}{2}$  mm. The growth lines are usually fine and regular and these are often crossed by discontinuous transverse lines, plainest at the top of the whorl. Of 78 shells from one lot from Wetumpka, 11 showed revolving folds of more or less prominence. The folds are seldom present in *incisum* coming from farther up the river. Color varies from olive-ocher to cinnamon-brown. Bands occur much more commonly than not. Of 77 banded shells from Wetumpka, 74 had a band at the top of the whorl, one at the periphery and a third at the base. This is the prevailing banding formula in the species from other localities. The aperture is ovate, varying slightly. The columella in adults is white, rather wide, broadly rounded and regularly curved vertically, being thickened into a small node at the mouth of the fissure. The outer lip is sharp-edged, sinuous.

Juveniles are conic, angulated at the base, having the whorls flat and without carinae. A channelled sinus, present in all the young examined, is much more pronounced than in the case of adults. The fissure begins with the third whorl and is easily distinguished in the fourth. Six or seven whorls for the fully-grown shell are indicated.

The range of *incisum* is from Weduska Shoals, Shelby County, to Wetumpka, Elmore County.

Lea's type is a narrow, somewhat constricted form of the Wetumpka aspect. His *virens* is a young shell. *Curta* Mighels appears to me to be readily recognizable from the description. I examined the type of *buddii* Lea, the locality for which is given in error as Tuscaloosa, but felt uncertain about the identification. Mr. W. B. Marshall of the National Museum kindly furnished me later with an excellent photograph and I can say with confidence that the shell is the same as *incisum*. The cut in Tryon (6, p. 371) could not have been made from the type. The constriction in *constrictum* is fairly common to the species. *Funiculatum* Lea is a deformed mollusk.

At the mouth of the Yellowleaf Creek of Chilton County, Mr. T. H. Aldrich took numbers of a small form of *Gyrotoma* which, though suggestive of *walkeri* because of its delicacy, I assign to *incisum* on account of the deeper fissure. These shells have a kind of family resemblance to *Anculosa aldrichi* H. H. Smith, taken at the same locality. This *Anculosa* also is

dwarfed. Larger Gyrotomae and larger Anculosae have been collected in the same place. The student is led to wonder whether these dwarfed shells do not dwell in some particular spot on these shoals where the conditions of food supply, current, temperature or some other cause tend to stunt molluscan growth as sometimes in very cold springs shell life is at once small and plainly of mature development.

*Gyrotoma walkeri* H. H. Smith, new species

Pl. II, figs. 30, 31, and 32

*Shell*: Cylindrical, shouldered, solid; body whorl slightly constricted, apex eroded, base rounded and with only a suggestion of a sinus. Growth lines very fine, crossed by delicate, waving lines to be seen on all parts of the exterior except where it is worn smooth. Rest period scars rather rough, forming a few irregularly spaced nodules. Fissure very shallow, very oblique, 2 mm. deep at the suture. There is no girdle. Suture impressed, irregular. Color buckthorn-brown. Bands three, one ending at lower edge of fissure, one at periphery and one at the base. Aperture ovate, yellowish-white within. Columella white, broadly-rounded, having a heavy deposit of its material at the fissure. Outer lip firm, sharp-edged, forming a sinuous line with the fissure.

*Operculum*: Ovate, thick, dark reddish-brown, measuring 3 1-2 mm. diameter by 5 1-2 mm. altitude. The left margin is thickened, smooth-edged; right margin broadly curved, broken and worn; basal margin rounded, eroded close to the polar point. Whorls three, the first two regularly and tightly coiled. Growth lines fine to coarse.

*Measurements*: Altitude, 15 mm.; diameter, 10 mm. Aperture, base to suture, 10 1-2 mm.; base to lowest point of fissure, 6 mm.; diameter 4 1-4 mm.

*Type Locality*: Coosa River, Cedar Island, Chilton County, Alabama.

Type in Museum of Zoology, University of Michigan; paratypes in Alabama Museum of Natural History.

This species appears to be a derivative of *G. incisum* Lea which has developed fixed, uniform specific characteristics. It is small for the genus and varies much more in the size of mature specimens than in form. The largest shell measures 17 x 11 mm. It is from Weduska Shoals. No folds appear upon any of the material. Growth lines are usually fine, but sometimes coarse and roughened near the shoulder. The waving transverse lines are strikingly beautiful in a few specimens which have not suffered a great amount of wear.

The fissure varies slightly in depth, but in none is it deeper than 3½ mm. It is frequently only a sinuous indentation. The girdle is absent in all the specimens examined.

Color is sometimes as dark as burnt-umber. Of 65 shells, 51 have bands, the formula in all being exactly that of the type.

Very young shells are smooth, lacking carinæ, plicæ and all other sculpture except microscopic growth lines. The base is obtusely angulate. The sinus is well-marked, slightly oblique. The fissure, about ½ mm. deep, begins with the fourth whorl and is hardly more than a sinuous, inturned part of the outer lip. Eight whorls are indicated for full-grown individuals.

The known localities for *walkeri* are Weduska Shoals, Shelby County; The Bar, Cedar Island, Higgin's Ferry and Duncan's Riffle, Chilton County; Butting Ram Shoals, Coosa County. One of Mr. Smith's labels carries the note, "swift water."

*Gyrotoma amplum* Anthony

Pl. II, figs. 33, 34, and 35

*Gyrotoma ampla* Anth., Proc. Acad. Nat. Sci., Phila., XII, Feb., 1860, p. 66; Binney, Check List, 1860, No. 306; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 361.

*Melatoma amplum* Anth., Reeve, Monog. Melatoma, 1861, sp. 16.

*Schizostoma amplum* Anth., Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, p. 360; Lewis, Fauna of Ala., 1876, p. 22.

*Gyrotoma recta* Anth., Proc. Acad. Nat. Sci., Phila., XII, Feb., 1860, p. 64; Binney, Check List, 1860, No. 331; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Melatoma rectum* Anth., Reeve, Monog. Melatoma, 1861, sp. 10.

*Gyrotoma salebrosa* Anth., Proc. Acad. Nat. Sci., Phila., XII, Feb., 1860, p. 66; Binney, Check List, 1860, No. 333; Paetel, Cat., 1888, p. 362.

*Melatoma salebrosum* Anth., Reeve, Monog. Melatoma, 1861, sp. 15.

*Schizostoma salebrosum* Anth., Lewis, Amer. Journ. Conchol., V, 1869-70, p. 169; Tryon, Monog. Strepom., 1873, p. 376; Lewis, Fauna of Ala., 1876, p. 23; Hinkley, Nautilus, XVIII, 1904, p. 40.

*Gyrotoma robusta* Anth., Proc. Acad. Nat. Sci., Phila., XII, Feb., 1860, p. 67; Binney, Check List, 1860, No. 332; Brot, List, 1862, p. 28; Paetel, Cat., 1888, p. 362.

*Melatoma robustum* Anth., Reeve, Monog. Melatoma, 1861, sp. 14.

*Gyrotoma demissa* Anth., Proc. Acad. Nat. Sci., Phila., XII, Feb., 1860, p. 64; Binney, Check List, 1860, No. 316; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Melatoma demissum* Anth., Reeve, Monog. Melatoma, 1861, sp. 9.

*Schizostoma demissum* Anth., Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, p. 372; Lewis, Fauna of Ala., 1876, p. 23.

*Schizostoma glandula* Lea, Proc. Acad. Nat. Sci., Phila., XII, May, 1860, p. 187; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 249, pl. 35, fig. 53; Obs. Gen. Unio, IX, 1863, p. 71, pl. 35, fig. 53; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 168; Tryon, Monog. Strepom., 1873, p. 377; Lewis, Fauna of Ala., 1876, p. 23.

*Gyrotoma glandula* Lea, Binney, Check List, 1860, No. 319; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Schizostoma Hartmanii* Lea, Proc. Acad. Nat. Sci., Phila., XII, May, 1860, p. 187; Journ. Acad. Nat. Sci., Phila., V, n. s., p. 247, pl. 35, fig. 51; Obs. Gen. Unio, IX, 1863, p. 69, pl. 35, fig. 51.

*Gyrotoma Hartmanii* Lea, Binney, Check List, 1860, No. 322; Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Melatoma nucula* Anth., MSS., Reeve, Monog. Melatoma, 1861, sp. 19.

*Gyrotoma nucula* Anth., Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Schizostoma nuculum* Anth., Lewis, Amer. Journ. Conchol., V, 1869-70, p. 169; Tryon, Monog. Strepom., 1873, p. 361; Lewis, Fauna of Ala., 1876, p. 23.

*Schizostoma Showalterii* Lea, (non Lea, 1860), Proc. Acad. Nat. Sci., Phila., XVI, 1864, p. 112; Journ. Acad. Nat. Sci., Phila., VI, 1866, p. 149, pl. 23, fig. 56; Obs. Gen. Unio, XI, 1867, p. 105; pl. 23, fig. 56.

*Schizostoma Showalteriana* "Lea", Tryon, Amer. Journ. Conchol., I, Oct., 1865, p. 335; Tryon, Monog. Strepom., 1873, p. 375; Lewis, Fauna of Ala., 1876, p. 23.

*Schizostoma constrictum* Lea, Hinkley, Nautilus, XVIII, 1904, p. 40.

*Gyrotoma olivula excisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 181.

*Gyrotoma laeta incisa* (Lea), Hannibal, Proc. Malacol. Soc., 1912, p. 182.

*Description:* Shell smooth, ovate, rather thick, olivaceous; spire not elevated, but acute; whorls 6-7, subconvex; sutures well defined; fissure broad, rather deep and waved; aperture moderate, elliptical, flesh-colored and banded within; columella

smooth, or slightly thickened only at the fissure; body-whorl striate and banded; whorls of the spire not banded, but having a thickened, cord-like line near the suture.

*Habitat*: Coosa River, Alabama.

Length, eleven-sixteenths; breadth, seven-sixteenths of an inch. Length of aperture, seven-sixteenths; breadth of aperture, four-sixteenths of an inch.—Anthony.

This species is close to the form of *incisum* which has a comparatively deep fissure, as at Weduska Shoals. But the young of that form have the typically shallow fissure. It is not so in the case of *amplum*. Moreover, the fissure in *amplum* is sometimes straight, never in *incisum*. Sometimes the lower edge of the fissure of *amplum* is waved, but this has not been observed in *incisum*. The depth of the slit in the species under consideration varies in adults from  $6\frac{1}{2}$  to 9 mm. The girdle is stout, often irregular.

In form the shell is somewhat cylindrical, noticeably shouldered and in instances slightly constricted though not so frequently or so deeply as in *incisum*. Ordinarily the mollusk is without revolving folds, but occasionally they do occur. Commonly the body whorl bears low nodules just below the suture. Growth lines are fine, often prominent and are crossed in places by waving transverse lines usually discontinuous. The largest specimen taken by Mr. Smith measures  $23\frac{1}{2} \times 14\frac{1}{2}$  mm. Color varies from olive-yellow to Mars-brown. The prevailing banding formula is three bands equidistant and of the same width. Bands in this species show a marked tendency to become obsolete. The columella is white to bluish-white, having a porcelainous node at the fissure and ending at the base in a distinct sinus.

Anthony erected several species at the same time from shells which seem to have come from Dr. Schowalter just after that collector's first visit to Fort William Shoals. Their novelty led to the placing of undue emphasis upon characters of no great significance. Thus *recta* was made a species principally upon the form of the shell and the absence of bands. The accentuation of rest scars was the justification of *salebrosa*. *Robusta* was differentiated from *salebrosa* by reason of its smoothness. *Demissa*, a single specimen, appears to have been one of the not very common adults of the genus which have a fully developed columella. Dr. Lea published his descriptions of *hartmanii* and *glandula* hardly three months after Anthony's names had been printed. His *hartmanii* is an old, worn and broken specimen of *amplum*. It is somewhat difficult to distinguish *glandula* from *incisum*, but I was enabled to do this with care by means of a photograph sent to me by Mr. W. B. Marshall of the United States National Museum. *Showalteriana* is a pathological individual. The synonymy of *amplum* is an illustration of a curious competition in species-naming which obtained among American naturalists in the first half of the nineteenth century.

Hinkley (2, p. 40), who found this to be the most plentiful *Gyrotoma* on Fort William Shoals, identified it as *constrictum*, apparently following Tryon's decision in the case of *recta*. I have seen both the type of *constrictum* and some of Hinkley's shells and can say confidently they are not the same.

The range of the species is Three-Island Shoals to Peckerwood Shoals.

## UNIDENTIFIABLE SPECIES

*Gyrotoma babylonicum* (Lea)

*Schizostoma Babylonicum* Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 167; Trans. Amer. Phil. Soc., X, 1848, p. 94, pl. ix, fig. 54; Obs. Gen. Unio, IV, 1848, p. 94, pl. ix, fig. 54; Journ. Acad. Nat. Sci., Phila., V, n. s., 1862, p. 248; Obs. Gen. Unio, IX, 1863, p. 70; Lewis, Amer. Journ. Conchol., V, 1869-70, p. 166; Tryon, Monog. Strepom., 1873, pp. xv, 369; Lewis, Fauna of Ala., 1876, p. 22.

*Gyrotoma Babylonicum* Lea, Chenu, Man. de Conchyl., I, 1859, f. 2, 021; H. & A. Adams, Genera, I, 1858, p. 305; Binney, Check List, 1860, No. 307; Brot, List, 1862, p. 27; Paetel. Cat., 1888, p. 361.

*Gyrotoma lacta incisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 182.

*Description*: Shell striate, somewhat fusiform, rather thick, chestnut-color; spire obtusely conical; sutures impressed; whorls flattened; fissure small; aperture large, elliptical, somewhat flesh-colored within; columella smooth, angular at the base, thickened above.—Lea.

This species was described from one specimen and as from Tuscaloosa. Like Lea's *funiculatum* and his *showalterii* of 1864 it is a deformity and broken. The shell is now in the National Museum, being No. 119, 408. It is very much shouldered and is lacking in color bands. The fissure is slightly more oblique than in specimens of *pagoda* having unusually oblique fissures. It is much more oblique than in the case of *pumilum* which the shell of *babylonicum* resembles. While the mollusk does not suggest *incisum* in form, the fissure is that of many specimens of this species. I feel unable to decide as to which of these species *babylonicum* belongs. The chief characteristic upon which its specific position was established does not obtain among thousands of *Gyrotoma* examined. It is unquestionably an abnormal shell. If it should be decided that *babylonicum* is the same as *pumilum* the latter species, described in 1860, will go into the synonymy.

Hinkley (2, p. 41) made this shell a synonym of *wetumpkaensis* and the latter the same as *pyramidatum*. Whatever *babylonicum* may be it belongs to the members of the genus occurring at Wetumpka, while *pyramidatum* is the first species appearing in the river and does not go down to Elmore County.

*Gyrotoma cylindraceum* (Mighels)

*Schizostoma cylindracea* Mighels, Bost. Proc., I, Oct. 1844, p. 189; Tryon, Monog. Strepom., 1873, pp. xv, 361; Lewis, Fauna of Ala., 1876, p. 23; Hinkley, Nautilus, XVIII, 1904, p. 40.

*Gyrotoma cylindracea* Migh., H. & A. Adams, Genera, I, 1858, p. 305.

*Gyrotoma cylindracea* Mull., Binney, Check List, 1860, No. 315.

*Gyrotoma cylindracea* Gould, Brot, List, 1862, p. 27; Paetel, Cat., 1888, p. 362.

*Gyrotoma olivula excisa* (Lea), Hannibal, Proc. Malacol. Soc., X, 1912, p. 181.

*Description*: Shell nearly smooth, cylindrical, thick, with slight, revolving undulations; epidermis olivaceous; spire ovate-conic, eroded; whorls three or four, flattened, shouldered; suture distinct, aperture oval; fissure deep and wide.—Mighels.

The author gave Warrior River, Alabama, as the locality for his species. Mr. C. W. Johnson informs me that the Mighels collection was destroyed in the fire which burned the quarters of the Portland Society of Natural History in 1854, another fire in 1866 destroying a second collection. The

type of *cylindraceum* must be considered lost and the species cannot be recognized with any exactness from the description. Hinkley (2, p. 40) thought the shell might be a form of *ellipticum* Anth.

## SPURIOUS SPECIES

*Melatoma sphaerica* Anth. is apparently an Anculosa belonging to a described species of the group *A. picta* Conrad. Habitat, Coosa River, Alabama. References:

*Melatoma sphaerica* Anth., MSS., Reeve, Monog. Melatoma, sp. 8, April, 1861.

*Schizostoma sphaericum* Anth., Lewis, Amer. Journ. Conchol., V, 1869-70, p. 169; Tryon, Monog. Strepom., 1873, p. 364; Lewis, Fauna of Ala., 1876, p. 23.

*Anculosa* sp., Goodrich, Anculosae of Ala. River Drain., 1922, p. 56.

H. & A. Adams list *Gyrotoma altilis* Anth., *conica* Say, *curvata* Say and *foremanii* Lea. The *altilis* possibly refers to *Gillia altilis* Lea. Shuttleworth's *G. conica* may be intended or *Melania conica* Say, a Pleurocera. Tryon (10, p. 132) appears to think that *curvata* refers to *Pleurocera curvatum* Lea. Two Melanians were named *foremanii* by Lea, but neither belongs to Gyrotoma. Paetel repeats these errors and adds *aequalis* Lea, *circumlineata* Tryon, *Coosaensis* Lea, *ellipsoides* Lea, *rubicunda* Lea and *vauviana* Lea, all belonging to other genera than Gyrotoma, besides *angulata* Lea, having reference probably to *Melania angulata* Anth., a Gonio-basis.

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11. WILLIS, J. C., "Age and Area." Cambridge, 1922.

## PLATE I

## GYROTOMA

All figures of shells are  $3/2$  times natural size

Figures 1, 2, and 3. *G. pyramidatum* Shuttleworth. Coosa River, Ten-Island Shoals, St. Clair County. (Cat. No. 27425.)

Figures 4 and 5. *G. spillmanii* (Lea). Coosa River, Shelby County. Schowalter Collection. (Cat. No. 27426.)

Figures 6, 7, and 8. *G. pagoda* (Lea). Coosa River, Higgins Ferry, Chilton County. (Cat. No. 27427.)

Figure 9. *G. pagoda* (Lea). Coosa River, Higgins Ferry, Chilton County. Young shell. (Cat. No. 27428.)

Figures 10 and 11. *G. pumilum* (Lea). Coosa River, Wetumpka, Elmore County. (Cat. No. 27429.)

Figures 12 and 13. *G. alabamensis* (Lea). Coosa River, Weduska Shoals, Shelby County. (Cat. No. 27430.)

Figures 14 and 15. *G. cariniferum* Anthony. Coosa River, Ft. William Shoals, Talladega County. (Cat. No. 27431.)

Figures 16, 17, and 18. *G. lewisii* (Lea). Ft. William Shoals, Talladega County. (Cat. No. 27432.)





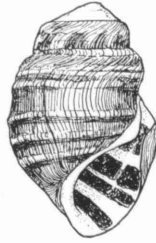
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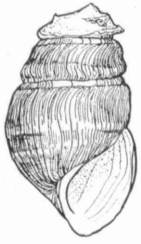
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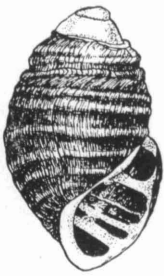
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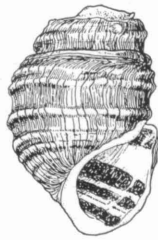
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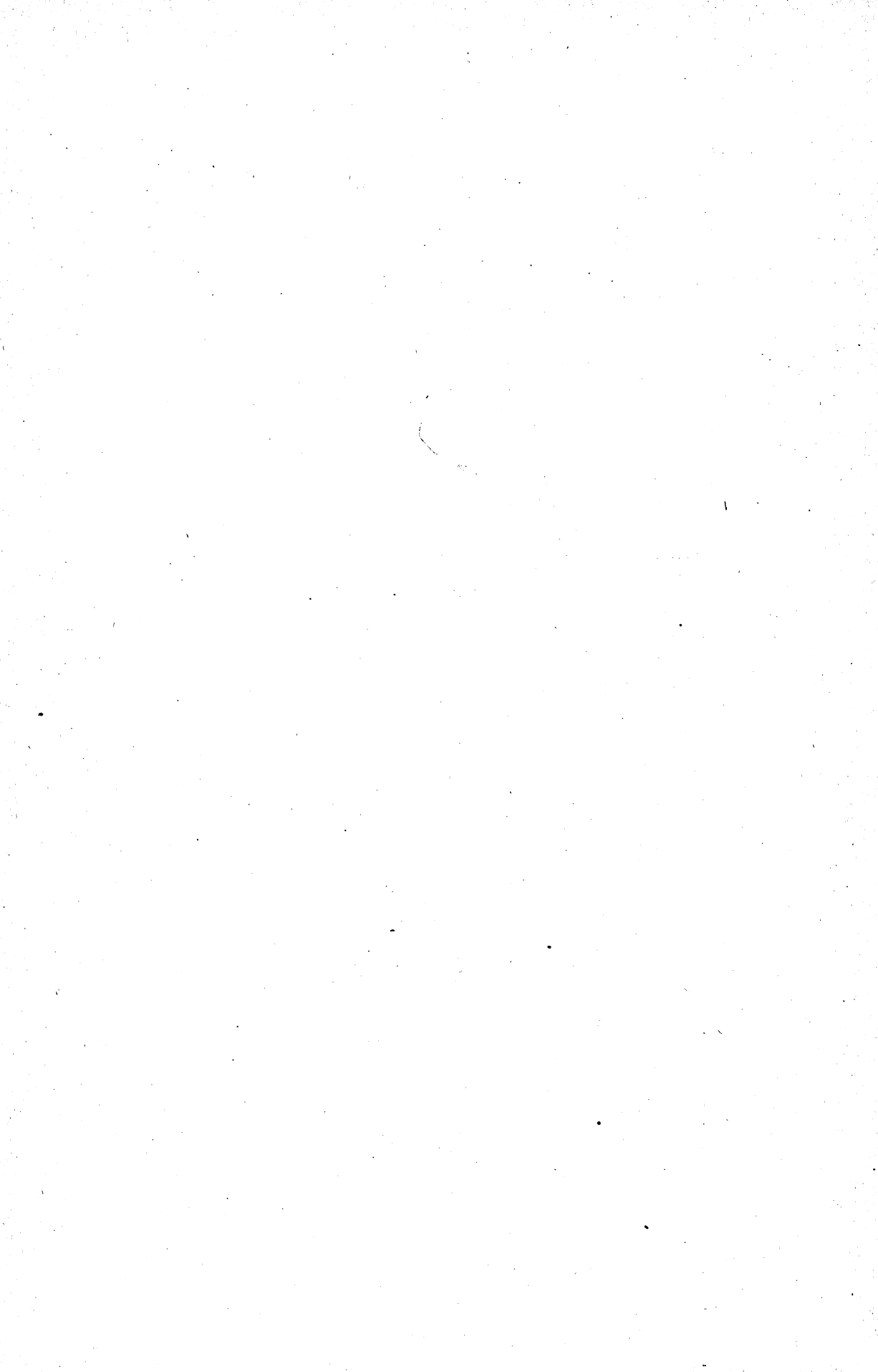


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## PLATE 11

## GYROTOMA

All figures of shells are  $3/2$  times natural size

Figures 19, 20, and 21. *G. hendersoni* H. H. Smith. Type. Coosa River, Ft. William Shoals, Talladega County. (Cat. No. 27433.)

Figures 22 and 23. *G. excisum* (Lea). Coosa River, Higgins Ferry, Chilton County. (Cat. No. 27434.)

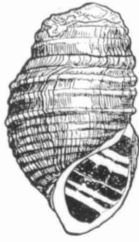
Figures 24 and 25. *G. laciniatum* (Lea). Coosa River, Weduska Shoals, Shelby County. (Cat. No. 27435.)

Figures 26 and 27. *G. incisum* (Lea). Coosa River, Wetumpka, Elmore County. (Cat. No. 27436.)

Figures 28 and 29. *G. incisum* (Lea). Coosa River, Weduska Shoals, Shelby County. (Cat. No. 27437.)

Figures 30, 31, and 32. *G. walkeri* H. H. Smith. Type. Coosa River, Cedar Island, Chilton County. (Cat. No. 27438.)

Figures 33, 34, and 35. *G. amplum* Anthony. Coosa River, Ft. William Shoals, Talladega County. (Cat. No. 27439.)



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