ON THE SHELLS OF THE HOLSTON RIVER.

BY JAMES LEWIS, M. D.

The Holston River rises in the mountainous regions of the western parts of Virginia and North Carolina. Flowing in a south-westerly direction through Eastern Tennessee, it receives numerous tributaries, one of which, the Clinch River, is a stream of nearly equal magnitude with the Holston, and at its junction with the Little Tennessee River (a stream of some size, rising in the south-western part of North Carolina), merges into the Tennessee River, which is properly but a continuation of the Holston under another name. In all the considerable streams which are united in this system of drainage, is a common fauna, varied locally by species which are not common to the whole system.

During two years past, a portion of the Holston River, extending from Little River Shoals to Chota Shoals, a distance of about 20 miles, has been explored by Miss Annie E. Law, of Concord, East Tennessee, and the various species of mollusca collected by her are the principal subject of the following notes, to which is appended a supplementary list of shells quoted by writers as found in the Holston River and at Knoxville. This, it is presumed, embraces all or nearly all that can be profitably suggested respecting the shells of the Holston from the knowledge we have of them at the present time. Before entering upon the consideration of species, it may be proper to remark that certain shells which heretofore have been quoted as found in the Holston have not so occurred in Miss Law's explorations. In reply to inquiry, Miss Law remarks, in a recent letter, "I have never found *Goniobasis* in the Holston. . . It seems to belong exclusively to small streams. Neither have I detected any among the shells found in Indian Mounds, nor among the vast beds of fossil shells washed up by the great freshet three years ago."

A small bivalve shell, described by Mr. Lea under the name *Margaritana Holstonia*, and referred to the Holston, has not been found by Miss Law in the Holston, but is somewhat abundant in some of the small streams of Monroe County.

Possibly conditions may have changed within a few years; but it seems to me more reasonable to surmise that localities have not always been accurately stated by collectors, and the descriptive naturalist has often located his species by conjectures based upon their association in a package, rather than from positive statements, which correspondents sometimes forget to furnish.

I have endeavored, through Miss Law's assistance, to obtain such information as would serve to render our knowledge of distribution reasonably accurate. But it may be presumptuous to suppose that a *perfect* series of notes on the species of so large a stream as the Holston might be the result of explorations made in so short a time as two years.

In the following notes I have been governed mostly by my own convictions. In a few instances I have deferred to the opinions of others whose more extended acquaintance with species entitle their views to consideration.

UNIONIDÆ.—[Catalogue and Notes.]

1. *Unio Æsopus*, Green.
2. " *alatus*, Say.
3. " *arcæformis*, Lea.
4. " *Barnesianus?* Lea. Two specimens, hardly mature, are all that have been seen. Mr. Wheatley suggested the species might be *U. Greenii*, Con. That species, however, belongs to a different system of drainage (Alabama River). The shells under consideration agreeing very nearly with Mr. Lea's description of *U. Barnesianus*, I have provisionally adopted that name for them.
5. " *biangulatus*, Lea.
6. " *brevidens*, Lea.
7. " *cælatus*, Con. On the authority of Mr. Wheatley.
8. " *caperatus*, Lea. Regarded sometimes as a variety of *U. dromas*, Lea; it seems to me to be a good species.
9. " *capsæformis*, Lea.
10. " *circulus*, Lea.
11. " *Clinchensis*, Lea. My determination of this somewhat common species may be questioned.
12. " *Conradicus*, Lea. Two young specimens, supposed to be *Conradicus*, may prove to be *subtentus*, Say.
13. " *Cooperianus*, Lea.
14. " *cornutus*, Barnes.
15. " *crassidens*, Lamarck.

16. *Unio cuneolus*, Lea. Shells regarded as *cuneolus* are at present somewhat uncertain.
17. " *cylindricus*, Say.
18. " *dolabelloides*, Lea. Mr. Lea changes the orthography in recent references to this species.
19. " *dromas*, Lea.
20. " *ebenus*, Lea.* Among Miss Law's earlier shells were specimens regarded as *ebenus*, which at a later date were identified as *Lesueurianus*, Lea, no doubt synonymous.
21. " *Edgarianus*, Lea. Not abundant.
22. " *elegans*, Lea.
23. " *fabalis*, Lea.
24. " *foliatus*, Hildreth. Three specimens found at Little River Shoals at various times.
25. " *glaber*, Lea. A rare species.
26. " *glans*, Lea. " " "
27. " *gibbosus*, Barnes. Common.
28. " *gracilis*, Barnes.
29. " *Haysianus*, Lea. *U. Sowerbyanus*, Lea, is, no doubt, a sexual counterpart.
30. " *Holstonensis*, Lea. A single specimen, apparently this species, is all that has been found.
31. " *intermedius*, Con. A common species in the Holston and Clinch Rivers. Besides the common form, I have a single specimen which varies notably, and which, if not abnormal, may prove to be a distinct species.
32. " *iris*, Lea. Two specimens, only, have been seen; doubtfully identified.
33. " *irroratus*, Lea.
34. " *Lesleyi*, Lea. Not abundant.
35. " *ligamentinus*, Lam.
36. " *metanever*, Raf.
37. " *monodontus*, Say.
38. " *Mooresianus*, Lea.
39. " *multiradiatus*, Lea. This, I think, includes *U. perradiatus*, Lea.
40. " *mytiloides*, Raf. *Fide* C. M. Wheatley.
41. " *ovatus*, Say.
42. " *patulus*, Lea. A single specimen.

* Many of the species common in Ohio and other Western States are *smaller* in the Holston River. This remark does not apparently apply with more force to *ebenus* than to several other species.

43. *Unio pernodosus*, Lea. Two specimens. It is apparently a good species.
44. " *perplexus*, Lea.
45. " *perradiatus*, Lea. Retained in deference to Mr. Wheatley. (See *multiradiatus*).
46. " *phaseolus*, Hildreth.
47. " *plenus*, Lea.
48. " *propinquus*, Lea. Abundant.
49. " *pudicus*, Lea. The young shells appear to me to be *pudicus;* the mature ones bear a strong resemblance to *U. Lyonii*, Lea. My determination is questionable
50. " *pustulosus*, Lea.
51. " *Pybasii*, Lea. Occurs also in small streams.
52. " *Ravenelianus*, Lea. A single specimen. May not be correctly determined.
53. " *rectus*, Lam.
54. " *securis*, Lea.
55. " *sparsus*, Lea A single well characterized specimen.
56. " *Stewardsonii*, Lea.
57. " *subtentus*, Say.
58. " *tenuissimus*, Lea.
59. " *tesserulæ* Lea. A single immature shell; determination questionable.
60. " *triangularis*, Barnes.
61. " *tuberosus*, Lea. Occurs in the Holston, Clinch and Tennessee Rivers with a more inflated form than is seen in typical specimens.
62. " *undulatus*, Barnes.
63. " *varicosus*, Lea.
64. " *verrucosus*, Barnes.
65. *Margaritana dehiscens*, Say. Rare.
66. " *marginata*, Say.
67. " *rugosa*, Bar. Rare.
68. *Anodonta oblita?* Lea. A single small specimen. Determination doubtful.

Univalves, (in alphabetical order).

69. *Aneulosa Cincinnatiensis*, Lea. In presenting my opinions on the species I am now considering, it may be well to premise that I began the study of the Strepomatidæ of the Holston River strongly impressed with the correctness of Mr. Tryon's determinations and synonymy, and with a desire to profit by his then unquestioned advantages. After a very thorough study of an immense number of specimens, of different ages and varieties, I arrived at results which are as follow:

In 1838 Mr. Lea described and figured a shell from the Ohio River, under the name of *Melania Cincinnatiensis*. I have specimens from the Holston River that *exactly* conform to the terms of his description, and among them are specimens that might be substituted for the specimen that was the original of his figure. At a later date Mr. Lea described the mature shell as *Anculosa tintinnabulum*. In the series of specimens by which I unite *Cincinnatiensis* and *tintinnabulum*,* the smallest is less than 0·08 inches in diameter, being about half as large as the original "*Mel. Cincinnatiensis.*" The series progresses through a large number of individual specimens to the largest adult *tintinnabulum*. I feel assured that identification was never more complete.

Mr. Tryon in his synonymy and elsewhere expresses the opinion that *Mel. Cincinnatiensis*, Lea, is the young of *Anculosa prærosa*, Say. Some of the varieties (so called) of *Anculosa prærosa*, have bicarinate young, but their *forms* are such that when of the dimensions of Mr. Lea's typical *Cincinnatiensis* (diameter 0·16 inch) they *do not exactly*, but only *approximately*, correspond thereto, and therefore must yield to the claims of *tintinnabulum*.

Having conclusively ascertained that the young of *Anculosa tintinnabulum* are *bicarinate* and *exactly* correspond to Mr. Lea's figure of *Mel. Cincinnatiensis*, it remains now to compare these young specimens with the young of *Anculosa subglobosa* of corresponding size; if there is *perfect* agreement, Mr. Tryon's synonymy of *subglobosa* (which includes *tintinnabulum*) may be allowed to pass unquestioned. If there are *very conspicuous* and *constant* differences it seems to me that these, considered in connection with the constant differences I observe in the adults, imply they are distinct species. My specimens of *A. subglobosa* embrace numerous specimens from $\frac{1}{8}$ inch diameter to the full grown adult, none of which are carinate, nor can I find *any* evidence by which I might identify *subglobosa* with *tintinnabulum*.

70. *Anculosa prærosa*, Say. There are clearly as many as ten or twelve well marked and constant varieties (?) referable to this species. The differences in some of these are remarkable, and are not confined to the adult specimens. Of some of these varieties I have very small specimens. In one variety carinæ are scarcely discernible in the smallest specimens. In others there are traces of carinæ upon shells of nearly or quite $\frac{1}{4}$ inch in diameter. Possibly in some of the most marked instances these differences might be regarded as specific. From all I can learn, I infer some of the varieties of *A. prærosa* occupy isolated stations, not being mingled together indiscriminately. This inference seems to be confirmed by the occurrence of a very well characterized variety at a point on the Tennessee River from which Mr. Wheatley has numerous specimens.

* With reference to my position in this matter, I will remark that Mr. U. P. James, of Cincinnati, finds *A. tintinnabulum* in the Ohio River. I have a single specimen from the Ohio River, labeled "*prærosa*" by Mr. Wheatley.

71. *Anculosa subglobosa*, Say. This species is somewhat rare in the Holston, but occurs in considerable numbers in Little River. The young are smooth, shining, depressed, subglobose, with a somewhat pointed, elevated apex. The outer lip differs constantly from that of *Cincinnatiensis* (= *tintinnabulum*, Lea). The young shells also very decidedly differ from those of *Anculosa* (Mel.) *virgata*, Lea, which Mr. Tryon has placed in the synonymy of *subglobosa*.

72. *Anculosa Tryoni*, Lewis. Plate , fig. . Shell pear-shaped, with the apex somewhat broadly and regularly rounded; wider and subconstricted below; suture slightly impressed on the apicial whorls, more conspicuously impressed below; apex, in very young shells, a minute, elevated, dark point, which at later stages of growth is lost by erosion, usually leaving a minute axial pit; whorls 3 (to 4 ?)* rapidly enlarging; aperture outwardly somewhat regularly rounded from the slight constriction below the suture to the base—acutely angular above, subangular below; outer lip sharp, thicker within; pillar much thickened, having a subtubercular calcareous deposit near the superior angle of the aperture; plane of the aperture nearly regular, and obliquely inclined to the axis. Color variable—yellow, orange, olivaceous, purple or brownish. Bands many, two or none; sometimes visible within when obsolete without. Length 0·90 inch. Width 0·60 inch. Aperture nearly $\frac{2}{3}$ the length of the shell.

In Conch. Jour. vol. ii, page 133, figures 101, 102, Mr. Tryon presents varieties of this species, as *Anculosa tæniata*, Con. *A. tæniata* is, perhaps, a smaller species than *A. Tryoni*, less varied in form, color and bands, and also exhibits peculiarities in the arrangement and modification of the bands not observable in *A. Tryoni*. The suture and also the form of the whorls are different. Occasional specimens of *A. tæniata* are somewhat disposed to exhibit broad, slightly elevated, revolving lines on their surfaces. This feature is absent in *A. Tryoni*, which may be characterized as a smooth species. *A. tæniata* also belongs to a different system of drainage, viz., the Alabama River and its trib-

* The apex of the adult specimens is usually considerably eroded.

utaries. There are *small* shells (a variety of *A. Tryoni*) in the Holston which likewise differ from the Alabama River shells. *A. Tryoni* is found abundantly near Concord.

73. *Anculosa virgata*, Lea. I have no difficulty in identifying certain small shells of the Holston by Mr. Lea's figure and description of *Melania virgata*. Mr. Wheatley has the same species from the Tennessee River, which he calls "*Anculosa vittata*, Lea," his specimens being possibly a little larger and less perfect than those found in the Holston. In my Catalogue of the Shells of the Coosa River I included *Anculosa vittata*, Lea, quoting from Mr. Lea's "Observations." Later, I have from Dr. Schowalter (who furnished Mr. Lea original specimens of *A. vittata*) a statement of error of locality, which he corrects by stating that *A. vittata* was not found in the Coosa, but in a smaller stream, a tributary of the Coosa. I am persuaded that *A. vittata* can scarcely occur in two systems of drainage so distinct. If, however, such is found to be the case, *vittata* will unquestionably yield priority to *virgata*. Miss Law informs me that *A. virgata* is found on one of the dams at Little River Shoals, and is attainable only under difficulties. She has found it in no other locality. It differs in *habit* from *Anculosa subglobosa*, Say, with which Mr. Tryon has united it in his Synonymy and elsewhere.

74. *Ancylus* ? An abundant species on the rocks in the Holston. I have not been able to identify the species, but have no doubt so common a species may long since have been described.

75. *Angitrema verrucosa*, Raf. A common and somewhat variable species in the Holston, Clinch and Tennessee Rivers. Immature specimens that agree with Mr. Lea's figure of *Melania Holstonia* are not rare. Smooth specimens sent to Mr. Wheatley were returned by him as *Lithasia fuliginosa*, Lea. I am not acquainted with that species, but by a comparison of Mr. Lea's figure of it I am unable to identify my shells with it.

76. *Eurycœlon Anthonyi*, Redf. Found somewhat abundantly on *Chota Shoals*, but is quite rare in other portions of the Holston examined by Miss Law. I have a single specimen of this variable species that sufficiently resembles Mr. Lea's figure of *Lithasia Tuomeyi*. Others resemble his figure of *Anculosa turbinata*. This species grows larger in portions of the Tennessee River reached by Mr. Wheatley's correspondents. Miss Law has found very large specimens of this species in Indian Mounds, showing that in former times it probably attained a much greater development than at the present day.

77. *Io brevis*, Anth.

78. *Io spinosa*, Lea.

79. *Io turrita*, Anth. Mr. Lea, in a letter relative to *Io*, expressed a doubt if there were more than one species of spinous *Io*. I infer he would include all the spinous species under *fluvialis*, Say. In this opinion I am disposed to coincide with him, considering the varieties of *Anculosa prærosa*, Say (which afford a parallel), a good precedent. I observe in Miss Law's shells some peculiarities which I think have not been noted. *Io brevis* has the first four whorls of perfect specimens smooth. *Io spinosa* has tubercles on all the upper whorls. *Io turrita* has undulations terminating in tubercles, on the upper whorls. I quote from Miss Law's letters the following interesting remarks: "The muscular power of *Io* is astonishing. I frequently find one adhering to a rock half as large as my head, and when I take up the shell it brings the rock with it, and requires much force to separate it." *Io* is not confined to the Holston, as might be inferred from the recorded statements of its habitat. Miss Law has sent me specimens from the Clinch River. Mr. Wheatley has specimens from the Tennessee River. I have no doubt it will also be found in the Little Tennessee River, and possibly in other considerable streams that form part of the same system of drainage.

80. *Melantho ponderosus*, Say. I change the adjective termination for grammatical reasons. This species does not attain as great size in the Holston, nor is it as abundant as in the Tennessee River.

81. *Physa Saffordii*, Lea. Possibly not correctly determined. The shells collected by Miss Law are probably quite abundant.

82. *Somatogyrus Currierianus*, Lea. I have from Miss Law numerous shells identical with *Somatogyrus parvulus*, Tryon, found, at very low stages of water, in little pools left by the receding water along swift, shallow, gravelly portions of the Holston. Less abundantly, a somewhat larger shell agreeing with *S. aureus*, Tryon. Also larger shells identical with "*Amnicola Currieriana*, Lea," found in still water, along muddy portions of the Holston, near the shore. They are, without doubt, different ages of one species. Mr. Lea's name for the species takes precedence.

83. "*Strephobasis Clarkii*," Lea. Near Concord, somewhat abundant. Varieties approximate "*Mel. plena*, Anth.," and suggest a doubt whether *S. Spillmanii*, Lea, should be regarded as a synonym of *plena*. I have a specimen of *S. corpulenta*, Anth., to which the same remark will apply.

84. *Strephobasis corpulenta*, Anthony.* Little River Shoals. Rare. I have young specimens of this species that closely resemble Mr. Lea's figure of *Trypanostoma napoideum*.

85. *Strephobasis Lyonii*, Lea. Little River Shoals. Abundant.

86. *Trypanostoma affine*, Lea. I admit this species in deference to Mr. Wheatley.

87. *Trypanostoma canaliculatum*, Say.

88. *Trypanostoma curtum*, Hald. Recorded by Mr. Tryon as *Strephobasis curta*, Hald. Dr. Hartman, basing an opinion on the form of the opercle, and its connection with the proligerous lobe, is disposed to regard this species as a *Trypanostoma*. The species is remarkable for its numerous varieties, many of which appear to be entirely local, as has been remarked of *Anculosa prærosa*, Say.

I venture to suggest the following synonymy, not as being entirely conclusive, but as being in many particulars deserving of inquiry:

Trypanostoma curta, Hald. Dr. Hartman's MSS.
Melania curta, Hald. Date? Locality?
† [H.] *Melania turgida*, Lea. June 18, 1841. Young short and wide; apex entire. (L.)‡
[H.] *Melania picta*, Lea. June 18, 1841. Banded variety. (L.)
Melania solida, Lea. May 2, 1845. Adult, wide and solid; apex eroded. (L.)
Strephobasis solida, Lea. April 16, 1861. *Mel. solida*, Lea, redescribed. (L.)
Trypanostoma simplex, Lea. April 15, 1862. Young shells; no bands. (C. M. W.)
Trypanostoma minor, Lea. April 15, 1862. Young shells; no bands; var. (C. M. W.)
§ *Trypanostoma pumilum*, Lea. April 15, 1862. Banded, slender var.; Ohio River. (L.)
Trypanostoma bivittatum, Lea. April 15, 1862. Two banded, young. (C. M. W.)
[H.] *Trypanostoma trochulus*, Lea. April 15, 1862. Wide, young; apex entire. (L.)

* Recent specimens raise grave doubts if the shells here referred to are satisfactorily determined.

† Species credited to the Holston are preceded by the letter H.

‡ L. = Lewis. C. M. W. = Wheatley.

§ I have specimens from the Holston River, labeled *Try. pumilum*, Lea, by Mr. Lea.

Trypanostoma moriforme, Lea. April 15, 1862. Constricted on middle of whorl. (C. M. W. & L.) (Two species confounded?)
* *Strephobasis olivaria*, Lea. June 3, 1863. Adult; slender variety. (L.)
Strephobasis Hartmaniana, Lea. [1870, MSS.] Slender, solid variety; Tenn. R. (C. M. W. & L.)

If the above synonymy should be verified, the question of priority lies between *Mel. curta*, Hald., and *Mel. turgida*, Lea.

89. *Trypanostoma filum*, Lea. Not very abundant.

90. *Trypanostoma gradatum?* Anthony. A beautiful light yellowish brown shell of 7 or more whorls, with a remarkably twisted columella. The young shells have been confounded with *Strephobasis corpulenta*, Anth., from which they differ principally by the prolongation of the anterior portion of the outer lip. The shell at all ages has much the aspect of a *Strephobasis*, but the form of the lip is that of *Trypanostoma*. My specimens are much larger than the recorded dimensions, and may be undescribed. Found on Little River Shoals. Rare. Identification not entirely satisfactory.

91. *Trypanostoma ligatum?* Lea. A few specimens only have been seen, from Little River Shoals. Not authoritatively determined.

92. *Trypanostoma moniliferum?* Lea. Not many.

93. *Trypanostoma parvum*, Lea. Little River Shoals and Little River. More numerous in Little River. Specimens presented to Mr. Lea were pronounced by him larger than his original specimens.

94. *Trypanostoma ponderosum*, Anth. I follow Mr. Wheatley in adopting Mr. Tryon's synonymy of this species. Fine specimens, identical with Mr. Lea's figure of *Try. dux*, are not uncommon.

95. *Trypanostoma undulatum*, Say. With some hesitation I admit this species among the Holston River shells, confessing my inability to recognize it.

The following notes relative to habits and distribution, taken from Miss Law's letters, are of interest, and refer principally to Little River Shoals:

"*Anculosa* [*A. prærosa* and *A.* '*tintinnabulum*,' Lea] and *Angitrema* [*A. verrucosa*, Raf.] are everywhere tolerably abundant in swift, shallow water. *Anculosa virgata*, Lea, I have seen nowhere but on the dam in the south part of the Holston [at Little River Shoals]; *Strephobases* are scattered throughout the

* I have an *original specimen* from Mr. Lea.

shoals. *Trypanostoma*, in still water, near the banks, and *Io* only where the water is very rapid. *Euryecælon* is scarce here, and affects sheltered crevices among the rocks, eschewing mud entirely."

Supplementary List of Species quoted from printed records as "found in the Holston," not yet received from Miss Law as being found in that stream:

Unio amœnus, Lea; *U. argenteus*, Lea; * *U. compressissimus*, Lea; *U. Copei*, Lea; *U. fassinans*, Lea; *U. mæstus*, Lea; *U. perpictus*, Lea; *U. pilaris*, Lea; *U. puniceus*, Hald.; † *Margaritana Holstonia*, Lea; ‡ *Goniobasis simplex*, Say; § *Goniobasis, glabra*, Lea; *Gon. strigosa*, Lea (*Try. strigosum*, Tryon); *Io fluvialis*, Say; *Io inermis*, Anth.; *Trypanostoma Roanense*, Lea; *Trypanostoma subrostratum*, Lea.

Species quoted from printed records as found at Knoxville, not yet received from Miss Law as being found in the Holston:

Goniobasis Stewardsoniana, Lea; ‖ *Gon. Estabrookii*, Lea; *Trypanostoma Knoxvilliana*, Lea; *Try. prasinatum*, Con.; ¶ *Try. subulæforme*, Lea.

At Chota Shoals Miss Law found specimens of a variety of *Anculosa*, which Mr. Lea refers to "*tintinnabulum*." The shells have *nearly* the form of that species, but are remarkable for a beautiful greenish mottled appearance, unlike that of any other shells I have seen from any portions of the Tennessee system of drainage. They also have a remarkably thin and tender epidermis, which is readily removed in cleaning by treatment that does not similarly affect other shells of the Holston. Until more information can be obtained respecting them, it is scarcely proper to present them with the expectation that they will be received as a new species.

Mohawk, N. Y., Oct. 24, 1870.

* The habits of *U. compressissimus*, as stated by Mr. Lea in describing this species, may have kept it from Miss Law's observation.

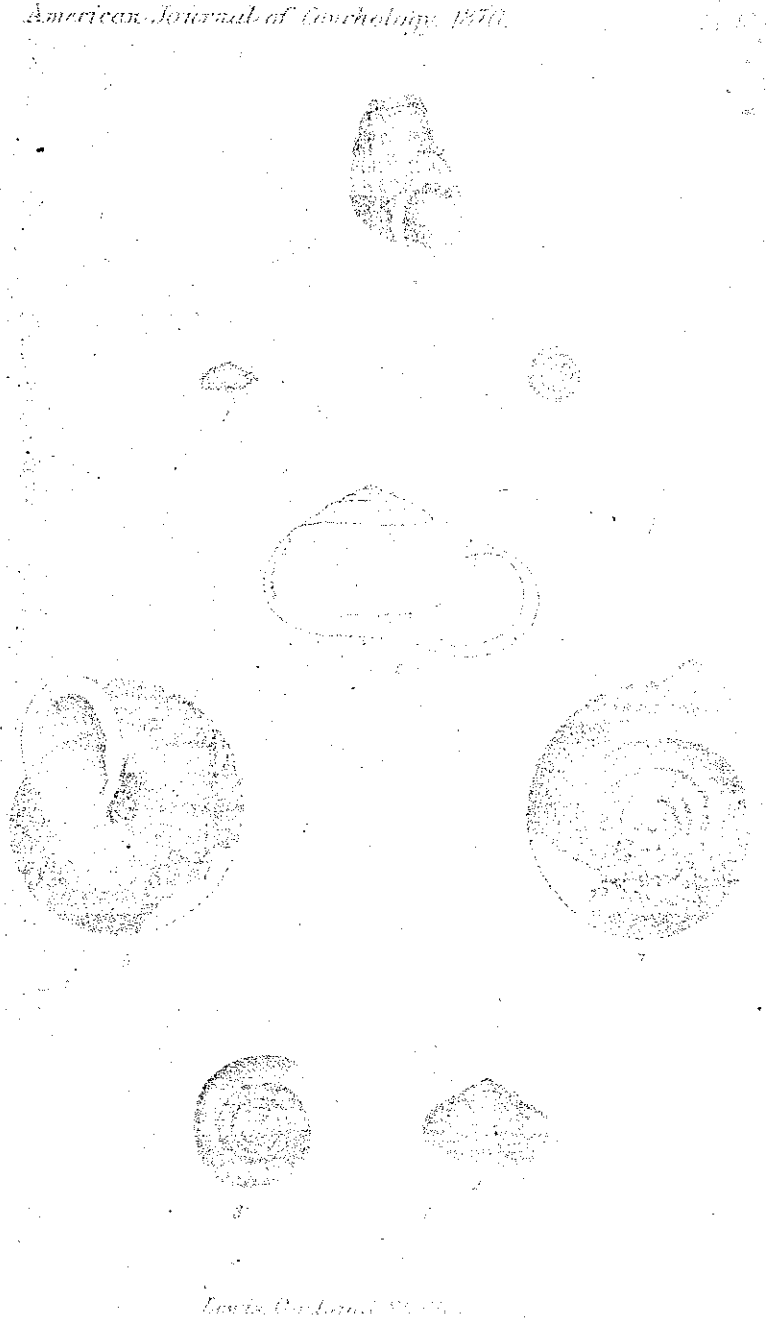
† *Marg. Holstonia*, Lea, occurs in small streams in Monroe and possibly also in Blount Co.

‡ Shells that I have regarded as *Gon. Saffordii*, Lea, very like Mr. Tryon's figures of *G. simplex*, occur in Turkey Creek, near Concord.

§ *Gon. glabra* occurs in small streams in *Monroe Co.?*

‖ The ferruginous coating mentioned by Mr. Lea in his remarks on this species is common to shells from *creeks* in East Tennessee.

¶ *Try. subulæforme*, Lea, occurs in Turkey Creek, near Concord.



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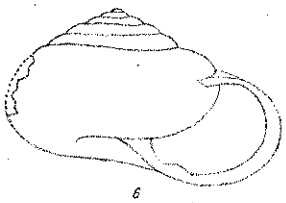

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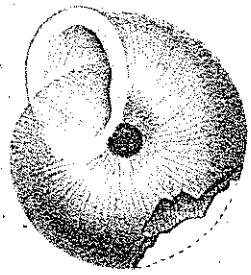

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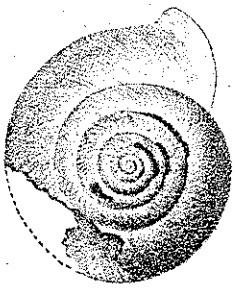

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Lewis, On Land Shells of Tennesee

Am. J. Conchology 6: 216-228