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THE MUSSEL FAUNA OF THE UPPER CUMBERLAND BASIN BEFORE ITS IMPOUNDMENT[1]

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ABSTRACT

During 1947-1949, shortly before impoundment of Lake Cumberland by closure of Wolf Creek Dam, a study was made of the Naiad fauna of the upper Cumberland River basin (Kentucky, U. S. A.). Results are compared with an earlier survey of the same area in 1911. In the survey here reported, 59 distinct freshwater mussels or clams were found of which 16 belong to the "Cumberlandian" group unique to the Cumberland and Tennessee Rivers. Only 4 species (including a single Cumberlandian form) had surmounted Cumberland falls and none of these were restricted to that area. The earlier survey had disclosed 60 species, of which only 56 coincided: 3 species recovered in the later survey had not been found previously and 4 species then collected were not found later. In the 36 years since the earlier survey various mussels have suffered decimation by coal mine acids in the uppermost main stem and in the major tributaries to this area of the river. The genus ***Dysnomia*** has been practically eliminated from its former region of greatest variety. A number of other mussels have gained in prevalence.

Only some of the marked changes observed in prevalence, relative abundance and distribution may be explained by the decline in pearling and the presence of mine acids. The upper Cumberland was not significantly exploited by the pearl button industry. In certain instances the causes of the variation are still obscure.

The Cumberland and Tennessee Rivers are inhabited by many of the common mussels of the Mississippi Basin; living there also are a number of species that have been reported from no other drainage areas. Students of mussels, particularly A. E. Ortmann, have referred to these endemic forms as the Cumberlandian Group (see Table 4), although more of them occur in the Tennessee River and none are unique to the Cumberland. Studies of the mussel fauna of the Tennessee River have been reported in a number of articles, but the mussels of the Cumberland River are known mainly from a single publication of Wilson and Clark (1914) based upon a 1911 survey. Ortmann collected there but used his data to supplement observations on the Tennessee.

The Cumberland and Tennessee both enter the Ohio River from western Kentucky. Their mouths are separated by only a 12 1/2 mile reach of the Ohio, and the lower 50 miles of their channels (in Kentucky and Tennessee) are generally within 10 miles of each other. At one locality (about 20 river miles up the Tennessee from its mouth) the Cumberland loops to within a mile of its sister river. The Cumberland originates in southeastern Kentucky and northeastern Tennessee. Its main stem flows west and south from Kentucky into Tennessee, assumes a westerly course in Tennessee, and then bends northwest to reenter Kentucky and join the Ohio. The main stem of the Tennessee is largely formed by rivers that originate in western Virginia and North Carolina and proceed toward a rendezvous in the general region of Knoxville, Tennessee. They are later joined by a tributary that drains a small area in northern Georgia. The main stem moves southwest across Tennessee and enters Alabama just west of the Alabama-Georgia line. Its course in Alabama

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(southwest, then northwest) requires about 200 channel miles. It then bends almost due north through Tennessee and finally takes a nornorthwest to northwest path in Kentucky.

It is assumed that the close proximity (or possible earlier confluence) of the mouths and lower reaches of these two rivers has facilitated dispersion of Cumberlandian naiads throughout, each from individual focal points in either river. Wilson and Clark (1914) and Ortmann (1918, 1924, 1925) believed they located focal areas for a number of forms.

Information for this article was obtained shortly before closure of Wolf Creek Dam across the Cumberland River just below Rowena Ferry in Russell County, Kentucky (between Stations 21 and 22, Fig. 1). Field studies covered the period October 1947 to December 1949. Impoundment has since formed "Lake Cumberland" that extends upstream to Cumberland Falls and into the lower reaches of most tributaries that are represented in our collections.

Additional distributional records--lacking since Ortmann's work of the 1920's led to revision of interspecific relations of the Cumberlandian and other groups--had long been sought, and time to secure them in the upper Cumberland under relatively natural conditions was growing short in 1947. This situation also offered one of the few remaining opportunities to study big river mussels before and after impoundment of their normal habitat.

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STREAM CHARACTERISTICS AND HABITATS

The main stem of the Cumberland River begins at the union of Poor, Clover, and Martin's Forks near Harlan, Kentucky (Fig. 1). Its course is generally westward until it leaves the State from Monroe County.

This report concerns the eastern reach of the river from Harlan County, Kentucky, to the Tennessee line. This stretch is separated into two distinct mussel realms by Cumberland Falls (between Stations 9 and 10, Fig. 1). The Laurel and Rockcastle Rivers enter shortly below the falls and Big South Fork flows in at Burnside. About 50 years ago the U. S. Army Corps of Engineers constructed a system of locks and dams that was intended to maintain year round towboat navigation up to the region of the falls. At the time of our study (1947-49) the system had largely fallen into disuse, although the dam at Lock 21 (Station 18) formed a pool that extended above Burnside.

The Upper Cumberland drainage basin contains many coal deposits that are rather extensively mined. Iron sulfide that occurs with the coal is usually exposed to water, oxygen, and bacterial action in these mines and the following reactions take place:

$$FeS_2 + 2O_2 \longrightarrow FeSO_4 + S$$
$$FeS_2 + 7O_2 + 2H_2O \longrightarrow 2FeSO_4 + 2H_2SO_4$$

Sulfuric acid (H_2SO_4) created by the second reaction is responsible for the acidity of drainage from the mines. The presence of this mine water has undoubtedly restricted occurrence of naiads in some locations, particularly in Big South Fork. A pH of 5.4 was found at Station 16 on this stream in November, 1949. A few badly eroded shell fragments were the only evidences of a former mussel population there.

The upper stream bed is rocky, varying from large areas of bedrock, such as those just above the falls, to bars of small stones and gravel. Some sand occurs in protected pockets and intermixed with

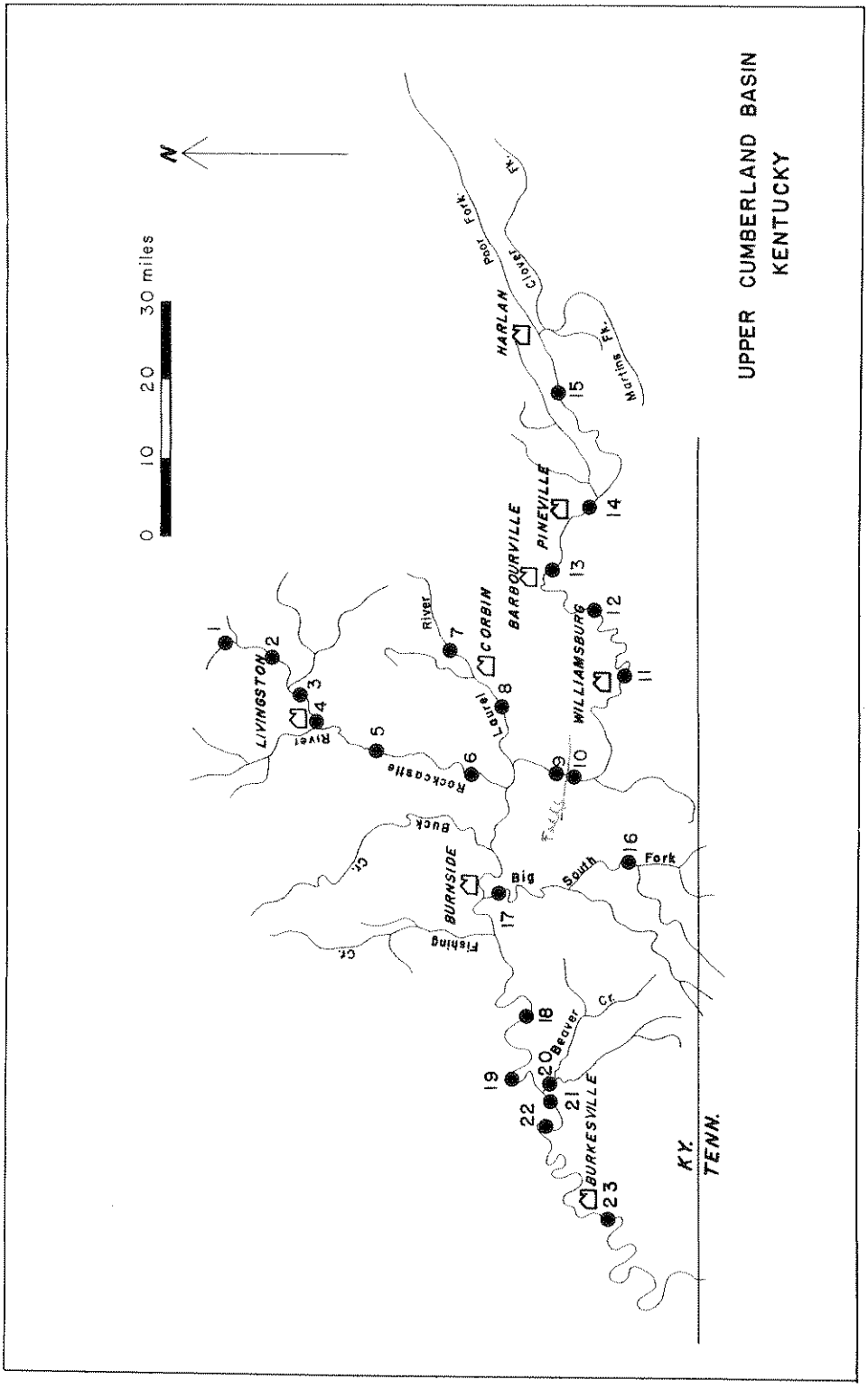


FIG. 1. Map of the Upper Cumberland Basin showing locations of major towns (building profile) and collecting stations (solid circles).

stones, but no extensive sand bars were noted. In the area just below Cumberland Falls sand pockets among large stones and slabs contained great numbers of mussels, many of which were quite large and very old. Shingle bars are important naiad habitats in the river below the falls, and mussels were usually abundant in areas of shingle and gravel up to the vicinity of Pineville where they appeared to be decimated by mine acids. Rockcastle River has a rocky bottom with scattered small shingle or shingle and gravel bars up to the region of Laurel Fork. Sand and gravel accumulations in pools and shingle and gravel riffles yielded many mussels in Laurel Fork; Laurel River had numerous bed-rock areas and mussels occurred among rather large stones (6-12in.diameter); and Beaver Creek contained numerous shingle and gravel bars. The lower two miles of Big South Fork were included in the Lock 21 pool; all workable bottoms were shingle or larger stones and long rocky rapids occupied about 2 1/2 miles of stream bed above the pool. Acid coal mine waters have destroyed all mussels in this stream from the region of Yamacraw (Station 16) to the area just above the mouth. Very few mussels were found in the vicinity of the mouth. Collections were made at the following 23 locations shown in Fig. 1.

Station
1. Laurel Fork of the Rockcastle near McGee
2. Laurel Fork of the Rockcastle River
3. Rockcastle River near Ardery
4. Rockcastle River above Livingston
5. Rockcastle River at Billows
6. Rockcastle River near mouth
7. Laurel River at Lily
8. Laurel River at Keavey
9. Cumberland River below Cumberland Falls
10. Cumberland River above Cumberland Falls
11. Cumberland River at Suttons Mill
12. Cumberland River at Gausdale
13. Cumberland River at Artemus
14. Cumberland River above Pineville
15. Cumberland River at Wallins
16. Big South Fork at Yamacraw
17. Big South Fork above Burnside
18. Cumberland River below Lock 21
19. Cumberland River at Horseshoe Bottom
20. Beaver Creek near mouth
21. Cumberland River at Rowena Ferry
22. Cumberland River at Long Bottom (just below Wolf Creek Dam)
23. Cumberland River at Neeleys Ford

Figs. 67, 68 show some mussel bars in the Cumberland below Lock 21, Fig. 2 portrays the lower Rockcastle River, and Fig. 3 is a fairly typical stretch of the main stem above the falls. Views offered by these photos are reasonably representative of areas sampled.

METHODS

Mussels were collected by hand: probing into various loose substrates with the fingers, turning over large stones, digging out sand pockets, robbing muskrat piles, locating siphons, tracks or displaced individuals. In the main stem below the falls collection by these methods was possible only when and where water was shallow enough to permit wading, usually on shingle bars. These areas had dense mussel populations that were most readily sampled by probing through stones with the fingers. It was necessary to dig deeper in colder weather, and one species, *Lastena lata*, always seemed to avoid the uppermost layers. *Cumberlandia monodonta* occurred only on those bars where it could find the shelter of large stones.

Muskrat piles were most common in Beaver Creek, on main stem bars at Stations 19, 21 and 23, and in the lower

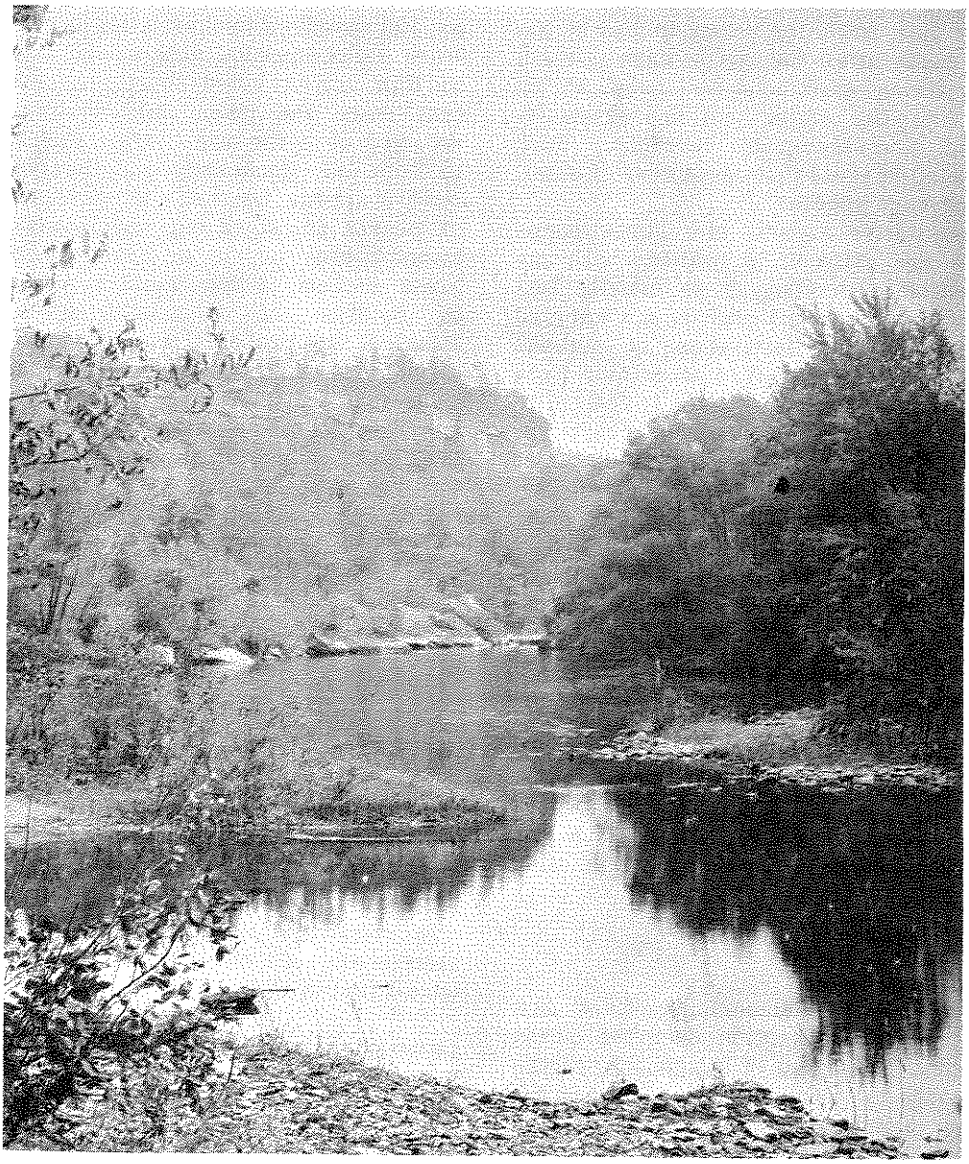


FIG. 2. Rockcastle River shortly above mouth near Mt. Victory, Kentucky. Station 6.

Rockcastle River. These rodents place mussels on rocks and logs above the water line and later return to dine on the soft parts after the shells have opened. Many living specimens and empty shells fall into the water and are gradually moved downstream by currents. Such areas often yield fine specimens of small and/or rare species.

Quantitative aspects of a mussel population are difficult to evaluate with any collection methods. It is usually impossible to cover all regions of a sampled reach and the effectiveness of methods used is often difficult to ascertain. Collectors are therefore generally obliged to use a system that is somewhat subjective. In this account clams are termed abundant if they were generally spaced within 12in. (20.5 cm) of each other, common if their number per square meter was at least 4, and rare if more poorly represented. Species were considered abundant if they formed 25% or more of an abundant population or 40% or more of a common population, common if they comprised as much as 5% of an abundant population or 20% of a common population, and rare if less numerous. Larger species were seldom as closely grouped as were smaller ones and they were considered abundant or common if they formed slightly smaller percentages than those listed.

COMMERCIAL VALUE

The upper Cumberland River has received little attention from the button industry. A number of indigenous species reputedly have nacre that is too hard for button manufacture, and the more important shell beds have been relatively inaccessible. Areas mapped for fishing by button companies in the early 1900's proved unprofitable and lay virtually untouched for 30 years prior to 1947.

Until about 1915, local residents practiced pearling to a considerable extent during slack agricultural seasons. Mussels stripped in search of pearls were thrown out upon the banks and great piles of crumbling shells offer mute evidence of effort formerly expended along this line. Wilson and Clark (1914) noted as many as 200 pearlers working a single bed and were shown some valuable pearls. Interest in this activity died shortly after their trip down the river and pearling was unheard of in the late 1940's. Conditions in both the Rockcastle and Cumberland Rivers appear favorable for development of pearls (most of our specimens contained slug pearls or baroques) but a great amount of time must be expended in location of a valuable specimen. Pearling was probably abandoned after its unprofitable nature became evident. Local fishermen advised that *Lampsilis ovata* and *Elliptio crassidens* were considered the most valuable pearl mussels. We found slug pearls in almost all species collected (Fig. 69).

Wilson and Clark (1914) predicted a great future for the mussel fishery of the Cumberland, but little materialized in the upper reaches.

SYSTEMATIC ACCOUNT OF NAIAD OCCURRENCE

FAMILY MARGARITANIDAE

The species recovered in the present survey of the upper Cumberland are listed in Table 1 (p 429). In the following, details are given on each of the 59 species or forms found. A species that is probably now extinct, *Pegias fabula*, is also mentioned. All but 4 of these forms are illustrated in Figures 4 to 66.

Cumberlandia monodonta (Say) 1829. Figs. 4 and 8.

Confined to the main river below the falls; lives under large stones and may be collected only when or where water is shallow enough to permit wading and moving of such stones; very poorly represented in muskrat piles. Living specimens were collected only at Horseshoe Bottom (Station 19).

This mussel is uncommon in the lower Cumberland or Tennessee, and is regarded as rare in the Ozarks and other regions of the Mississippi Basin. Ortmann (1918)

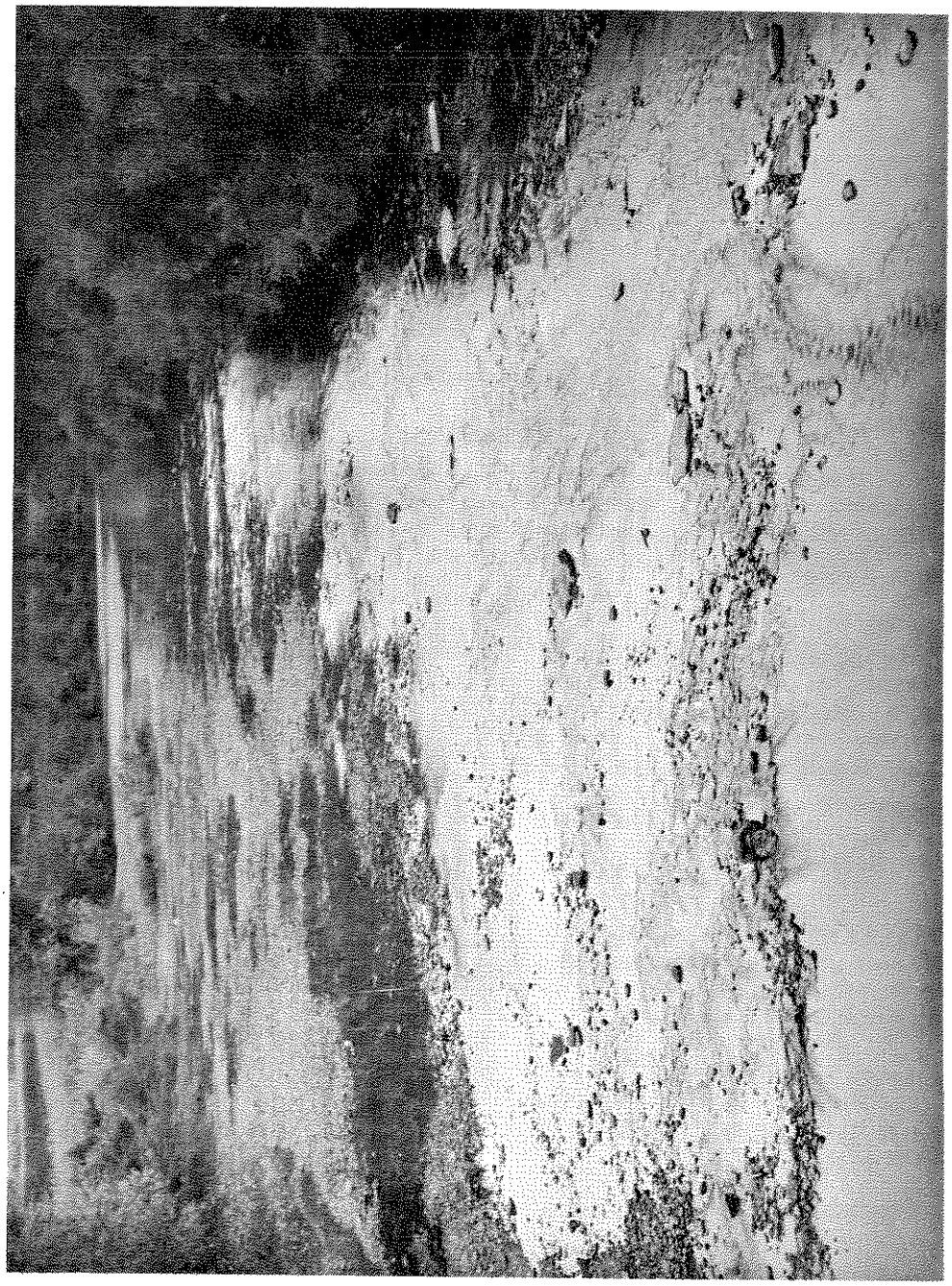


FIG. 3. Cumberland River at Sulton's Mill, Kentucky. Station 11.

found it focally abundant in the upper Tennessee, Clinch, and Holston Rivers, and reported many dead shells at Mussel Shoals in 1925. Wilson and Clark (1914) did not find it in the upper Cumberland, and encountered it only occasionally in the lower river.

Common name: Spectacle Case.

FAMILY UNIONIDAE

SUBFAMILY UNIONINAE

Fusconaia flava (Rafinesque) 1820. Fig. 9.

Small flattened specimens were found in Beaver Creek (Station 20) but it was not encountered elsewhere. Wilson and Clark (1914) reported it only from the East Fork of Stones River at Waterhill, Tennessee. Ortmann (1926) considered it native to smaller headwaters only.

Fusconaia undata (Barnes) 1823.

This species was also taken only in Beaver Creek; 3 small, flattened specimens were found. Wilson and Clark (1914) rarely uncovered it and also obtained only small shells.

Common name: Pigtoe.

Fusconaia subrotunda (Lea) 1831. Fig. 6.

A typical mussel of the large bars in the main stem below the falls, but not a particularly abundant one. Very large flattened specimens occurred in the Rockcastle River below Mt. Victory. Reported from the Ohio, Green, Kentucky, and other streams of the Ohio Basin. Ortmann (1925) found it only in the main stem of the Tennessee.

Amblema costata Rafinesque 1820. Fig. 10.

This species is characteristic of smaller streams and was found in the Cumberland only at Station 22. It was very common in the Rockcastle up to the vicinity of Laurel Fork. It occurred also in Beaver Creek. Wilson and Clark (1914) reported it only from smaller streams.

Common names: Three-ridge; Blue point.

Megalonaias gigantea (Barnes) 1823. Fig. 7.

Abundant in the main stem below Burnside but absent in all tributaries and the area immediately below the falls. Wilson and Clark (1914) failed to find it in the upper Cumberland.

Common name: Washboard.

Quadrula cylindrica (Say) 1817. Fig. 11.

A rare shell in the upper Cumberland that exhibited no marked predilection for any type of environment, occurring in both the main stem and smaller streams (Table 1).

Common name: Rabbits-Foot.

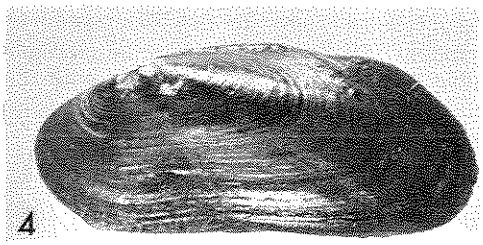
Quadrula mentanevra Rafinesque 1820. Fig. 14.

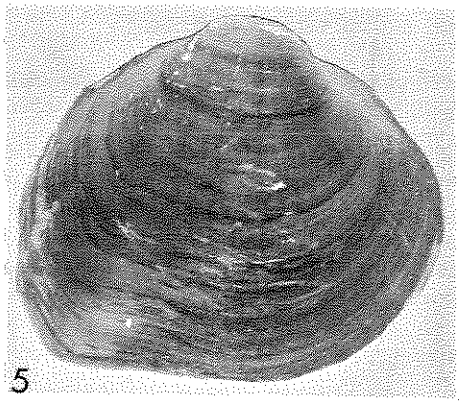
A typical big river form, but found also in Beaver Creek and the lower Rockcastle River; missing, however, from the area just below the falls. It is a very abundant mussel on the main stem bars, but considered rare by Ortmann (1925) and Wilson and Clark (1914). These collectors could hardly have overlooked such numbers as existed in 1947-49.

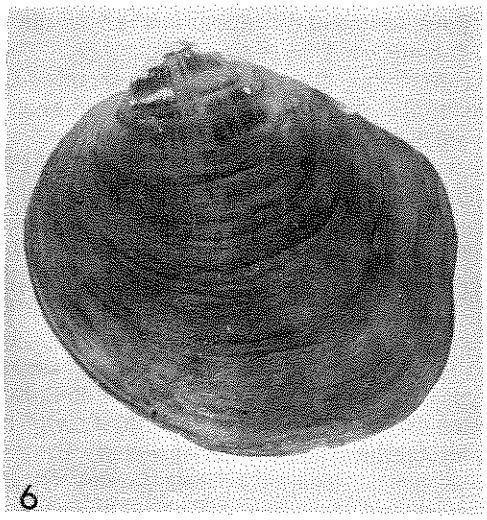
Common name: Monkey-face.

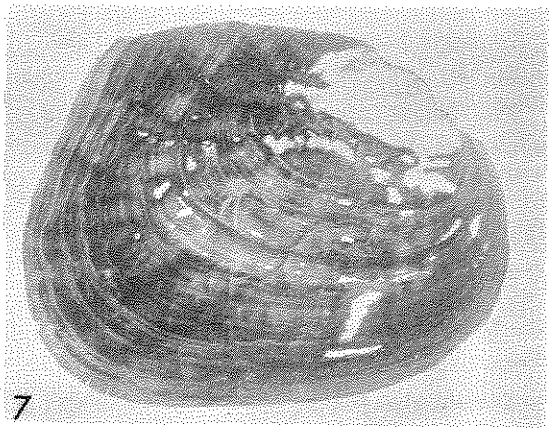
Quadrula pustulosa (Lea) 1831. Figs. 12 and 15.

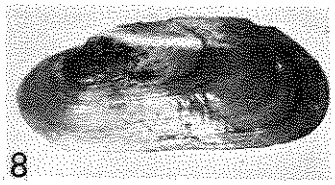
Very abundant on big river bars and also in lower reaches of the Rockcastle River and Beaver Creek. The only *Quadrula* present just below the falls. Cumberland River specimens are typical of the species, exhibiting the broad green umbonal stripe, and losing pustules toward the headwaters. Some specimens from just below the falls were considerably flattened (Fig. 12).

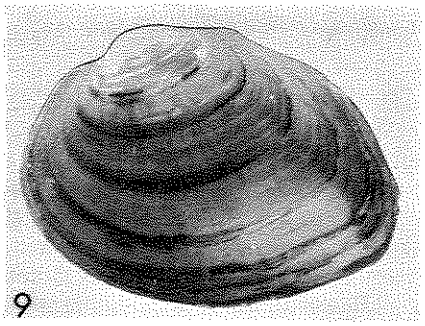












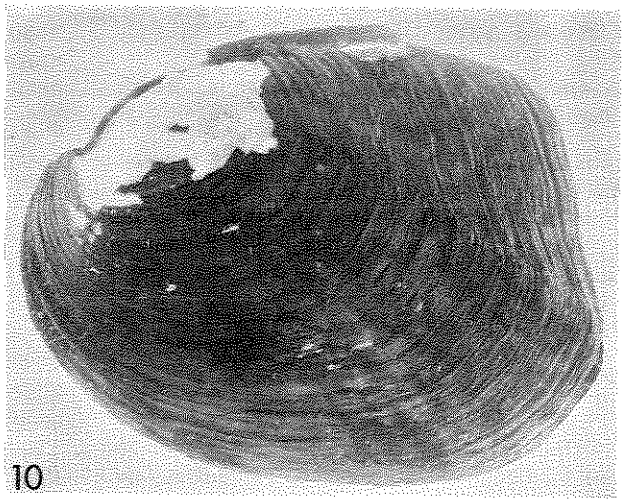


FIG. 4. *Cumberlandia monodonta* (Say)
FIG. 5. *Pleurobema cordatum* (Rafinesque)
FIG. 6. *Fusconaia subrotunda* (Lea)
FIG. 7. *Megalonaias gigantea* (Barnes)
FIG. 8. *Cumberlandia monodonta* (Say)
FIG. 9. *Fusconaia flava* (Rafinesque)
FIG. 10. *Amblema costata* Rafinesque

Common name: Warty back.

Tritigonia verrucosa Rafinesque 1820. Fig. 23.

This mussel is one of the most widespread of the upper Cumberland system. It was most numerous on the big river bars, but was also quite abundant in the Rockcastle. Many large specimens showing marked sexual dimorphism were taken just below the falls. Wilson and Clark (1914) noted a similar distribution.

Common names: Pistol grip; buckhorn.

Cyclonaias tuberculata (Rafinesque) 1820. Fig.13.

The finest specimens of this species occurred in the lower Rockcastle. It was present on some of the main stem bars but was largely replaced there by the variety *granifera*.

Common name: Purple warty-back.

Cyclonaias tuberculata granifera (Lea) 1838. Fig. 16.

The inflated big river form of *C. tuberculata* was found only on big river bars.

Common name: Purple warty-back.

Plethobasus cyphyus (Rafinesque) 1820. Fig. 19.

A rare species in the upper Cumberland taken only at Stations 19 and 22. It was also rare at the time of Wilson and Clark (1914) who reported it had very hard nacre.

Common names: Bullhead; Sheepnose.

Plethobasus cooperianus (Lea) 1834. Fig. 17.

Also rare in the upper Cumberland in the late 1940's but reported as common by Wilson and Clark in 1914. A very attractive species with pale pink diffused through the white nacre. The periostracum is pale brown, usually less pustulate than the specimen illustrated. Reported as rare in the Tennessee by Ortmann (1918, 1925). May be confused with *Quadrula pustulosa* but lacks the green umbonal band.

Common name: Cumberland Pigtoe.

Pleurobema cordatum (Rafinesque) 1820. Fig. 5.

Four forms of this species were common in the upper Cumberland drainage. The parent form, *cordatum*, was restricted to the main stem where it was numerous on big shoals. It was very abundant in the collections of Wilson and Clark (1914) who considered it the most important commercial species in the river.

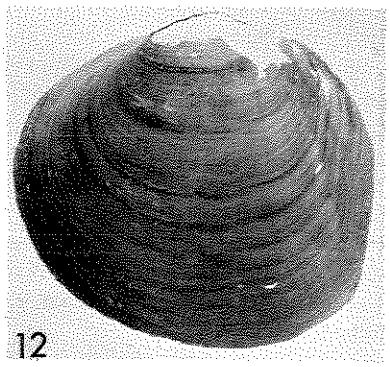
The three distinct variants of *P. cordatum* are usually listed as trinomials by students of North American naiads, although they often occur side by side with the parent form. *P. c. coccineum* is normally the only member of the complex found in headwaters, but it often lives in downstream areas frequented by *P. cordatum*. The other two forms (*P. c. plenum* and *P. c. pyramidatum*) seemingly have the same habitat preferences as the parent form. The trinomial system is a convenience, and this complex has long been a part of our mussel lore, but no claims are made for the validity of the subspecific rank.

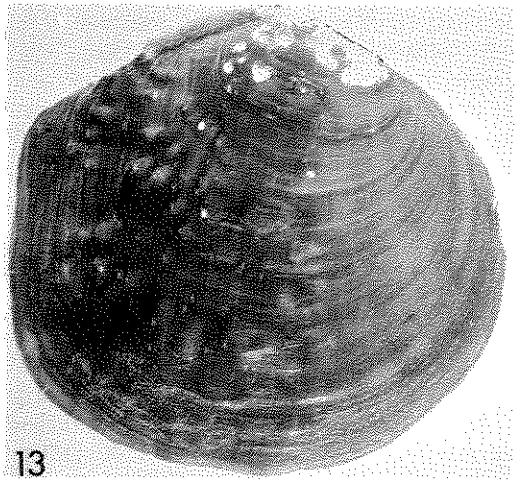
Common name: Ohio River Pigtoe.

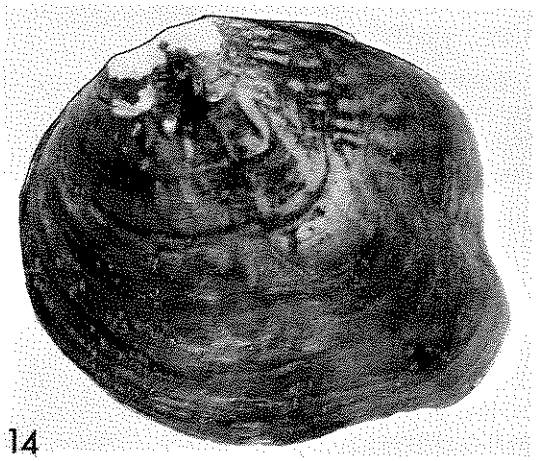
Pleurobema cordatum plenum (Lea) 1840. Fig. 22.

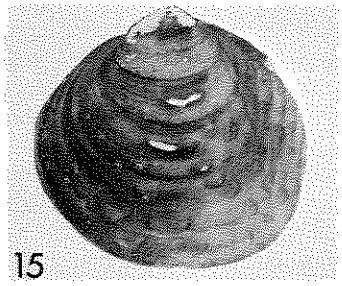
Although called a rare form of *P. cordatum* by Wilson and Clark (1914) and by Ortmann (1925) *P. c. plenum* was a common shell in the Cumberland at the time of our collections, and was found in goodly numbers on all main stem bars. This variety appears intermediate between the typical *P. cordatum* and *P. c. pyramidatum*. It is slightly more rounded than *P. c. pyramidatum* with a less distinct sulcus.

Pleurobema cordatum pyramidatum (Lea)









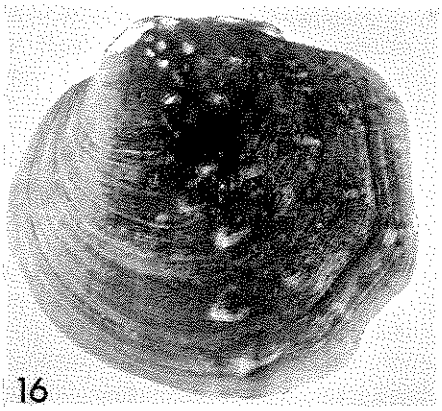


FIG. 11. *Quadrula cylindrica* (Say)
FIG. 12. *Quadrula pustulosa* (Lea) Headwater type
FIG. 13. *Cyclonaias tuberculata* (Rafinesque)
FIG. 14. *Quadrula metanevra* (Rafinesque
FIG. 15. *Quadrula pustulosa* (Lea) Downriver form
FIG. 16. *Cyclonaias tuberculata granifera* (Lea)

1831. Fig.21.

This, the highest, shortest form of the *cordatum* group, occurred only on the big river bars. Its extreme form is unmistakable, but some specimens are difficult to separate from *P. c. plenum*. It is tempting to group both forms under *P. c. pyramidatum*, which has priority, but they are generally distinct and perhaps deserve to retain separate identities at present.

Pleurobema cordatum coccineum(Conrad) 1836. Fig.20.

This variety occurred in the main river but attained its maximum concentrations in the Rockcastle, clearly demonstrating its general relationship to headwaters.

Pleurobema oviforme (Conrad) 1834. Fig. 18.

Ortmann (1918, 1924, 1925) assumed this species had replaced the Ohio valley form *P. clava* in the Cumberland and Tennessee. We found it only in Beaver Creek and in the extreme headwaters of the Rockcastle River in Laurel Fork. Ortmann described 2 forms in the Tennessee, a flattened headwater *P. o. argenteum*, and an inflated big river *P. o. holstonense*. Its appearance and occurrence in the upper Cumberland suggest it has definite affinities to *P. cordatum coccineum*. In the lower and middle Rockcastle River *Pleurobema* is represented only by the variety *P. c. coccineum* and the *P. oviforme* specimens found in Laurel Fork appear to be an extreme headwater form of *cocineum*. Wilson and Clark (1914) did not find *P. oviforme* below Burnside and thought it a small stream type. Ortmann's discoveries in the Tennessee suggest different relationships, and indicate that additional collections should be carried out there before any attempt is made to revise the position of *P. oviforme*. If it were known only from our collections in the Cumberland it should certainly be considered a form of *P. cordatum* that replaces *P. c. coccineum* in small upper reaches.

Elliptio crassidens (Lamarck) 1819. Fig. 25.

Primarily a main stem species that was not present in the Rockcastle River above Mt. Victory (Station 6), in Beaver Creek, or the Lower Laurel River, and rarely occurred in Big South Fork; however, 2 specimens were picked up in the Laurel River at Lily under marked headwater conditions. This was a puzzling occurrence and may reasonably be regarded as accidental and as an aftermath of some unusual condition. It shows, however, that no general pattern may be taken for granted. *E. crassidens* was very abundant in the main river below the falls and formerly was highly regarded as a pearl species. Larger examples had thick shells and were usually much eroded. Nacre was usually dark pink but several white nacred specimens were noted.

Common name: Elephant ear.

Elliptio dilatatus (Rafinesque) 1820. Fig. 27.

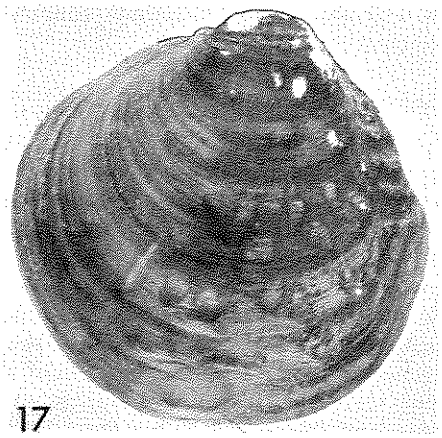
This mussel occurred at every station except No. 7, and was the most widely distributed and abundant mussel in the upper Cumberland in the late 1940's. Wilson and Clark (1914) reported it much less abundant than *E. crassidens* and poorly represented in a great number of their collections. Its predominance at the time of our study was one evidence of considerable change in the mussel fauna over the preceding 36 years.

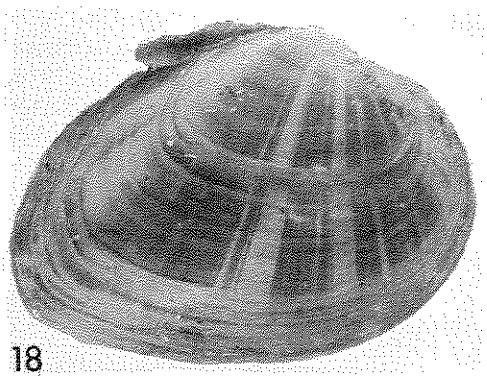
This species clearly demonstrates isolation of mussels above Cumberland Falls. Everywhere below the falls its nacre was uniformly purple, but specimens from above, were partly white or wholly white inside.

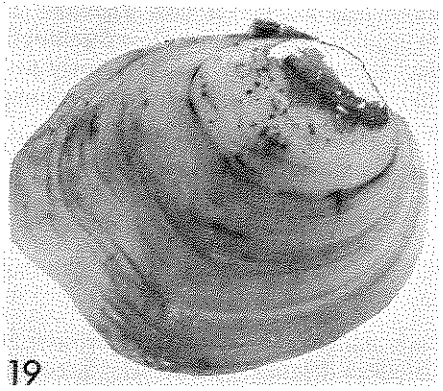
Common names: Lady finger; spike.

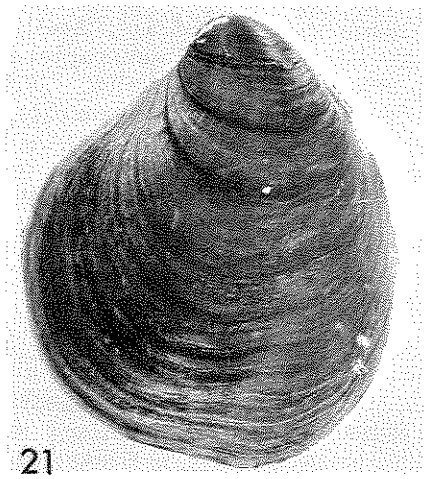
Lastena lata (Rafinesque) 1820. Figs. 24 and 28.

A rare Mississippian form that was found in fair numbers on main stem shoals below the falls. It burrowed deeply among the small stones and gravel and was









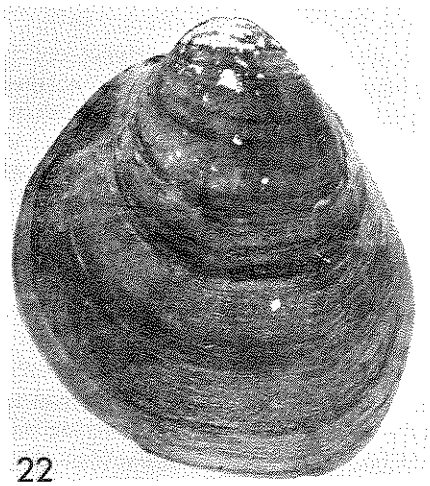


FIG. 17. *Plethobasus cooperianus* (Lea)
FIG. 18. *Pleurobema oviforme* (Conrad)
FIG. 19. *Plethobasus cyphus* (Rafinesque)
FIG. 20. *Pleurobema cordatum coccineum* (Conrad)
FIG. 21. *Pleurobema cordatum pyramidatum* (Lea)
FIG. 22. *Pleurobema cordatum plenum* (Lea)

captured because of digging down with the hands. Beautifully rayed specimens were taken (Fig. 24). Ortmann (1918, 1924, 1925) rarely found it in the Tennessee System, and Wilson and Clark (1914) seldom collected it in the Cumberland. They suggested that its rarity in their collections may have simply represented the ineffectiveness of crowfoot bars for this species.

SUBFAMILY ANODONTINAE

Lasmigona costata (Rafinesque) 1820. Fig. 30.

This species preferred headwater streams and occurred in the main stem only at Station 19. It was most abundant in the Rockcastle River. Ortmann (1918, 1924, 1925) reported it as a small stream type in the Tennessee drainage. Wilson and Clark (1914) rarely found it in the upper Cumberland and not at all in the lower river. Our Rockcastle River specimens contained numerous baroque pearls.

Common name: Fluted shell.

Alasmidonta marginata (Say) 1819. Fig. 29.

A rather uncommon mussel in the Cumberland. (Table 1). Our specimens were small and attractively rayed. Wilson and Clark (1914) considered it rare, and Ortmann (1924, 1925) reported it as rare in the Tennessee. All three authors thought it a small stream form, but we found it to be more abundant in the main stem.

Common name: Elk toe.

Pegias fabula (Lea) 1836.

This species was found by Wilson and Clark (1914) in the Rockcastle River near Livingston, but extensive searches of the same area during 1948 and 1949 failed to uncover it. It was reported as rare in the Tennessee by Ortmann (1918, 1925). This is apparently a headwater form and may now be extinct in the Cumberland system. It is hoped that mention of it here will stimulate additional search as opportunity permits.

Strophitus rugosus (Swainson) 1822. Fig. 26.

A common mussel on the main stem bars, but also present in the Laurel and Rockcastle Rivers and Beaver Creek. It was most abundant at Station 19. *S. rugosus* and *Elliptio crassidens* were the only mussels found in the upper Laurel River. Our specimens had a dark brown or black periostracum and salmon and bluish nacre. It was seldom seen by Wilson and Clark (1914) but they did find it above the falls. It now appears to be restricted to the region below Cumberland Falls. Ortmann found it abundantly in the upper and rarely in the lower Tennessee River.

Common name: Squaw foot.

SUBFAMILY LAMPSILINAE

Ptychobranchus fasciolaris (Rafinesque) 1820. Fig. 32.

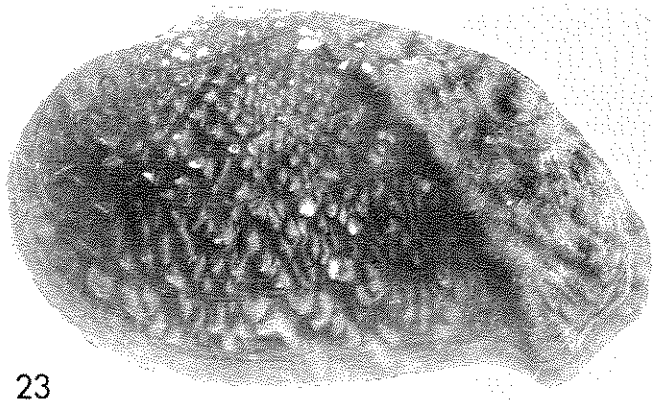
This mussel was almost as widespread as *Elliptio dilatus* (Table 1). Specimens taken just below the falls (Station 9) were very large and of great age. Shells had a white thick nacre and would apparently have some commercial value. Wilson and Clark (1914) found it commonly, but never noted it to be abundant. In the late 1940's it was abundant on many large river bars and in the Rockcastle River.

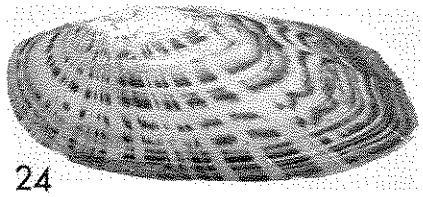
Common name: Kidney shell.

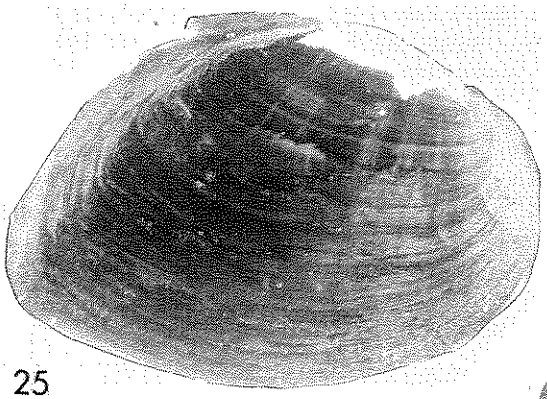
Obliquaria reflexa Rafinesque 1820. Fig. 31.

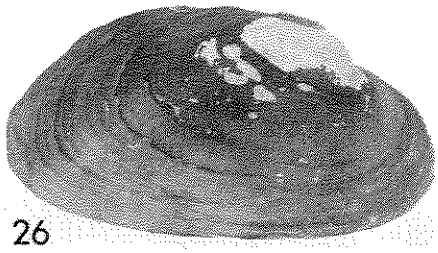
Considered abundant by Wilson and Clark (1914) but rare in our collections. We found it at all Cumberland River stations below the falls, in Beaver Creek, and the lower Rockcastle River. Ortmann reported it from Big South Fork (1924) but it now appears to be extinct in lower reaches of that stream.

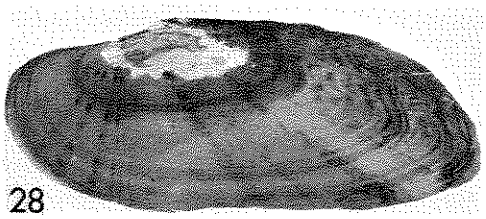
Common name: Three-horned warty back.











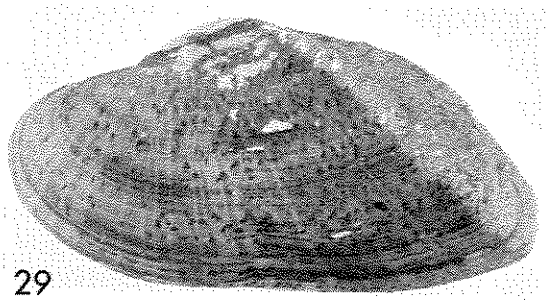


FIG. 23. *Tritigonia verrucosa* (Rafinesque)
FIG. 24. *Lastena lata*(Rafinesque)
FIG. 25. *Elliptio crassidens* (Lamarck)
FIG. 26. *Strophitus rugosus* (Swainson)
FIG. 27. *Elliptio dilatatus* (Rafinesque)
FIG. 28. *Lastena lata* (Rafinesque)
FIG. 29. *Alasmidonta marginata* (Say)

Cyprogenia irrorata (Lea) 1828. Fig. 33.

This species was not commonly found and then only on the main stem bars. Wilson and Clark (1914) also found it infrequently. Ortmann considered it an interior basin form that was widespread but not abundant in the Cumberland and Tennessee.

Dromus dromas (Lea) 1834. Fig. 35.

This is a true Cumberlandian form which we found only on the main stem bars below the falls, but in considerable numbers. The shell is very hard, with some pinkish but mostly white nacre, and is reputedly unfit for button manufacture. The flattened headwater form, *D. caperatus* (Lea) 1845 formerly occurred in Big South Fork (Wilson and Clark, 1914) but we believe it is now extinct in the upper Cumberland. *D. dromas* is an attractive naiad with neatly rayed epidermis. Young individuals may have a hump near the umbones, but this area is usually eroded in older specimens. It is apparently more abundant in the Cumberland than in the Tennessee (Ortmann 1918, 1925).

Common name: Camel shell.

Obovaria retusa (Lamarck) 1819. Fig. 34.

This species was fairly common on the big stream bars below the falls but it did not enter any of the tributaries. Some unusually large specimens were taken from Station 23. Nacre is dark salmon or purple in beak cavities. Reported as rare by Wilson and Clark (1914) and as rare in the Tennessee by Ortmann (1918, 1924, 1925).

Obovaria subrotunda (Rafinesque) 1820. Fig. 37.

This species was very common in the Cumberland below the falls, although it did not go up to the region just below them (Station 9). It also occurred in the lower Rockcastle and in Beaver Creek. Those from the tributaries were flatter than the main stem specimens. Flattened headwater forms are often referred to the variety *O. s. lens* (Lea).

Actinonaias carinata gibba (Simpson) 1900. Fig. 38.

This shortened, compressed form of the mucket has been found only in the Tennessee and Cumberland systems. Ortmann (1925) reported typical *A. carinata* from Duck River and *A. c. gibba* in the main Tennessee. Examples of *A. carinata* resembling *A. c. gibba* have been reported from the Green and Ohio Rivers, but it seems generally agreed that the true southern mucket (*gibba*) is strictly a Cumberlandian form. This was a very common mussel in the main stem below the falls. It was found up to Mt. Victory in the Rockcastle River, and rarely in Big South Fork above Burnside. Wilson and Clark (1914) considered it the most valuable button shell in the river.

Common name: Southern mucket.

Actinonaias pecterosa (Conrad) 1834. Figs. 39 and 42.

This *Actinonaias* is also a true Cumberlandian form, but it is a headwater rather than a big river species. It occurred very rarely above the falls (one specimen at Station 11), was very abundant just below the falls (Station 9) and in the Rockcastle River up to Laurel Fork; it was also present in Big South Fork and Beaver Creek. This species is longer and lower than *A. carinata gibba* (Figs. 39, 42) and has distinctive blotched or chevroned rays. It occurred with *A. c. gibba* at Stations 9, 6, and 16, and shows definite affinities to the latter form. An exhaustive search was made for intergrades, and although some specimens from Station 9 nearly qualified, the hunt was unsuccessful. Ortmann (1918) noted that *A. pecterosa* was most abundant where *A. c. gibba* began to disappear in the upper Tennessee system.

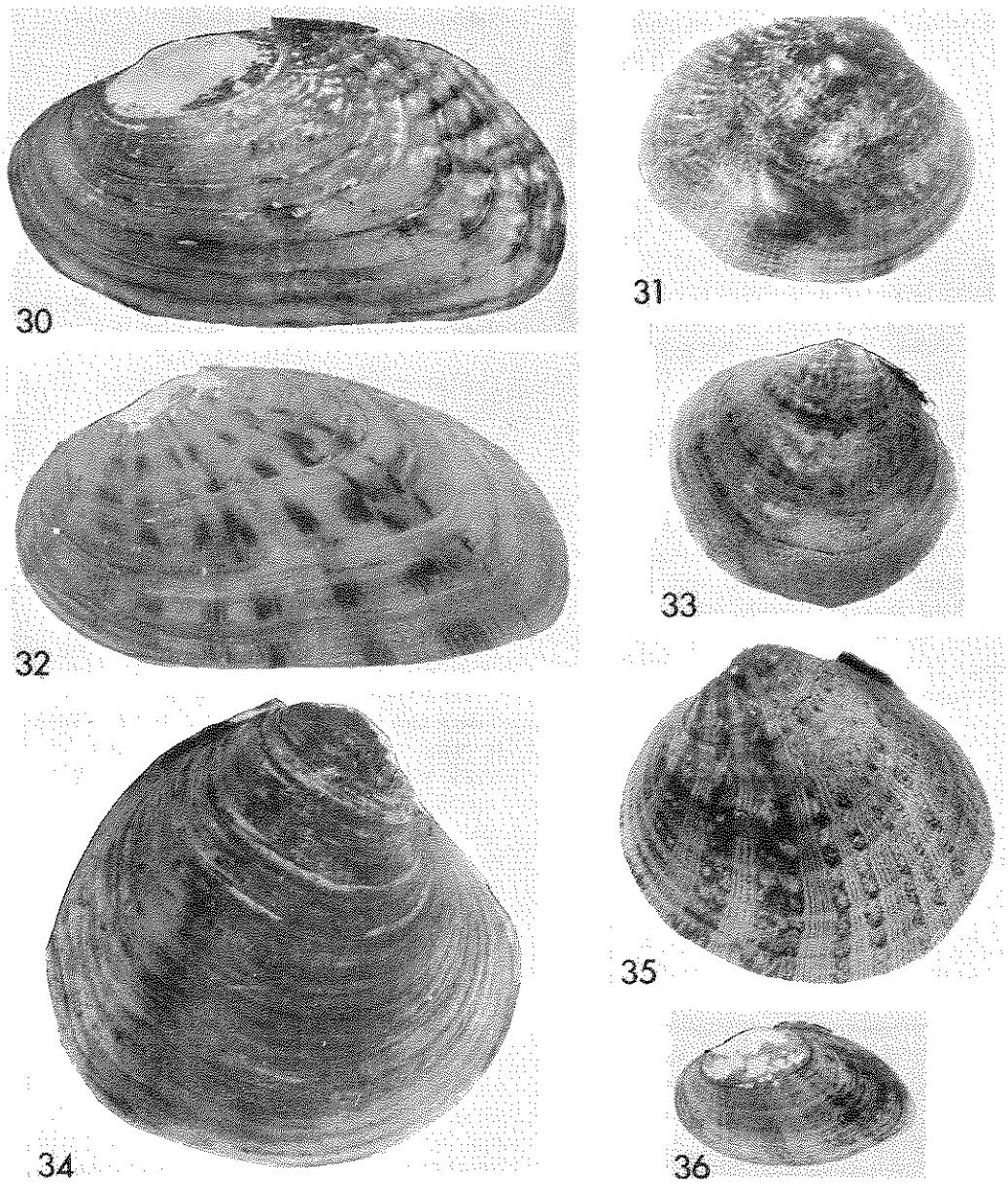


FIG. 30. *Lasmigona costata* (Rafinesque)
FIG. 31. *Obliquaria reflexa* Rafinesque
FIG. 32. *Ptychobranchus fasciolaris* (Rafinesque)
FIG. 33. *Cyprogenia irrorata* (Lea)
FIG. 34. *Obovaria retusa* (Lamarck)
FIG. 35. *Dromus dromas* (Lea)
FIG. 36. *Truncilla donaciformis* (Lea)

It was abundant in Cumberland headwaters at the time of Wilson and Clark's (1914) study.

Truncilla donaciformis (Lea) 1828. Fig. 36.

A rare species in the Cumberland that was found only at Stations 18 and 19. Wilson and Clark (1914) found it limited in distribution and it was rarely noted in the Tennessee system by Ortmann (1924, 1925). Our specimens were small and quite eroded.

Truncilla truncata Rafinesque 1820. Fig. 40.

Rather uncommon, but more numerous and widespread than *T. donaciformis* (Table 1). It was most abundant in the main stem below the falls but was also present in Beaver Creek. Reported uncommon by Wilson and Clark (1914) and as rare in the Tennessee and Cumberland by Ortmann (1925).

Common name: Deer toe.

Plagiola lineolata Rafinesque 1820. Fig. 45.

Common in the Cumberland below the falls, but not just below the falls (Station 9). Very abundant on big bars below Lock 21 and in the mouths of Beaver Creek and Rockcastle River. It attained very large size at Stations 19 and 23. It was considered common by Wilson and Clark (1914) but was reported as rare in the Tennessee by Ortman (1918, 1924, 1925). It was once thought a good button shell in the Cumberland.

Common name: Butterfly.

Leptodea fragilis (Rafinesque) 1820. Fig. 48.

This mussel was fairly common on big stream bars and occurred in Beaver Creek. Wilson and Clark (1914) and Ortmann (1918, 1924, 1925) thought it a big river species not found in smaller streams.

Common name: Paper shell.

Leptodea laevissima (Lea) 1830. Fig. 43.

Reported as rare by Wilson and Clark (1914) and as rare in the Tennessee by Ortmann (1925). We found it at Stations 6, 19, and 20 in 1948 and 1949. It is not exclusively a big river species but it is rare in the upper Cumberland.

Common name: Paper shell.

Leptodea leptodon (Rafinesque) 1820. Fig. 41.

A very rare shell throughout the interior basin, and found only at Horseshoe Bottom (Station 19) in 1948. Rarely found by Wilson and Clark (1914) and seldom taken by Ortmann in the Tennessee (1918, 1924, 1925).

Proptera alata (Say) 1817. Fig. 50.

This species occurred in all regions below the falls except in the Laurel River. It was very common on the main stem bars where it attained great size. It was not thought especially common by Wilson and Clark (1914), but Ortmann found it to be common and abundant in the Tennessee drainage.

Common name: Purple heel-splitter.

Carunculina moesta (Lea) 1841.

This is a Cumberlandian form that is closely allied to *C. glans* of other parts of the interior basin. It was found only at Stations 19 and 21 on the main stem, but Wilson and Clark (1914) reported it only from tributaries. This small species is easily overlooked, and it is not always possible to exercise the particular screening techniques its collection demands.

Medionidus conradicus (Lea) 1834. Fig. 46.

The type locality of this species, the region just below the falls (Station 9),

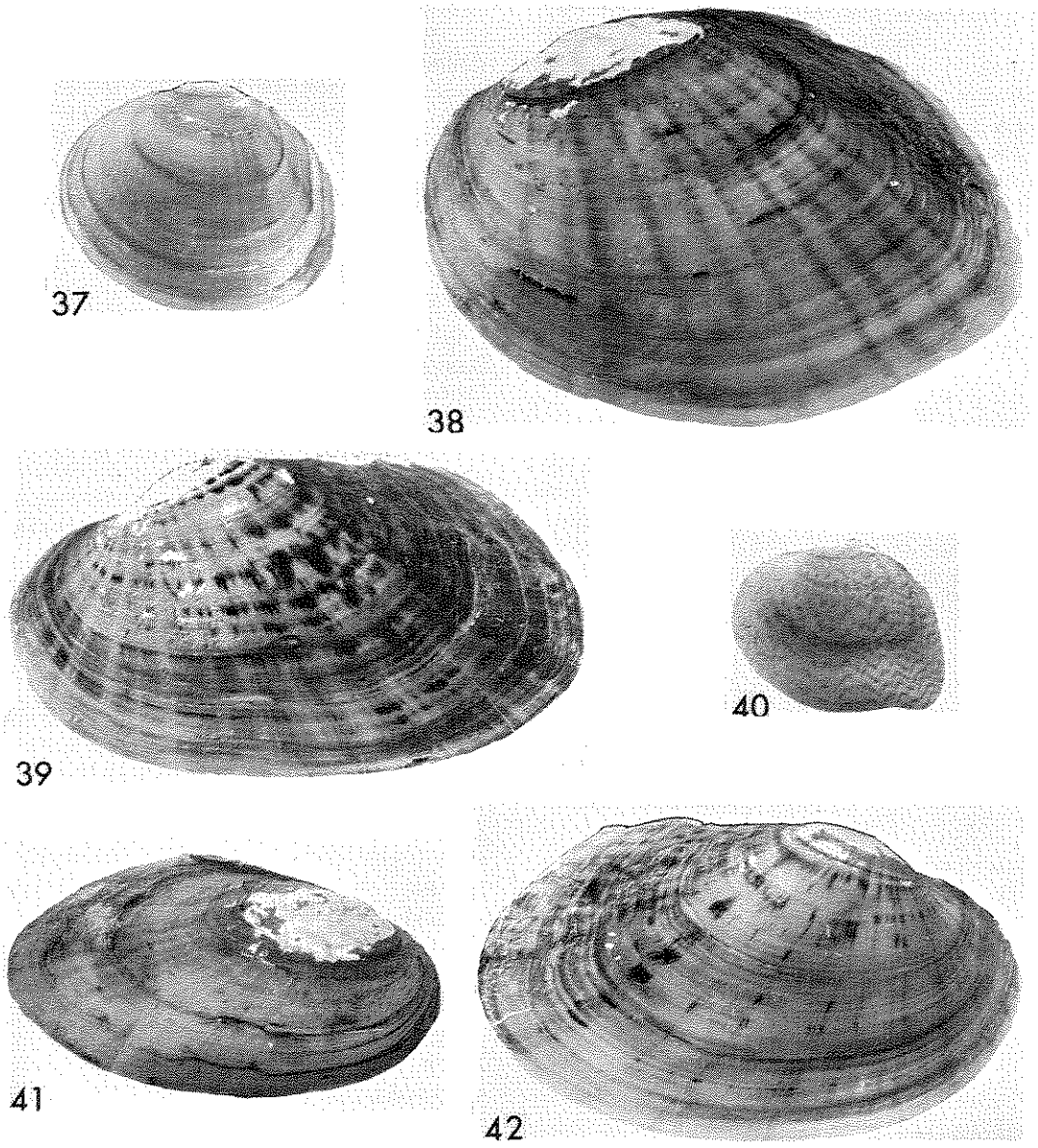


FIG. 37. *Obovaria subrotunda* (Rafinesque)
FIG. 38. *Actinonaias carinata gibba* (Simpson)
FIG. 39. *Actinonaias pectorosa* (Conrad)
FIG. 40. *Truncilla truncata* Rafinesque
FIG. 41. *Leptodea leptodon* (Rafinesque)
FIG. 42. *Actinonaias pectorosa* (Conrad)

contained it in great numbers in September 1948. It did not occur at any other main stem station, but was abundant in Beaver Creek and the Rockcastle River, ascending the latter far up into Laurel Fork. It was found mainly in small streams by Wilson and Clark (1914) and in small tributaries of the Tennessee by Ortmann (1918, 1924, 1925), who considered it one of the most characteristic Cumberlandian "types". This genus has not been reported from other parts of the Mississippi Basin.

Micromya nebulosa (Conrad) 1834. Fig. 49.

This species was found only in the Rockcastle River and in the main stem at Station 9. It is a very variable mussel and specimens found in the upper Cumberland represent a rather unusual form. It was not reported by Wilson and Clark (1914). Ortmann (1924, 1925) considered it a species most characteristic of smaller streams. Its type locality is the Black Warrior River, Alabama, but Ortmann (1925) preferred to call it a Cumberlandian "type" although aware of its occurrence in the Alabama River system.

Micromya picta (Conrad) 1834. Fig. 47.

Found only in Beaver Creek and Rockcastle River. It attained very large size in the Rockcastle and went up into Laurel Fork. Wilson and Clark (1914) did not find it in the upper Cumberland. This is a true Cumberlandian form also reported from the Tennessee (Ortmann 1924, 1925).

Common name: Painted shell.

Micromya trabalis (Conrad) 1834. Fig. 52.

Another Cumberlandian form and one that resembles *M. fabalis* (Lea) of othe parts of the interior basin. We found i to be common in the upper Cumberland, absent only from Big South Fork and the Laurel River. It ascended the Rockcastle up into Laurel Fork. Wilson and Clark (1914) found it only in the upper Cumberland. Ortmann (1918, 1925) thought it rare in the Tennessee. The periostracal color of this species is dark green. A characteristic ray pattern appears on the specimen shown in Fig. 52.

Micromya vanuxemensis (Lea) 1838. Fig. 44.

We found this species alive only in Beaver Creek. It shows affinities to *M. lienosa* of the Alabama River system, but is distinct from that species. It does not develop the pointed posterior dorsal shell margin that characterizes *M. lienosa* and it apparently attains a smaller size. Our specimens had a dark brown periostracum and red nacre. Empty shells were found in Big South Fork.

Ligumia recta latissima (Rafinesque) 1820. Fig. 51.

This species occurred at all stations below the falls except those in the Laurel River. It was very abundant and almost reached Laurel Fork in the Rockcastle, but was not considered abundant by Wilson and Clark (1914). Ortmann reported it common in the Tennessee. The nacre of our specimens was very attractive, fading from salmon pink in the beak cavities to white or bluish white near margins.

Common names: Long John; Black sand shell.

Lampsilis fasciola Rafinesque 1820. Fig. 54.

One of the few species occurring above the falls, this mussel was also common below the falls, particularly in the Rockcastle River. However, it was not present at all stations below the falls (Table 1). It is a common interior basin form that reportedly increases in number near the headwaters of all streams it inhabits. It was very abundant in the Cumberland above the falls.

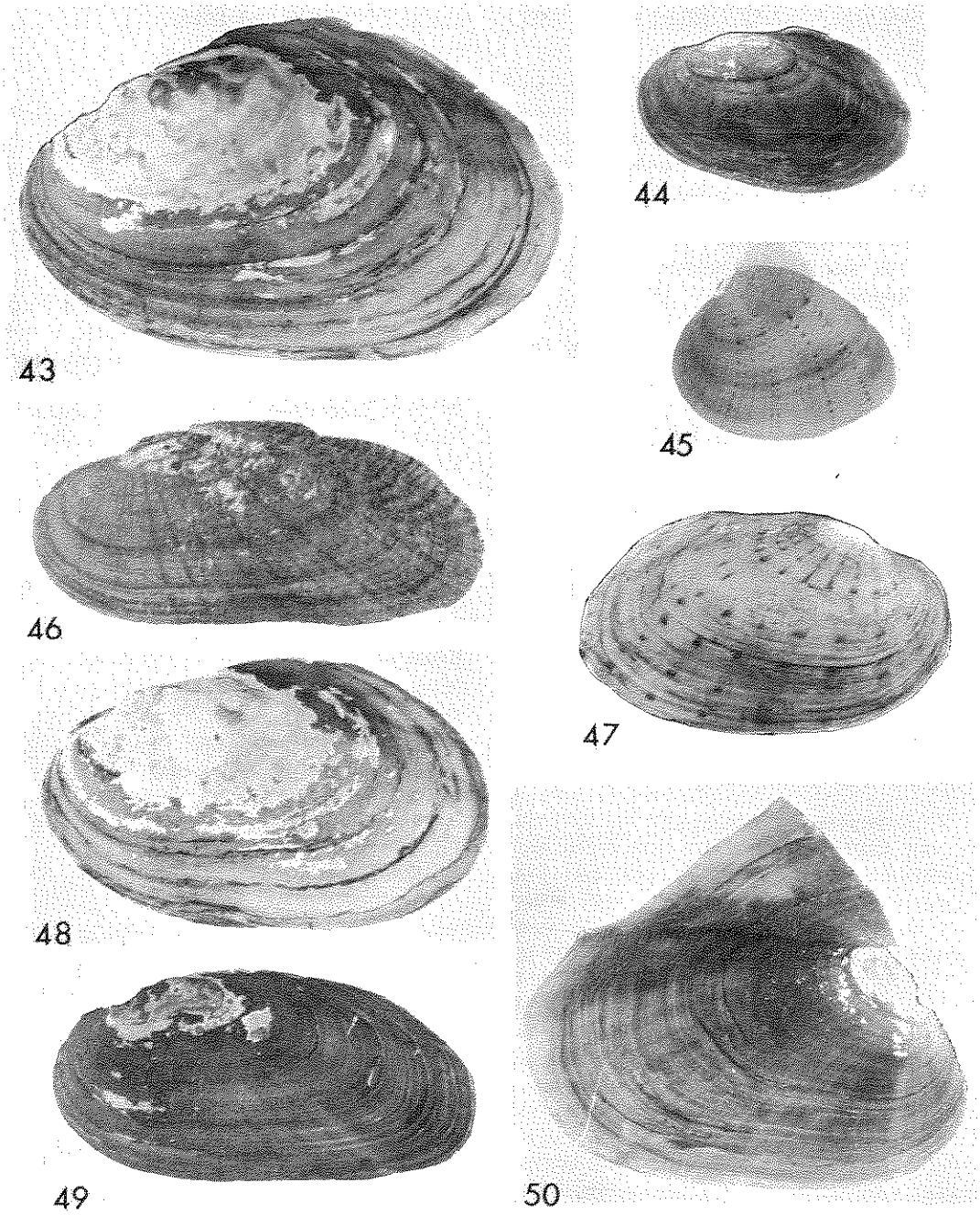


FIG. 43. *Leptodea laevissima* (Lea)
FIG. 44. *Micromya vanuxemensis* (Lea)
FIG. 45. *Plagiola lineolata* Rafinesque
FIG. 46. *Medionidus conradicus* (Lea)
FIG. 47. *Micromya picta* (Conrad)
FIG. 48. *Leptodea fragilis* (Rafinesque)
FIG. 49. *Micromya nebulosa* (Conrad)
FIG. 50. *Proptera alata* (Say)

Lampsilis orbiculata (Hildreth) 1828. Fig. 53.

This is another Mississippian species that was still common in the main stem below the falls but apparently less abundant than at the time of the Wilson and Clark (1914) survey. It slightly resembles *A. carinata gibba* and is a very distinctive species of *Lampsilis*. Ortmann (1918, 1925) found it relatively uncommon in the Tennessee.

Lampsilis ovata (Say) 1817. Fig. 55.

This typical big river species of *Lampsilis* occurred only below the falls and in the mouth of Beaver Creek. It has an attractive light yellow epidermis, a sharp posterior ridge, and green rays. Wilson and Clark (1914) encountered it more commonly in the upper than in the lower river; Ortmann (1918, 1924, 1925) found it preferred larger rivers in the Tennessee basin. We found it a good source of slug pearls (baroques), and learned it was once a favorite of pearlers.

Common name: Pocketbook.

Lampsilis ovata ventricosa (Barnes) 1823. Fig. 58.

A headwater form that replaced *L. ovata* in the Cumberland above the falls, the Rockcastle and Laurel Rivers, and Big South Fork. It is quite similar to *L. ovata* but lacks a sharp posterior ridge and, typically, is slightly more elongate in outline. Specimens from smaller headwaters, Laurel River and Laurel Fork of the Rockcastel, were considerably shortened and stunted. It was associated with *L. ovata* only at Station 19, and this coexistence appeared unusual. Ortmann (1918, 1924, 1925) reported its occurrence with *L. ovata* in larger rivers, and stated that it went upstream beyond *L. ovata* and became a pure race. With the one exception at Station 19 *L. ovata ventricosa* was a pure race in the Cumberland. Wilson and Clark (1914) called this form *L. ventricosa*, apparently unaware of its relation to *L. ovata*. It was very abundant above the falls in 1948 and 1949.

Common name: Pocketbook.

Dysnomia brevidens (Lea) 1831. Figs. 59 and 62.

A very common big river form below Cumberland Falls and present also in the lower Rockcastle River and Beaver Creek. Wilson and Clark failed to find it in the main river and reported it as very common in Big South Fork, where it was extinct in the late 1940's. Wilson and Clark (1914) collected only dead specimens. Ortmann (1918, 1924, 1925) found it rarely in the Tennessee. Prior to closure of Wolf Creek Dam it was abundant at Station 19 and common at other main stem collecting sites below the falls.

Dysnomia capsaeformis (Lea) 1834.

This small thin shelled mussel was found at scattered localities including the main stem below the falls, Rockcastle River, Big South Fork, and Beaver Creek. It resembles *D. florentina* but may be distinguished by the solid green color on the posterior expansion of the female shell. Also a member of the Cumberlandian group, considered by Ortmann (1925) to be more numerous in the Tennessee River.

Dysnomia florentina (Lea) 1857. Figs. 56 and 57.

May be separated from the foregoing by the absence of the solid green color on the posterior expansion of the female shell, and more numerous denticulations on the margin of the expansion. Found on most main stem bars, abundantly at Station 19. Reported as rare by Wilson and Clark (1914) and as rare in the Tennessee, except at Mussel Shoals, by Ortmann (1918, 1925).

Dysnomia florentina walkeri (Wilson and Clark) 1914. Figs. 64 and 65.

A larger compressed type that replaces *D. florentina* in headwaters. The epidermis is yellower than that of the typical

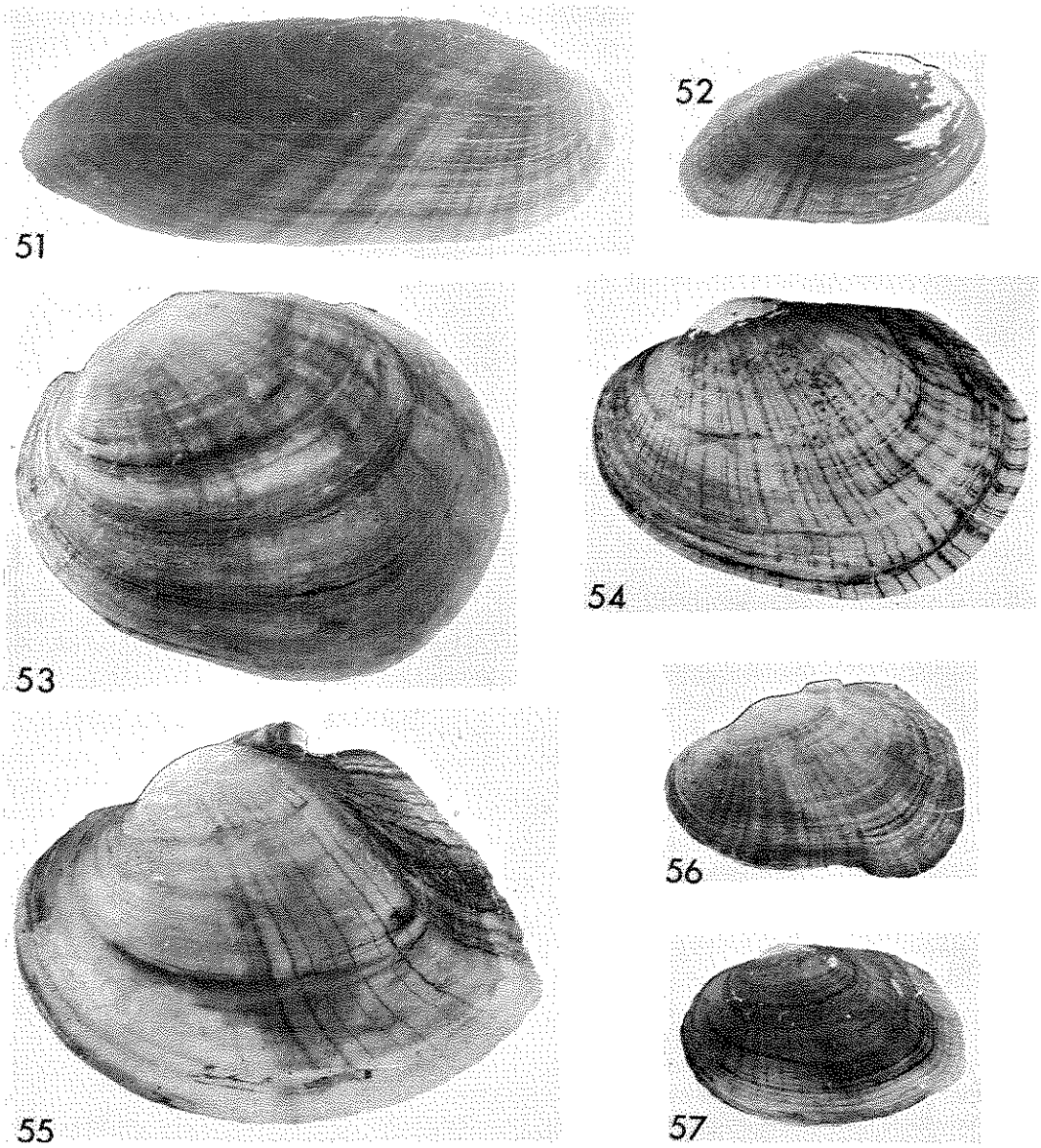


FIG. 51. *Ligumia recta latissima* (Rafinesque)
FIG. 52. *Micromya trabalis* (Conrad)
FIG. 53. *Lampsilis orbiculata* (Hildreth)
FIG. 54. *Lampsilis fasciola* Rafinesque
FIG. 55. *Lampsilis ovata* (Say)
FIG. 56. *Dysnomia florentina* (Lea) female
FIG. 57. *Dysnomia florentina* (Lea) male

D. florentina. First found by Wilson and Clark (1914) in small tributaries of the Tennessee loop of the Cumberland and later found in the Tennessee River by Ortmann (1918, 1924) who decided it was a variety of *D. florentina*. It was found by us only in Beaver Creek, but it formerly occurred in Big South Fork.

Dysnomia haysiana (Lea) 1833. Fig. 60.

This species is one of the most attractive members of the genus, being small and solid with a polished, brown-rayed periostracum. We found one specimen in Big South Fork where it was formerly locally abundant. Its type locality is the Cumberland River.

Common name: Acorn.

Dysnomia lewisi (Walker) 1910. Figs. 61 and 66.

Ortmann (1918) considered this species the rarest *Dysnomia*. Wilson and Clark did not mention it in 1914. We secured a female at Station 21 and a male at Station 22. The species is unmistakable and can be easily recognized by characters shown in the Figs. It is a Cumberlandian type and shows some affinities to *Dysnomia foliata* of the Ohio River, which is now assumed extinct.

Common name: Leaf shell.

Dysnomia sulcata (Lea) 1829.

This *Dysnomia* is rare in all parts of the interior basin where its distribution appears to center in the Ohio and Wabash Rivers (Ortmann, 1925). We secured only one specimen, at Neeleys Ford.

Common name: Cats claw.

Dysnomia triquetra (Rafinesque) 1820. Fig. 63.

This abundant species of the Mississippi basin was common along the main stem below Lock 21, and occurred in Beaver Creek. Wilson and Clark (1914) noted that its range extended down into Tennessee, but they did not find it in the lower Cumberland.

Common name: Snuffbox.

DISCUSSION

Our collections in the upper Cumberland system netted 30 genera with 59 species or forms, of which 16 belong to Ortmann's typical "Cumberlandian" forms (see Table 4). These mussels are listed in Table 1, which shows their distribution and relative abundance, in the order adopted in the Systematic Account.

The mussels collected had been subjected to considerable abrasion and some acid action and only exceptional shells escaped erosion of the umbonal areas. Many old specimens had very thick shells and were worn down to more elongated shapes. Numerous individuals had sand blisters and many had lost almost all the periostracum.

Comparison of our findings with those of Wilson and Clark (1914) in the same area, in 1911, indicated that rather marked changes in occurrence, distribution and abundance had occurred in the 36-38 years following their survey. These authors reported 60 forms, but the actual discrepancy involves 7 species, since we found 3 species they did not report: *Cumberlandia monodonta*, *Micromya nebulosa* and *Dysnomia lewisi*, while they reported 4 species: *Alasmidonta minor*, *Dysnomia arcaeformis*, *Pegias fabula* and *Quadrula intermedia* that we failed to collect.

Up to the Cumberland Falls the usual upstream decline of number of species was evident (down to 15 at Station 9 from more than 40 at Station 21). The falls were an effective barrier to most species and a total of only 6 have been recorded above them. In the present survey only 4 forms occurred above the falls: *Lampsilis fasciola*, *L. ovata ventricosa*, *Elliptio dilatatus* and *Actinonaias pectorosa*. The first 3 had apparently been in residence there for many generations while the last, *A.*

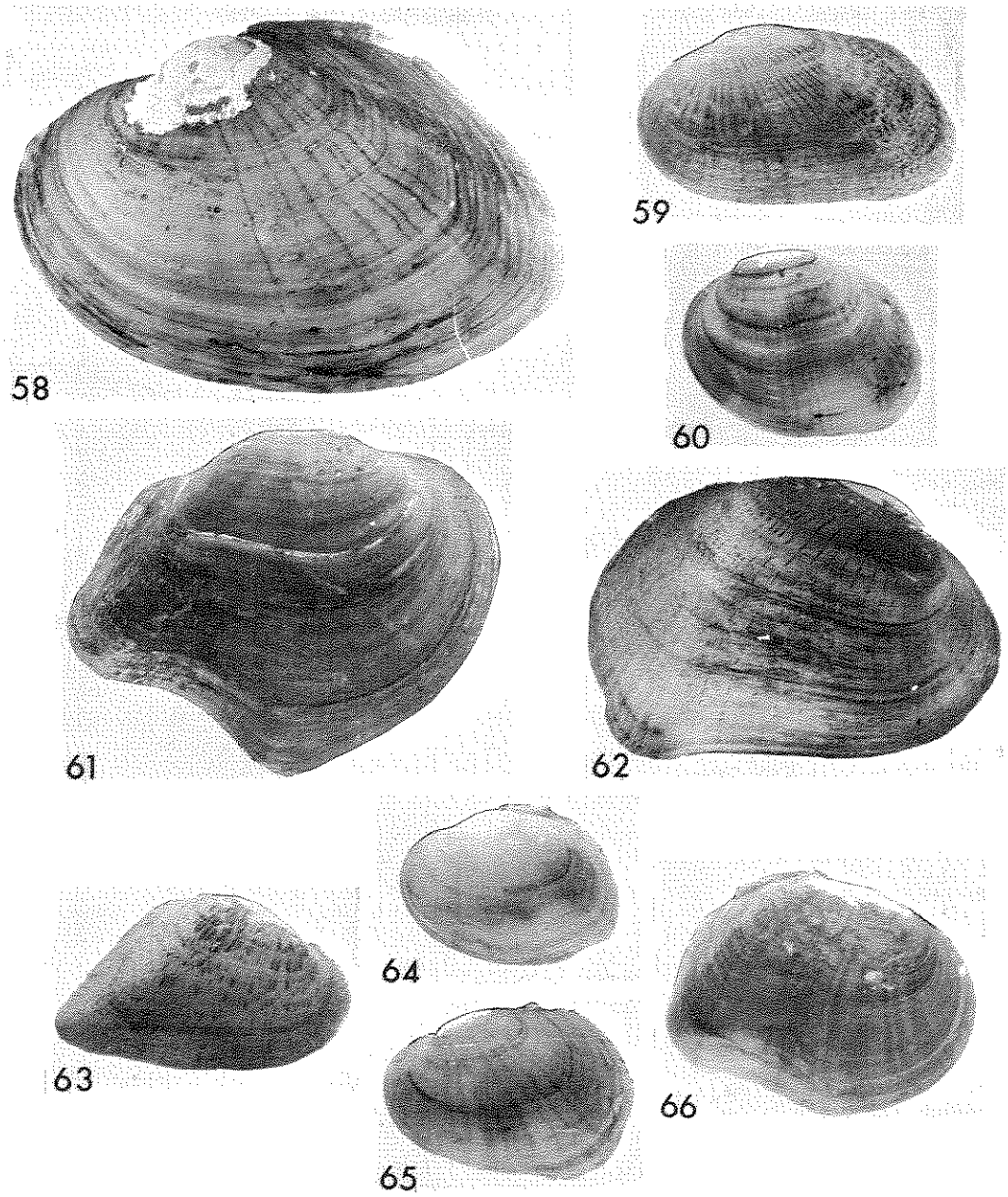


FIG. 58. *Lampsilis ovata ventricosa* (Barnes)
FIG. 59. *Dysnomia brevidens* (Lea) male
FIG. 60. *Dysnomia haysiana* (Lea)
FIG. 61. *Dysnomia lewisi* (Walker) female
FIG. 62. *Dysnomia brevidens* (Lea) female
FIG. 63. *Dysnomia triquetra* (Rafinesque)
FIG. 64. *Dysnomia florentina walkeri* (Wilson and Clark) male
FIG. 65. *Dysnomia florentina walkeri* (Wilson and Clark) female
FIG. 66. *Dysnomia lewisi* (Walker) male

TABLE 1. Distribution and abundance[4] of 59 naiad species found at 23 stations in the upper Cumberland system.

Species	Station[5]									
	1	2	3	4	5	6	7	8	9	10
Cumberlandia monodonta										
Fusconaia flava										
Fusconaia undata										
Fusconaia subrotunda										
Amblema costata			c	c	a	c				
Megalonaias gigantea										
Quadrula cylindrica										
Quadrula metanevra										
Quadrula pustulosa						c			a	
Tritigonia verrucosa			c	c		c			a	
Cyclonaias tuberculata			c	c	a	c				
Cyclonaias t. granifera										
Plethobasus cyphyus										
Plethobasus cooperianus										
Pleurobema cordatum										
Pleurobema cordatum plenum										
Pleurobema c. pyramidatum										
Pleurobema c. coccineum			c	c	c	c				
Pleurobema oviforme[6]	r	r								
Elliptio crassidens						r	r		c	
Elliptio dilatatus	c	c	c	c	c	c		r	a	
Lastena lata										
Lasmigona costata			c	c	c					
Alasmidonta marginata				r						
Strophitus rugosus				r			r			
Ptychobranchus fasciolaris	r	r	c	c	c	c			a	
Obliquaria reflexa						r				
Cyprogenia irrorata										
Dromus dromas[6]										
Obovaria retusa										
Obovaria subrotunda						c				
Actinonaias carinata gibba[6]						c			a	
Actinonaias pectorosa[6]			c	c	c	c			a	
Truncilla donaciformis										
Truncilla truncata									r	
Plagiola lineolata										
Leptodea fragilis										
Leptodea laevissima						r				
Leptodea leptodon										
Proptera alata					c	c			c	
Carunculina moesta[6]										
Medionidus conradricus[6]	r	r	c	c					a	
Micromya nebulosa[6]	r	r	r	r					r	
Micromya picta[6]	r	r	c	c	c					
Micromya trabalis[6]	r	r	c	c	c				a	
Micromya vanuxemensis[6]										
Ligumia recta latissima			c	c	c	c			a	
Lampsilis fasciola	r	r	c	c	c	c			c	c
Lampsilis orbiculata										
Lampsilis ovata										
Lampsilis o. ventricosa	c	c	c	c	c	c		r	a	a
Dysnomia brevidens[6]						c				
Dysnomia capsaeformis[6]						r				
Dysnomia florentina[6]										
Dysnomia f. walkeri[6]										
Dysnomia lewisi[6]										
Dysnomia haysiana[6]										
Dysnomia sulcata										
Dysnomia triquetra										

[4]a, abundant; c, common; r, rare.
[5]See Fig. 1.
[6]"Cumberlandian" type.

Table 1. (continued)

Station												
11	12	13	14	15	16	17	18	19	20	21	22	23
								c			r	r
									r			
									r			
								r			r	
							r		r		r	
							c	c			c	c
									r	r	r	r
								a	c	a	c	a
						r	c	a	c	a	c	c
						c	c	c	r	r	c	a
						r		c			r	
							r	r	r		r	c
								r			r	
								r			r	
								c			c	c
							c	c	r		c	r
								c		c		r
								c			r	
									r			
						r	c	a			c	a
a	c	c	c	c		c	a	a	c	a	a	a
								r		r	r	r
								r	r			
								r	r	r	r	
			r	r			r	c	r		r	r
						r	c	a	c	a	a	a
							r	c	r	r	c	r
							r	r		r	r	r
								c		c	c	c
								c		c	c	c
							c	c	c	c	c	c
						r	c	a		c	c	c
r						r			r			
						r						
							r	r	r	r		
							c	c	r		c	a
							r	r	r		r	r
								r	r			
								r				
						r	c	a	c	c	c	
								r		r		
									a			
									r			
							c	c	r		c	c
						r			r			
						r	c	c	r	c	c	c
a	c	c	c	c		r		c	r	r	c	
							r	r		r	r	r
							c	a	r	c	a	a
a	a	a	c	c		r			r			
							c	a	r	c	c	c
						r		c	r			r
								a		r	r	c
						?			r			
										r	r	
						r						
												r
							c	c	r	c	c	c

a zone falls

pecterosa, which is the only true "Cumberlandian" form, was taken in only one specimen at Station 11 and appeared to be a recent immigrant. Wilson and Clark (1914) listed *Alasmidonta minor* and *Strophitus rugosus* in addition to the 3 well established species we found above the falls. All species recorded above the barrier were also common or abundant in many areas below it.

Mussels were rare only in Big South Fork and the Laurel River. They were abundant on big bars in the main stem below Lock 21 (Station 18), not quite as numerous above the falls and in the Rockcastle River and only common in Beaver Creek. The region just below the falls had very dense concentrations of a few species.

The changes in abundance of the various species in the 2 surveys are marked. Only 1 form, *Actinonaias carinata gibba* and 1 complex, the *Pleurobema cordatum* complex did maintain themselves among the prevailing forms since the earlier survey, though not exactly in their former order of importance, as shown in Table 2.

Actinonaias carinata gibba apart, the 19 other forms most common in the present survey do not coincide with the 9 forms reported as numerous in the earlier survey. These species or varieties are quoted in Table 3, in the order of the Systematic Account.

It is not assumed that our data are strictly comparable with those secured 36 years before, but the changes listed appear clear cut from conditions described by Wilson and Clark and differences in prevailing groups listed below at least seem valid. Circumstances responsible for such changes are difficult to ascertain. Decline in mussel and pearl fishing may have been influential in some cases for the increase of some species, and pollution, particularly by coal mine acids, has had demonstrable effects in decline of others. Fluidity in dynamics of the mussel population may not be ignored, and some variations observed may perhaps illustrate a natural trend over 36 years.

Ortmann's records and studies led him to conclude that the Cumberlandian naiad group is composed of 37 forms, as listed in Table 4 in alphabetical order.

TABLE 2. Comparison of the 4 most prevalent naiad species of the 2 surveys of the upper Cumberland, in descending order of abundance.

Wilson and Clark in 1911	Neel and Allen in 1947-1948
Pleurobema cordatum	*Elliptio dilatatus*
Elliptio crassidens	*Quadrula metaneura*
Obliquaria reflexa	*Actinonaias carinata gibba*
Actinonaias carinata gibba	*Pleurobema cordatum* complex

Ortmann was aware that the 3 species *Alasmidonta minor*, *Micromya nebulosa* and *M. vanuxemensis* were found outside the Cumberland and Tennessee basins in the Alabama and Kentucky River systems, but he believed they developed in the 2 former rivers and then "strayed" into other basins. There seems no reason to question the validity of the name "Cumberlandian" for the other 34 species and varieties.

Dysnomia, with 11 species or varieties, has the greatest number of "types" in the Cumberlandian group and the Cumberland and Tennessee Rivers appear to be its center of development. Big South Fork was their likely focal point in the Cumberland, but they have almost completely

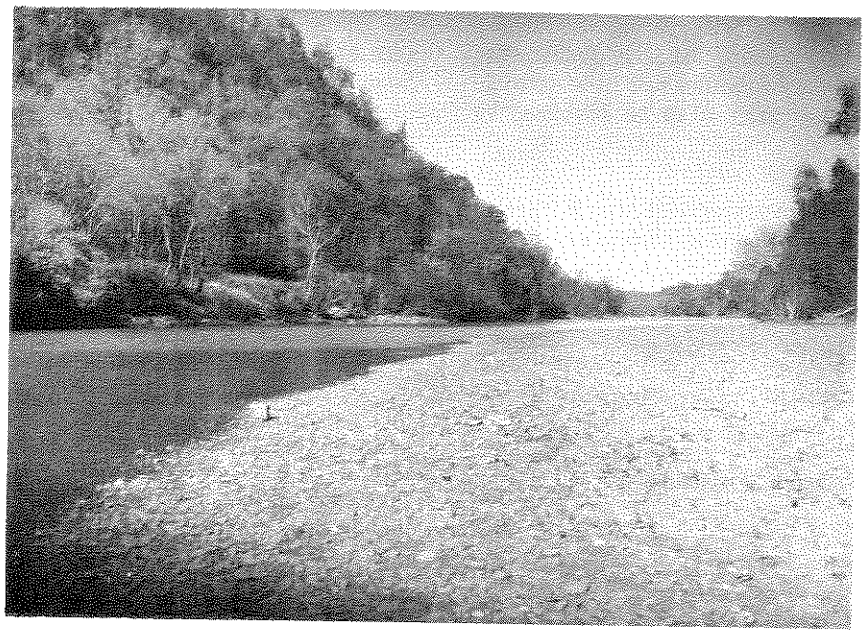


FIG. 67. Shingle bar at Neeleys Ford. Station 23.

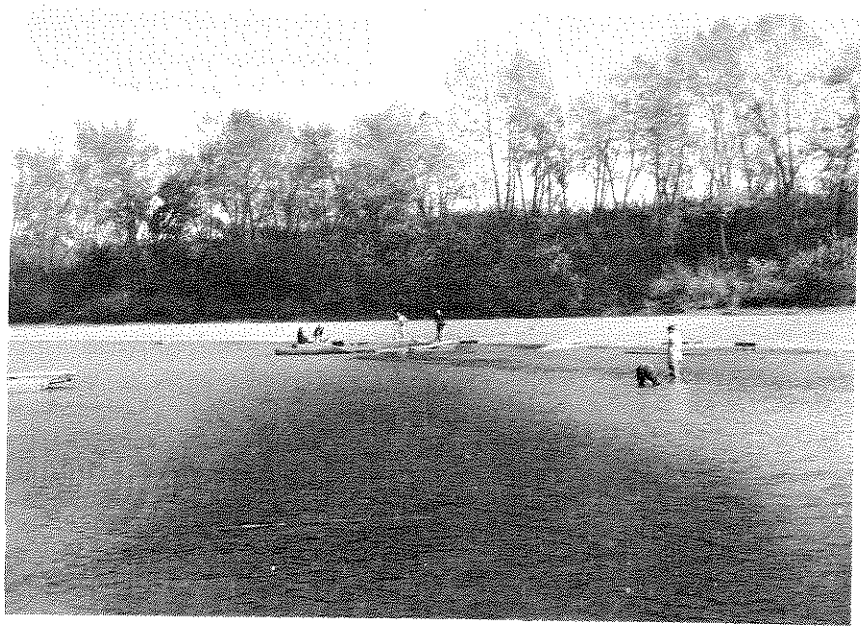


FIG. 68. Collecting at Horseshoe Bottom. Station 19.

succumbed to the effects of acid mine waters in that river. It is probable that some of these dysnomias are now extinct. Mine drainage may also be involved in the disappearance of *Alasmidonta minor* and *Strophitus rugosus* from above the falls.

TABLE 3. Comparison of the different naiad species most common in the 2 surveys of the upper Cumberland.

Wilson and Clark in 1911	Neel and Allen in 1947-1949
-	*Cumberlandia monodonta*
Plethobasus cooperianus	-
-	*Megalonaias gigantea*
-	*Quadrula metaneura*
Pleurobema cordatum	-
-	*Pleurobema cordatum plenum*
-	*Pleurobema cordatum pyramidatum*
Elliptio crassidens	-
-	*Elliptio dilatatus*
Pegias fabula	-
Strophitus rugosus (above falls)	-
Alasmidonta minor	-
-	*Lasmigona costata*
-	*Ptychobranchus fasciolaris*
Obliquaria reflexa	-
-	*Dromus dromas*
-	*Obovaria retusa*
-	*Proptera alata*
-	*Carunculina moesta*
-	*Medionidus conradicus*
-	*Micromya picta*
-	*Ligumia recta latissima*
-	*Lampsilis fasciola*
-	*Lampsilis ovata ventricosa*
Dysnomia florentina walkeri	-
Dysnomia haysiana	-
	Dysnomia brevidens
	Dysnomia florentina

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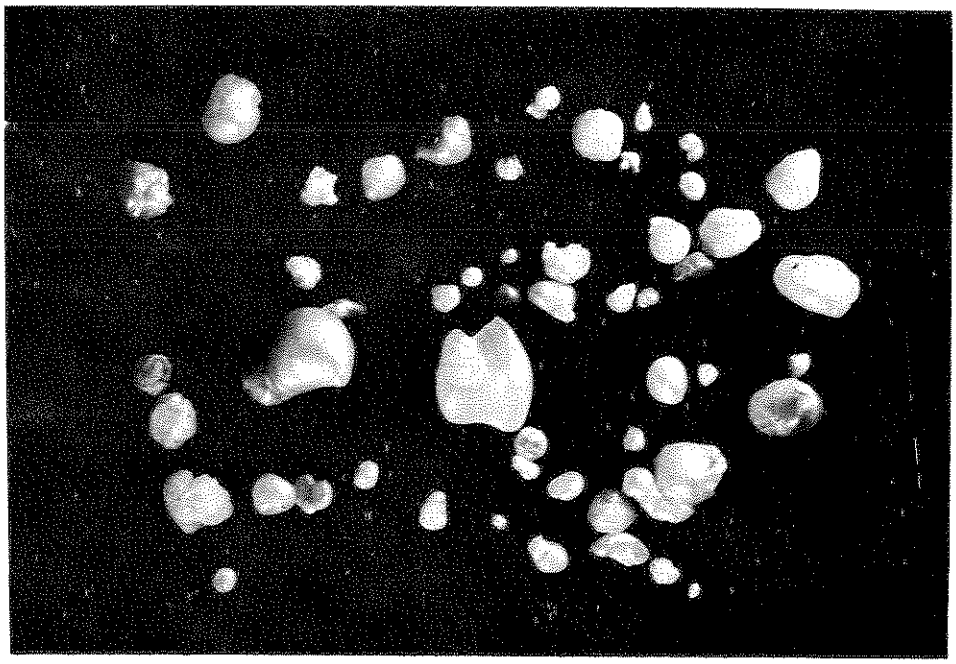

FIG. 69. Baroque or slug pearls from Cumberland and Rockcastle River mussels.

TABLE 4. Cumberlandian naiad fauna as defined by Ortmann.

Actinonaias carinata gibba (Simpson)[7]	*Fusconaia barnesiana* (Lea)[9]
Actinonaias pectorosa (Conrad)[7]	*Fusconaia barnesiana bigbyensis* (Lea)[9]
Alasmidonta minor (Lea)[8]	*Fusconaia barnesiana tumescens* (Lea)[9]
Carunculina moesta (Lea)[7]	*Fusconaia cuneolus* (Lea)[9]
Conradilla caelata (Conrad)[9]	*Fusconaia cuneolus appressa* (Lea)[9]
Dromus dromas (Lea)[7]	*Fusconaia edgariana* (Lea)[9]
Dromus dromas caperatus (Lea)	*Fusconaia edgariana analoga* (Ortmann)[9]
Dysnomia arcaeformis (Lea)	*Lasmigona holstonia* (Lea)[9]
Dysnomia biemarginata (Lea)	*Lexingtonia dolabelloides* (Lea)[9]
Dysnomia brevidens (Lea)[7]	*Lexingtonia dolabelloides conradi* (Vanatta)[9]
Dysnomia capsaeformis (Lea)[7]	*Medionidus conradicus* (Lea)[7]
Dysnomia florentina (Lea)[7]	*Micromya nebulosa* (Conrad)[7,10]
Dysnomia florentina walkeri (Wilson and Clark)[7]	*Micromya picta* (Conrad)[7]
Dysnomia haysiana (Lea)[7]	*Micromya trabalis* (Conrad)[7]
Dysnomia lewisi (Walker)[7]	*Micromya vanuxemensis* (Lea)[7,10]
Dysnomia lenior (Lea)	*Pegias fabula* (Lea)
Dysnomia torulosa propinqua (Lea)[9]	*Pleurobema oviforme* (Conrad)[7]
Dysnomia turgidula (Lea)	*Pleurobema oviforme argenteum* (Lea)[9]
	Pleurobema oviforme holstonense (Lea)[9]

[7]Found in present survey of the upper Cumberland.
[8]Found also in Kentucky River system.
[9]Reported only from the Tennessee River.
[10]Found also in Alabama River system.

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ZUSAMMENFASSUNG

DIE NAIADENFAUNA DES OBEREN CUMBERLANDBECKENS VOR SEINER STAUUNG

In den Jahren 1947-1949, kurz vor der Entstehung des Cumberland-Stausees durch die Errichtung des Wolf-Creek-Dammes, stellten die Autoren Untersuchungen über die Muscheln des oberen Cumberlandflussystems (in Kentucky, V. S. A.) an, deren Ergebnisse hier mit denjenigen einer vorherigen, aus dem Jahre 1911, verglichen werden. In unserer Studie fanden wir 59 verschiedene Arten, von denen 16 der den Cumberland- und Tennessee-Flüssen eigenen, sogenannten "cumberländischen" Gruppe, angehörten. Oberhalb des Cumberlandfalles waren nur 4 Arten (einschliesslich einer einzigen cumberländischen) vertreten, doch waren diese keineswegs auf jene Gegend beschränkt. In der früheren Studie waren zwar 60 Arten zitiert worden, doch stimmten davon nur 56 mit den unsrigen überein, da 3 der später anwesenden vorher nicht gefunden worden waren während 4 der früher angegebenen später fehlten. In den 36 Jahren zwischen den beiden Untersuchungen sind offensichtlich im oberen Hauptfluss und in seinen dortigen wichtigeren Nebenflüssen verschiedene Muschelarten durch saure Abwässer aus Kohlengruben dezimiert worden. So wurde z.B. die Gattung *Dysnomia* aus dem Gebiete ihres ehemals vielfältigsten Vorkommens praktisch vertilgt. Andere Arten an anderen Standorten hingegen waren häufiger vertreten als zuvor.

Die beobachteten ausgesprochenen Veränderung en in der Verbreitung und relativen Häufigkeit mehrerer Arten lassen sich nur teilweise durch den Niedergang der Perlfischerei oder durch säurehaltige Abwässer erklären. Auch wurde das obere Cumberlandgebiet weitgehend von der Perlmutterknopfindustrie verschont, so dass die Gründe für manche der auffälligen Schwankungen bis heute unklar sind.

RÉSUMÉ

LA FAUNE NAIADE DU BASSIN SUPERIEUR DU FLEUVE CUMBERLAND AVANT SON ENDIGUEMENT

Pendant les années 1947-1949, juste avant la formation du lac Cumberland par l'erection du barrage de Wolf Creek, les auteurs ont fait une étude de la population naiade du bassin supérieur du Cumberland (Kentucky, E. U. A.) dont les résultats sont ici comparés à ceux d'une étude antérieure, en 1911, de la même région. Au courant de l'investigation récente nous avons trouvé 59 formes naiades distinctes, dont 16 appartenaient au groupe "cumberlandais" spécial qui n'existe que dans les fleuves Cumberland et Tennessee. Quatre espèces seulement (comprenant une seule cumberlandaise) avaient surmonté les chutes Cumberland, mais aucune d'entre elles n'était restreinte à cette région seulement. Dans l'étude précédente le nombre d'espèces citées était de 60, mais il n'y avait que 56 qui coincidaient, car 3 des espèces trouvées dans la seconde étude manquaient alors, tandis que 4 espèces trouvées alors étaient absentes plus tard. Dans les 36 années depuis la première investigation, certaines naiades ont été décimées dans le tronc principal supérieur du fleuve et dans ses branches majeures régionales par les eaux acides provenant des mines à charbon. Ainsi, le genre *Dysnomia* a été presque totalement éliminé de l'aire de sa plus grande variété antérieure. D'autre part nombre d'espèces ont gagné en prévalence ailleurs.

Ces changements prononcés en distribution et abondance relative de certaines espèces ne peuvent être expliqués qu'en partie par le charbonnage ou par le déclin de la pêche aux perles. Notons que l'industrie de boutons en nacre n'a touché la région que très legèrement et que les cause de certaines variations observées restent encore obscures.

RESUMEN

LA FAUNA DE NAIADES DE LA CUENCA DEL ALTO CUMBERLAND ANTES DEL EMBALSE DE LA RESERVA DEL LAGO CUMBERLAND

Durante 1947-1949, poco antes del embalse del lago Cumberland por cierre del dique de Wolf Creek, se hizo un estudio de la fauna de almejas de la cuenca del alto río Cumberland (Kentucky, U. S. A.). Los resultados son comparados con un reconocimiento anterior de la misma área en 1911. En el reconocimiento que aquí se informa, se encontraron 59 distintas almejas de agua dulce, de las cuales 16 pertenecen al grupo "Cumberlandiano", peculiar de los ríos Cumberland y Tennessee. Sólo 4 especies (incluyendo una única forma Cumberlandiana)han remontado los saltos de Cumberland y ninguna de ellas estaba restricta a aquella área. El primer reconocimiento había revelado 60 especies, de las cuales sólo 56 coincidían: 3 especies recobradas en el último reconocimiento no habían sido encontradas previamente y 4 coletadas en el primero no se encontraron más tarde. En los 36 años desde el primer reconocimiento varias especies han sido diezmadas por ácidos de las minas de carbón en la parte más alta de la corriente principal y en sus tributarios mayores. El género *Dysnomia* ha sido prácticamente eliminado de su antigua región de mayor variedade, al paso que cierto número de otras almejas han ganado en abundancia.

Sólo algunos de los notables cambios en preponderancia, abundancia relativa y distribución pueden ser explicados por la declinación de la industria del nácar y la presencia de ácidos de las minas. El alto Cumberland no fué significativamente explotado por la industria del botón de nácar. En ciertos casos las causas de la variación son todavía obscuras.

ФАУНА ЖЕМЧУЖНИЦ ВЕРХНЕ-КУМБЭРЛЯНДСКОГО БАССЕЙНА ДО УЛУЧШЕНИЯ КУМБЭРЛЯНДСКОГО ВОДОХРАНИЛИЩА.

Джо Кэндал Нил и Выллиам Рэй Аллэн

АБСТРАКТ

В 1947 - 1949 гг., незадолго до улучшения озера Кумбэрлянд, постройкой дамбы Волф Крик, было сделано исследование фауны наяд верхнего бассейна реки Кумбэрлянд (Кентокки, США.). Результаты этого исследования сравниваются с результатами обследования в этом же районе, произведенным в 1911 г. В данном исследовании найдены 59 особенных "мидий" или жемчужниц, из которых 16 принадлежат к специфической "Кумберляндской" группе, эндемичной для рек Кумбэрлянд и Тэнэсси. Только 4 вида (включая сюда и одну кумбэрляндскую форму) были найдены выше кумбэрляндских водопадов и ни один из них не был ограничен этим ареалом. При прежнем обследовании были найдены 60 видов, из которых 56 соответствовали ныне найденным: 3 вида не были ранее известны и 4 вида собранные тогда, не были найдены теперь. За 36 лет после первого обследования многие виды двустворчатых были уничтожены кислотами из шахт каменного угля на верхних притоках бассейна реки. Род *Dysnomia* был фактически ликвидирован в его прежнем ареале, где раньше он был представлен разнообразием форм. Несколько других мидий стали преобладающими.

Только некоторые из заметных перемен были преобладающими; сравнительное обилие мидий и их распространение могут быть объяснены утончением их перламутрового слоя и наличием кислот из шахт. Верхний же район бассейна реки Кумбэрлянд не был эксплоатирован индустрией перламутровых пуговиц. Во многих отношениях причины перемен фауны еще не выяснены.