# THE MOLLUSKS OF THE DUCK RIVER DRAINAGE IN CENTRAL TENNESSEE

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Relatively few papers have been written on the mollusks of the Tennessee River drainage. The most important are those of A. E. Ortmann (1912, 1913, 1918, 1920, 1921, 1924a, 1924b, and 1925). Ortmann, collaborating with Bryant Walker, essentially developed the basic classification for the Naiades, or freshwater mussels. They were also sufficiently versed in the ecology and distribution of mussels to provide broad and significant outlines of zoogeographic relationships. With the meager gear then at their disposal, the best and only method to survey smaller streams was by hand-picking; for large rivers as the Tennessee itself (except in such shallow areas as 'Muscle Shoals') larger boats and clammer's gear were needed. Walker often identified mussels for those making surveys for the U. S. Bureau of Fisheries when intensive work was done in connection with the clamming industry and he was thus able to obtain valuable locality records. In that heyday of collecting, scuba diving had not come into use and, consequently, it was necessary to work at low water stages so that most of those early surveys were accomplished in late summer or fall. Even with modern gear low water stages are best for collecting.

Studies in the lower Tennessee and in the region of the mouth of the Duck River were principally made by M. M. Ellis of the (then) U. S. Bureau of Fisheries during July and August of 1931. He lived on a quarter boat and, with the use of a catamaran and a dredge, was able to make the most extensive collections of the mussels in the lower Tennessee that have ever been done. A study of these collections by H. van der Schalie was published in 1939. With the completion of the dam at Paducah and the formation of Kentucky Lake, Bates (1962) reported on the impact of that impoundment on the mussel fauna. All of the data compiled clearly indicate that the mussels in the lower Tennessee are typically a Mississippi assemblage; there are no Cumberlandian species.**

The Duck River and its major tributary, the Buffalo River, form an important part of the drainage system in central Tennessee. Mollusks (both mussels and pleurocerid snails) were formerly the most significant elements in the benthic fauna of those rivers. It should be stressed that such elements must be known in their original state to be of value in terms of their contribution to the biomass, as well as in their use for determining zoogeographic relations. Unfortunately, a measure of biomass was never attempted, although where the mussel beds occurred it is established that the bottom was paved with them. The virtual loss of practically all mussels in both these rivers at the present time is the occasion for this report, which essentially serves as a supplement to the report by Ortmann (1924) based on his collections made in 1921, 1922 and 1923. Calvin Goodrich and the author did some extensive collecting about ten years later (fall of 1931) and obtained a substantial number of additional records

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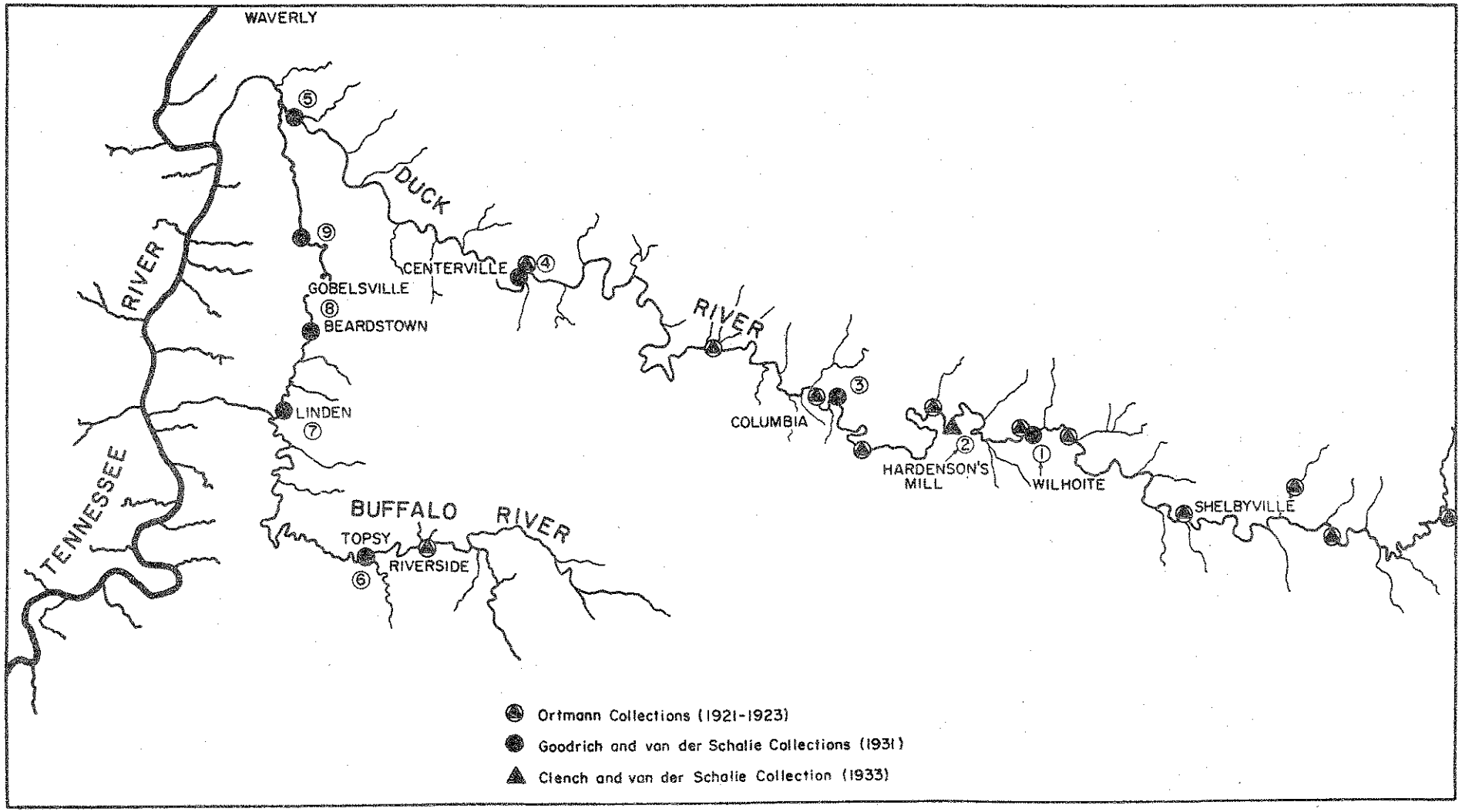
** Cumberlandian fauna is associated with the geologic Cumberlandian uplift and harbors a number of endemic species usually confined to the upper Tennessee drainage.

(see Map 1). Since records on the original fauna will never again be available, later studies should serve primarily to supplement Ortmann's paper, *The Naiad-Fauna of Duck River in Tennessee*. The collections made by Goodrich and van der Schalie in 1931 (see Table 1) were quite similar in the number of species and differed only to a small degree in composition as compared with those obtained by Ortmann (1924b:14-38).

Table 1. Species of Mussels Collected in the Duck River

| Species and Forms | Localities | | | | |
|---|---|---|---|---|---|
| | Wilhoite (1)* | Hardinson's Mill (2) | Columbia (3) | Centreville(4) | South of Waverly(5) |
| Actinonaias carinata Barnes | x | - | x | - | - |
| Actinonaias pectorosa Conrad | x | x | x | - | - |
| Alasmidonta marginata Say | x | x | x | - | - |
| Amblema costata Rafinesque | x | x | x | - | - |
| Amblema peruviana Lamarck | - | - | - | - | x |
| Anodonta grandis Say | x | x | - | - | - |
| Anodonta imbecillis Say | - | x | x | - | x |
| Carunculina cylindrella Lea (= moesta Lea) | x | x | x | - | - |
| Conradilla caelata Conrad | - | x | - | - | - |
| Cyclonaias tuberculata Rafinesque | x | x | x | x | - |
| Dysnomia brevidens Lea | x | x | - | - | - |
| Dysnomia capsaeformis Lea | x | - | - | - | - |
| Dysnomia florentina f. walkeri Wilson and Clark | x | x | x | - | - |
| Dysnomia triquetra Rafinesque | x | x | x | - | - |
| Elliptio dilatatus Rafinesque | x | x | x | - | - |
| Fusconaia barnesiana Lea | x | x | - | - | - |
| Fusconaia barnesiana f. bigbyensis Lea | x | - | - | - | - |
| Lampsilis anodontoides Lea | - | - | x | x | - |
| Lampsilis fasciola Rafinesque | x | x | - | - | - |
| Lampsilis ovata Say | x | x | x | - | - |
| Lampsilis ovata f. ventricosa Barnes | x | - | x | - | x |
| Lasmigona complanata Barnes | - | - | x | - | x |
| Lasmigona costata Rafinesque | x | x | x | - | - |
| Leptodea fragilis Rafinesque | - | x | x | x | x |
| Lexingtonia dolabelloides Lea | - | x | x | - | - |
| Medionidus conradicus Lea | x | x | - | - | - |
| Megalonaias gigantea Barnes | - | - | x | - | x |
| Obliquaria reflexa Rafinesque | - | - | - | x | x |
| Obovaria subrotunda Rafinesque | x | x | x | - | - |
| Obovaria subrotunda f. lens Lea | x | - | x | - | - |
| Pleurobema cordatum Rafinesque | - | x | - | - | - |
| Pleurobema cordatum f. catillus Conrad | x | - | x | - | - |
| Pleurobema cordatum f. pyramidatum Lea | - | x | x | - | - |
| Pleurobema oviforme Conrad | x | - | x | - | - |
| Proptera alata Say | - | x | x | x | x |
| Ptychobranchus fasciolaris Rafinesque | - | - | x | - | - |
| Quadrula cylindrica Say | x | x | x | - | - |
| Quadrula intermedia Conrad | - | x | - | - | - |
| Quadrula pustulosa Lea | - | x | x | - | x |
| Quadrula quadrula Rafinesque | x | x | - | - | x |
| Strophitus rugosus Swainson | x | x | x | - | - |
| Tritogonia verrucosa Rafinesque | x | x | - | x | x |
| Truncilla donaciformis Lea | - | - | - | x | x |
| Truncilla truncata Rafinesque | - | - | - | x | x |
| Villosa (Micromya) fabalis Lea | x | x | - | - | - |
| Villosa (Micromya) nebulosa Conrad | - | x | - | - | - |
| Villosa (Micromya) taeniata Conrad | - | x | - | - | - |
| Villosa (Micromya) vanuxemensis Lea | x | x | x | - | - |

*Numbers refer to these localities on Map 1.


WAVERLY
⑤
DUCK
RIVER
⑨
GOBELSVILLE
⑧
BEARDSTOWN
CENTERVILLE
④
RIVER
③
COLUMBIA
LINDEN
⑦
TENNESSEE
BUFFALO
RIVER
TOPSY
⑥
RIVERSIDE
②
HARDENSON'S
MILL
①
WILHOITE
SHELBYVILLE
Ortmann Collections (1921-1923)
Goodrich and van der Schalie Collections (1931)
Clench and van der Schalie Collection (1933)

In 1965 Isom and Yokley (1968) revisited the Ortmann stations and recorded 47 species of mussels (compared to 63 reported by Ortmann). The most recent survey of the Duck River was made in November of 1972 by Bates, Dennis, Isom, van der Schalie and Yokley. The rapid decline of the mussels and their present state of depletion is unbelievable; where once shoals were literally paved with mussels not even fragments of dead shells are now in evidence! The data given here, while essentially corroborating Ortmann's studies, are new and additional records. In the lower Duck there are now data to establish that part of the river firmly as a Mississippi assemblage; for the Buffalo much substantial information is added to the one station Ortmann surveyed in its headwaters.

**The Duck River**

Following the three surveys he made in 1921, 1922 and 1923, Ortmann (1924b) also made a careful study of the literature to determine what species had been accredited to the Duck River. His list contains 63 species and forms. He was concerned about some records given in a list privately printed by Hinkley and Marsh (1885); he was not able to verify some of the records in that early and general list. Those species and forms questioned by him and presumably not part of the Duck River mussel fauna are:

1. *Elliptio crassidens* Lamarck (20)*
2. *Cyprogenia irrorata* Lea (33)
3. *Obovaria retusa* Lamarck (34)
4. *Plagiola lineolata* Raf. (39)
5. *Leptodea leptodon* Raf. (42)
6. *Ligumia recta* f. *latissima* Raf. (53)

Collections made by Goodrich and van der Schalie in 1931 in the Duck River established 48 species, including 6 forms; these are tabulated by stations (Table 1). Not included are the mussels listed above as questionable by Ortmann. Since the number of specimens collected is not necessarily significant other than as an expression of the relative abundance of each species at the stations represented, these figures were not given in the table but sre available in the original data. The tabulation is interesting in that in the upper river stations (Wilhoite and Columbia) there was, as Ortmann found, a Cumberlandian fauna; the two lower (Centerville and South of Waverly) stations had only the Ohioan or Mississippian elements; there also was a marked reduction in species (see van der Schalie, 1939) comparable to that of the lower Tennessee with which this lower Duck assemblage is associated. The Cumberlandian species present in the upper but missing in the lower Duck River are, as follows:

1. *Actinonaias pectorosa* Conrad
2. *Carunculina cylindrella (=moesta)* Lea
3. *Dysnomia brevidens* Lea
4. *Dysnomia capsaeformis* Lea
5. *Dysnomia florentina* f. *walkeri* Wilson and Clark.
6. *Fusconaia barnesiana* f. *bigbyensis* Lea
7. *Medionidus conradicus* Lea
8. *Lexingtonia dolabelloides* Lea

A more complete list of the Cumberlandian fauna in the Tennessee drainage can be found in Ortmann's 1925 paper.

The important and useful summary by Isom and Yokley (1968) of mussels inhabiting the Duck River as late as 1965 listed 47 species as compared to the grand total of 63 Ortmann cited, using some of the now dubious records found in the literature. They were able to add to the list of Cumberlandian species in collecting specimens of *Plethobasus cooperianus* Lea. Other additions—but definitely in the 'rare' category—were *Elliptio crassidens* Lamarck and *Ligumia recta* f. *latissima* Raf.

In recent surveys made by several collectors (Bates, Condor, Dennis, Isom, van der Schalie and Yokley) it was evident that, except at possibly three sites, the mussels were either completely decimated or about to disappear from that drainage system. Responsibility for this may be traced to several sources. Even forty years ago Ortmann (1924b:4) stated:

> 'Duck River is in very good condition, no pollution entering it, except in the region of Centreville, where phosphate mines send muddy water to it; but the amount of pollution is small, and its character obscure, and only at Centreville some indication of an injurious effect was noticed....'

Except for mussel beds at (1) Columbia, (2) Sowell's Bend and (3) Lillard's Mill, which have themselves deteriorated within the past few years, the mussel fauna of the Duck River is virtually gone. The Buffalo River is not much better. In a survey of that stream made by Bates and van der Schalie about ten years ago little was found by way of native mussels, but

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* Ortmann's number.

the introduced *Corbicula* were there in abundance! Isom and Yokley (1968: 40-41) also indicated that the change in the fauna of Duck River 'can be explained in terms of water use. Pollution below cities and industries has affected some areas. Phosphate ore mining is extensive in the Duck River basin as it was in Ortmann's day. Ore washings from this enterprise have contributed to the siltation of habitat.'

The disappearance of the mussels in streams may well be due to 'pollution,' channelization and dam construction (impoundments) but it is not a foregone conclusion that those processes are solely responsible, or that they will necessarily eliminate the mussel fauna. Bates and van der Schalie have records on several years of survey work in the channels within the impoundments of the Tennessee River. The mussels did not disappear there following dam construction as many of us presumed they would. Bates (1962) studied the impact of impoundment in Kentucky Reservoir and verified the fact that many tons of mussels from that area are sent annually to Japan for the pearl industry. Also, cooperating agencies such as the TVA, who have their own survey teams, maintain regions below each dam where normal flow prevails; the original fauna usually remains in these areas which then can serve as 'pockets' for basic studies. Work has been under way for some time assessing the stocks in the old channels, in the 'overbank' areas and in the tailrace areas. Obviously, by coordinating their interests with programs already in the developmental stage, malacologists could more effectively achieve their goals to protect and sustain the fauna than by attempting to block, in areas badly decimated, the construction of dams and/or other projects scientifically planned to prevent pollution.

### The Buffalo River

The Buffalo River is the only major tributary to the Duck, paralleling the Tennessee as it flows south through Perry and Humphreys counties, with its mouth only a short distance east of the point where the Duck empties into the Tennessee River. Ortmann established only one station and that was in the headwaters at Riverside, Lewis County. The four sites on the Buffalo visited in 1931 by Goodrich and van der Schalie contained fauna definitely Cumberlandian in makeup. The assemblages as shown in the tabulations (Table 2) reveal their usual ecological pattern with creek, small-, medium- and large-river species. Ortmann's collection included 18 of the 42 species here recorded for the Buffalo. His records (shown in a separate column in Table 2) indicate a creek or small-river assemblage. The trend toward an increase in the number of mussel species downstream as the river gets larger can be seen, with 18 species recorded from Topsy Bridge but 31 found at the station downstream south of Lobelville.

The Lobelville station serves to reaffirm Ortmann's observations (1924: 46) of the Duck River fauna:

> 'Thus it is seen, that Duck River has a *mixed fauna*, consisting of *two elements: a small-river fauna*, composed largely of *Cumberlandian types* (about 38%), and an element belonging to the *interior basin* (about 62%); the latter consists chiefly of *large-river* types ....'

The Buffalo (Table 2), with the same number of species and almost the same assemblage as the Duck, represents a striking contrast to the fauna shown by van der Schalie (1939: 456) to inhabit the lower Tennessee. The species list for the Tennessee, roughly only a 'stone's throw' away, is entirely an interior basin assemblage. The upper Buffalo, at least, is definitely a Cumberlandian assemblage, clearly set apart from the Mississippian interior basin faunal elements of the lower Tennessee (Table 3).

The Duck and Buffalo rivers had a surprisingly rich mussel fauna, both in the numbers of species and in individuals. Both streams have some of the finest shoals in the world but, as previously indicated, the mussels have now been depleted drastically. In a summary of the data obtained by Goodrich and van der Schalie, as based on their collections in 1931 (Tables 1 and 2), it will be observed that these rivers had not changed materially from the conditions observed by Ortmann ten years earlier (1924b). However, in the more recent collections (1972 survey work) there are now scarcely any mussels. In contrast, the pleurocerids remain abundant and in many places unusually so. The data obtained in this recent survey are now being prepared for publication.

Some reference should be made to the statements by more recent investigators who use the generic name *Epioblasma* rather than the well-established *Dysnomia*. That this change is not warranted is eminently clear, as explained by Ortmann and Walker (1922:71), as follows:

> 'As to *biloba*, its recognition is important with regard to the validity

of the subgenus *Epioblasma* (as against *Dysnomia*). Ferussac is not sure about the identity of his authentic specimen *biloba* ....'

'Thus the description of *biloba* is not recognizable, and with this name also that of the subgenus, *Epioblasma*, goes into the discard.'

Table 2. Species of Mussels Collected in the Buffalo River.

| Species and Forms | Localities (Ortmann) Above Topsy | (Goodrich and van der Schalie)* Topsy Bridge | Above Linden | At Beardstown | 5 mi n of Gobelsville |
|---|---|---|---|---|---|
| Actinonaias carinata Barnes | - | - | - | - | x |
| Actinonaias pectorosa Conrad | x | x | x | x | x |
| Alasmidonta marginata Say | x | - | - | - | - |
| Alasmidonta minor Lea | x | - | - | - | - |
| Amblema peruviana Lamarck | - | - | - | - | x |
| Anodonta grandis Say | - | x | - | x | - |
| Anodonta imbecillis Say | - | x | - | - | - |
| Carunculina cylindrella Lea (= moesta Lea) | x | - | - | - | x |
| Cyclonaias tuberculata Raf. | - | - | - | x | x |
| Dysnomia capsaeformis Lea | - | - | - | - | x |
| Dysnomia florentina f. walkeri Wilson and Clark | - | - | x | - | x |
| Elliptio crassidens Lamarck | - | - | - | - | x |
| Fusconaia barnesiana Lea | x | - | - | - | x |
| Fusconaia barnesiana f. bigbyensis Lea | x | - | - | - | - |
| Lampsilis anodontoides Lea | - | - | - | - | x |
| Lampsilis fasciola Raf. | x | - | - | - | - |
| Lampsilis ovata Say | - | - | - | - | x |
| Lampsilis ovata f. ventricosa Barnes | x | x | - | x | x |
| Lasmigona complanata Barnes | - | - | - | - | x |
| Lasmigona costata Raf. | x | x | - | - | x |
| Lastena lata Raf. | - | - | - | - | x |
| Leptodea fragilis Raf. | - | - | - | - | x |
| Lexingtonia dolabelloides Lea | - | - | - | - | x |
| Lexingtonia dolabelloides f. conradi Vanatta | x | - | - | - | x |
| Obliquaria reflexa Raf. | - | - | - | - | x |
| Obovaria subrotunda Raf. | - | x | x | x | x |
| Obovaria subrotunda f. lens Lea | x | - | - | - | x |
| Pleurobema cordatum Raf. | - | - | - | - | x |
| Pleurobema cordatum f. catillus Conrad | - | - | - | - | x |
| Pleurobema oviforme Conrad | x | x | - | x | x |
| Pleurobema oviforme f. argenteum Lea | x | - | - | - | - |
| Proptera alata Say | - | - | x | x | x |
| Ptychobranchus subtentum Say | x | - | - | - | - |
| Quadrula cylindrica Say | - | - | - | - | x |
| Quadrula pustulosa Lea | - | - | - | - | x |
| Quadrula quadrula Raf. | - | - | - | - | x |
| Strophitus rugosus Swainson | x | x | x | x | x |
| Tritogonia verrucosa Raf. | - | - | - | - | x |
| Truncilla truncata Raf. | - | - | - | - | x |
| Villosa (Micromya) nebulosa Conrad | x | - | - | - | x |
| Villosa (Micromya) taenista Conrad | x | - | - | - | - |
| Villosa (Micromya) vanuxemensis Lea | x | - | - | - | x |

*Goodrich and van der Schalie collections represented on Map 1 by the following numbers:

(6) Topsy Bridge
(7) Above Linden
(8) At Beardstown
(9) 5 miles north of Gobelsville

TABLE 3. Species and forms of mussels collected in the Buffalo River by Goodrich and van der Schalie, arranged by subfamilies and showing Cumberlandian and Mississippian faunal elements.

| *MISSISSIPPIAN* | *CUMBERLANDIAN* |
|---|---|
| **UNIONINAE** | |
| *Amblema peruviana* Lamarck | **Fusconaia barnesiana* Lea |
| *Cyclonaias tuberculata* Raf. | **F. barnesiana* f. *bigbyensis* Lea |
| *Elliptio crassidens* Lamarck | *Lexingtonia dolabelloides* Lea |
| *Pleurobema cordatum* Raf. | *L. dolabelloides* f. *conradi* Vanatta |
| *P. cordatum* f. *catillus* Conrad | |
| *P. oviforme* Conrad | |
| *P. oviforme* f. *argenteum* Lea | |
| *Quadrula cylindrica* Say | |
| *Q. pustulosa* Lea | |
| *Q. quadrula* Raf. | |
| *Tritogonia verrucosa* Raf. | |
| **ANODONTINAE** | |
| **Alasmidonta marginata* Say | |
| *Alasmidonta minor* Lea | |
| *Anodonta grandis* Say | |
| *Anodonta imbecillis* Say | |
| *Lasmigona complanata* Barnes | |
| *L. costata* Raf. | |
| *Strophitus rugosus* Swainson | |
| **LAMPSILINAE** | |
| *Actinonaias carinata* Barnes | *Actinonaias pectorosa* Conrad |
| ****Carunculina cylindrella* Lea | ****Csrunculina moesta* Lea |
| *Lampsilis anodontoides* Lea | *Dysnomia capsaeformis* Lea |
| **Lampsilis fasciola* Raf. | *D. florentina* f. *walkeri* Wilson and Clark |
| *Lampsilis ovata* Say | ***Villosa nebulosa* Conrad |
| *Lampsilis ovata* f. *ventricosa* Barnes | *Villosa taeniata* Conrad |
| *Leptodea fragilis* Raf. | *Villosa vanuxemensis* Lea |
| *Obliquaria reflexa* Raf. | *Ptychobranchus subtentum* Say |
| *Obovaria subrotunda* Raf. | |
| *O. subrotunda* f. *lens* Lea | |
| *Proptera alata* Say | |
| *Truncilla truncata* Raf. | |

* Small river or creek forms found at Riverside by Ortmann.
** Ortmann uses *Micromya* as the generic name.
*** *cylindrella* = *moesta*? Synonymy uncertain.

In addition, the use of the genus *Toxolasma* for *Carunculina* was considered unacceptable (see Ortmann and Walker, 1924b: 54) as indicated in their statement:

> 'The revival of the generic name *Toxolasma* depends on the identity of *U. lividus* Raf. As will be shown under *Car. moesta*, *lividus* is not recognizable, and thus the name *Toxolasma* should be discarded.'

The problems encountered when well established names are changed without proper justification has recently beed discussed by Isom (1973), who pointed out some of the difficulties those working in the immediate, or related, fields had had.

Of ten species considered by some 'endangered' in the Duck River, none is restricted to that drainage. Except for some

healthy stocks of *Conradilla caelata* taken recently, few specimens of the other relatively rare species remain. In connection with the '*Epioblasma (=Dysnomia) turgidula* (Lea, 1858)' one has a problem of identity. The Museum of Zoology at the University of Michigan houses collections which are among the most extensive for mussels available. Because it appears that *Dysnomia turgidula* is a synonym of *D. deviata* (Reeve) and also seems to be synonymous with *D. curtisi* Frierson and Utterback, the distribution records would indicate a far wider range than is usually ascribed to it. Reliable records show its distribution as: Hardy, Sharp Co., Arkansas (U. M. #90742; Holston River, Rogersville, Hawkins Co., Tennessee (#90745); Bear Creek, Burleson, Franklin Co., Alabama (#90746). Under *Dysnomia curtisi*, it was reported from White River, Forsyth, Taney Co., Missouri. In brief, while the mussel fauna has almost disappeared from the Duck River drainage, the 'endangered' species may yet survive in other drainages.

The importance of the Duck and Buffalo rivers both in their rich faunal relations to the Tennessee drainage and in their use in interpreting the zoogeographic and physiographic relationships of the area, has been well stated by Ortmann (1924). His great interest and perceptive analyses were expressed to Calvin Goodrich in letters urging Goodrich to look for similar 'clinal' relations in pleurocerids as found by Ortmann in the mussels of those streams. While the concepts were well defined in Ortmann's publication, he stated in a letter to Goodrich (dated September 17, 1923):

> 'I think I have the Naiad fauna of Duck River rsther complete now. It is peculiar in containing certain Cumberland-Tennessee elements, but not all, and then again Ohio-Mississippi (Big-river) elements, but again not all forms belonging to this, some shells, common elsewhere, being missing ....'

Later, in a letter dated October 31, 1923, Ortmann stated:

> 'The Naiad-fauna of Duck River is peculiar in its affinities. Partly Cumberlandian-Tennesseean, partly Ohioan. (For instance, the 'Mucket' *(ligamentina)* is not the southern Mucket, but the *northern)*. But then again several important members are missing.'

Collaboration between the two did, indeed, follow over a period of years; the recognition of clinal relations among pleurocerid species was also expressed (again in the October 31 letter to Goodrich) by Ortmann as follows:

> 'I am very interested in what you say about the grading of forms of Pleurocerid ae of the upper streams into those of the lower. You remember, I have similar instances among the Naiades, and Walker also, in the beginning, did not want to believe this. I feel rather sure that a similar phenomenon exists at least in *L. geniculata-fuliginosa;* my finds *in the field* immediately suggested this to me, and remember, Adams has shown long ago that this is also the case in *Io,* and I have been able to confirm this. *So I am much in favor of your idea.*'

These clines among nominal species of the pleurocerids are a source of differences among some malacologists who would list as many as 18 species of snails belonging to those groups, while Goodrich recognized mainly nine. To date, the late Calvin Goodrich is still recognized as the best authority on the pleurocerid groups, and the nine species and forms listed here are those determined and collected in the surveys made by Goodrich and van der Schalie in the Duck and the Buffalo drainages. These species' differences will be considered in more detail in another publication.

## Pleurocerid Snails

In his studies of the mussels (naiades) of these rivers, Ortmann did not include his observations about the pleurocerids—the most abundant snails there. When considered in their patterns of distribution, it would remain a moot question as to which group, the mussels or the snails, represents the larger portion of the biomass. In the 1931 survey Goodrich concentrated on collecting pleurocerid snails, which were his main interest, while van der Schalie undertook the mussel work. Ortmann, in his correspondence previously mentioned urged Goodrich to examine the pleurocerids in terms of their distributions and their clinal tendencies. Such studies were made and Goodrich published a series of papers in which he attempted to show variations in sculpture (Goodrich, 1941) as well as relationships of the Ohio River drainage species to those of the Cumberlandian region (Goodrich, 1940).

The species listed by Goodrich to represent the pleurocerid fauna of both the Duck and Buffalo drainages (determined by him and now housed in the U. M. Museum of Zoology) are given in tabular form (Tables 4 and 5). One could, without regard for their clinal tendencies, increase the number to 18 species but Goodrich's identifications here limit the number to nine, including

three forms. In any case, the Duck River had, and still has, a very rich pleurocerid fauna both in the mainstream and in its tributaries. It would still be possible to conduct basic studies to resolve many of the problems that relate to species assemblages, clinal tendencies, etc., with this widely distributed group of snails.

TABLE 4. Species of pleurocerid snails collected by Goodrich and van der Schalie in 1931 at stations in the Duck River, Tennessee. (Specimens deposited in the U.M. Museum of Zoology. Numbers for each locality are those of the U.M. Museum of Zoology.

MANCHESTER, Coffee County: (Nos. 51390-91; 51580).
*Goniobasis edgariana* Lea
*Goniobasis laqueata* Say
*Lithasia geniculata* f. *pinguis* Lea

WILHOITE, Marshall County: (Nos. 53194-98)
*Goniobasis laqueata* Say
*Anculosa praerosa* Say
*Lithasia duttoniana* Lea
*Lithasia geniculata* f. *fuliginosa* Lea
*Pleurocera canaliculatum* f. *filum* Lea

COLUMBIA, MAURY County: (Nos. 53199-203).
*Anculosa praerosa* Say
*Goniobasis laqueata* Say
*Lithasia duttoniana* Lea
*Lithasia geniculata* f. *fuliginosa* Lea

CENTERVILLE, Hickman County: (Nos. 53204-06).
*Lithasia geniculata* Haldeman
*Anculosa praerosa* Say
*Pleurocera canaliculatum* f. *filum* Lea

SOUTH OF WAVERLY, Humphreys County: (Nos. 53207-12).
*Anculosa praerosa* Say
*Lithasia duttoniana* Lea
*Lithasia geniculata* Haldeman
*Pleurocera canaliculatum undulatum* Say
*Pleurocera curtum* Haldeman

TABLE 5. Species of pleurocerid snails collected by Goodrich and van der Schalie in 1931 at stations in the Buffalo River, Tennessee.

TOPSY BRIDGE, Wayne County: (Nos. 53225-27)
*Anculosa praerosa* Say
*Lithasia geniculata* f. *fuliginosa* Lea
*Pleurocera canaliculatum* f. *filum* Lea

ABOVE LINDEN, Perry County: (Nos. 5322-24).
*Anculosa praerosa* Say
*Lithasia geniculatum* Haldeman
*Pleurocera canaliculatum* Say

BEARDSTOWN, Perry County: (Nos. 52318-21).
*Anculosa praerosa* Say
*Goniobasis laqueata* Say
*Lithasia geniculata* Haldeman
*Pleurocera canaliculatum* Say

5 mi. north of GOBELSVILLE, Perry County: (Nos. 53214-16)
*Anculosa praerosa* Say
*Lithasia geniculata* Haldeman
*Lithasia geniculata* f. *fuliginosa* Lea

## SUMMARY AND CONCLUSIONS

If we combine the information given by Ortmann (1924b) with that given here and consider the latter as supplementary to his data, the following conclusions are warranted:

(1) Ortmann (1924) reported 63 species and forms of freshwater mussels (Naiades) in the Duck River drainage; the Goodrich and van der Schalie collections made in 1931 verify that there were at least 48; some credited by Ortmann from literature records were erroneously reported. Isom and Yokley reported 48 and added **Plethobasus cooperianus.**

(2) **"The Cumberlandian fauna is the original fauna of Duck River..." as stated by Ortmann** (1924b: 46), has been verified. The additional records also substantiate that below Centerville, and as far downstream as south of Waverly (1931 collections), only the 'interior' or **Mississippian (Ohioan)** faunal assemblage existed. The 1931 collections further confirm Ortmann's contention that: **"Duck River originally was more directly connected with the Cumberland and Tennessee, and, at that time, it was a rather small river ..."**

(3) Since Ortman was able to establish only one station in the headwaters of the Buffalo River, he could not show (as the 1931 survey did) that the Buffalo drainage also has a **Cumberlandian** fauna as far downstream as 'below Lobelville.' The richness of the fauna in the Buffalo (with 42 species and forms) was essentially the same as listed for the Duck. Isom and Yokley (1968) attest also to the disappearance of the mussels in the Buffalo.

(4) While the Buffalo River runs parallel to the lower Tennessee and relatively close to it, the Buffalo has a **Cumberlandian** aspect; the lower Tennessee is wholly **Mississippian** or an Interior basin fauna.

(5) The evidence available from the earlier collections shows that neither the Buffalo nor the Duck ever had an appreciable mussel assemblage in their tributaries or creeks; all of them have an abundance of pleurocerid snails. The absence of mussels in most tributaries remains unexplained.

(6) Since the time of the Ortmann surveys (1921-1923), the Goodrich and van der Schalie collections in 1931, and the Isom and Yokley studies, the mussels of both the Duck and Buffalo rivers have virtually disappeared; only small pockets remain between Columbia and Centerville on the Duck; they, too, are rapidly being altered.

(7) The oriental clam *(Corbicula)* has made serious inroads into both the Duck and Buffalo drainages, as was also indicated by Sinclair and Isom (1963). It may crowd out the native mussels where they still remain. Fortunately, the *Corbicula* clams serve as food for muskrats and mink, replacing, in that sense, the formerly abundant mussel fauna.

(8) The rapid changes, as well as the multiple use of rivers (discussed by Cairns in his 1972 paper), make the information available from earlier surveys indispensable for studies involving a knowledge of our natural heritage, past and present ecological conditions, and the prospects for using faunal assemblages in tracing former stream confluences. The Duck and the Buffalo definitely have a Cumberlandian fauna, a knowledge of which should be helpful in studies involving geology, physiography and zoogeographical faunal relations.

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# CLAUDE W. HIBBARD (1905-1973)

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In 1946, Hibbie returned to the University of Michigan as assistant professor and curator of fossil vertebrates. His duties included teaching which he enjoyed and excelled in, the multitudinous chores involved in caring for an already large collection of fossil vertebrates, and research in between. He won promotion to associate rank in 1949 and to full professor and curator in 1953.

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which he intended to work up after retirement but which he left in good order for his successors. Most of all, he encouraged all those who came in contact with him and who sought his advice on Pleistocene paleontology.

Those of us who were privileged to know him personally and benefited from his kindness and friendship will long remember him as a teacher and friend.

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