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The Pelecypoda of Dallas County, Texas[1]

Louis B. Read[2]

Our Texas fresh-water Pelecypoda have not been worked systematically for many years. Since the decline of the pearl button industry in the United States, but few publications dealing with the fresh-water mussels have appeared, and of these almost none was from the Southwest. Strecker's 1931 work on Texas Naiades was the last considerable work on our species. He followed Frierson's (1927) nomenclature. The present tendency is to follow Ortmann & Walker (1922), and in this paper I have followed the taxonomy of that work. Our species of Sphaeriidae have never been worked upon. Of course, a number of papers have been published describing Southwestern species, but they, also, have not been monographed for the area. I have generally followed Brooks & Herrington (1944) on the nomenclature of the sphaeriids.

Names of orders, families, and common names are those used by Baker (1928) who, in general followed Ortmann & Walker on the Unionidae and Sterki on the Sphaeriidae.

Physiography of Dallas County

The physiography of Dallas County is fairly uniform. The Trinity River with its tributaries is the only stream of consequence. The river itself flows through Quaternary floodplain deposits, cutting into the Eagle Ford shale of the Upper Cretaceous for a short distance northwest of the city of Dallas. Some of the tributaries flow for considerable distances through limestone of the Austin formation of the Upper Cretaceous. Most of the streams are sluggish, with the flow of water drastically reduced during the summer months. Mean annual temperature is about 66° F. with a January mean of about 45° F. and a mean July temperature

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of about 85° F. Annual precipitation is normally about 36 inches; April has an average of 5 inches and the remaining months an average of about 3 inches.

Methods and Equipment

My best collecting of naiades was done by getting into the water and systematically working over the substrate by hand. Dip nets, rakes, Ekman- and Peterson dredges were also used. Sphaeriids were collected by scooping sand into a sieve and sifting. Standard limnological methods were used in chemical analysis and for plankton counting; and the micro-Winkler method for dissolved O_2 determination was used in physiological experiments.

Systematics and Keys

KEY TO THE ORDERS OF THE PELECYPODA FOUND IN DALLAS COUNTY[3]

A. Adults usually greater than 3 cm. in length; shell nacreous inside. If teeth are present, lateral teeth only posterior to umbo. Mantle lobes not joined or if joined, siphons not extensible ..... Order PRIONODESMACEA Dall

AA. Adults less than 3 cm. in length; shell never nacreous, but may be slightly porcelaneous. Lateral teeth on both sides of the umbo. Mantle lobes joined; with well developed extensible siphons ..... Order TELEODESMACEA Dall

Order *PRIONODESMACEA* Dall

Only one family represented in Dallas County.

Family UNIONIDAE (d'Orbigny) Ortmann, 1911

Members of this family have either simple or compound well-developed water tubes in the gills, which may or may not all be used as marsupia. Shells are uniformly nacreous, and are toothed in all but two species observed in Dallas County. A glochidium is produced.

KEY TO THE GENERA OF THE UNIONIDAE IN DALLAS COUNTY

A. Shell possessing no hinge or pseudocardinal teeth ..... *Anodonta*

AA. Shell with hinge and pseudocardinal teeth.

B. Shell thin and fragile; laterally compressed; pseudocardinal tooth reduced to small scale-like process ..... *Leptodea*

BB. Shell heavy for size; teeth well developed.

C. Adult shell usually not over 5 cm. long, epidermis black, but brown to green near umbo; caruncles present on posterior mantle margin of female ..... *Carunculina*

CC. Adult shell more than 5 cm. long unless the shell is rounded, quadrate or wedge-shaped.

D. Shell rounded, quadrate or wedge-shaped.

E. Shell rounded or quadrate with one distinct ridge posteriorly; often with pustules.

F. Pustules, if present, not forming large knobs ..... *Quadrula*

FF. Row of 3 or 4 knobs down each side ..... *Obliquaria*

EE. Not as in E. above.

G. Shell rounded or quadrate.

H. Three or more ridges, no pustules ..... *Amblema*

HH. Ridges and pustules absent; shell inflated, with umbo forming angle of 45 degrees to longitudinal axis ..... *Obovaria*

GG. Shell more or less wedge-shaped; triangular.

I. Epidermis yellow, with greenish rays; nacre color variable ..... *Truncilla*

II. Epidermis dark, without rays.

J. Shell inflated; pallial line deep ..... *Fusconaia*

JJ. Umbonal area only inflated; pallial line not deep ..... *Pleurobema*

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[3]This key, and those following, are not intended to be comprehensive, but rather to provide a means of quick identification for the bivalves of this county. Keys to genera and species are based on shell morphology alone, and I have tried to eliminate many of the height-length criteria found in most pelecypod keys

DD. Shell elongate or elliptical in outline.
K. Short ridges parallel to longitudinal axis on posterior part of shell.
L. Ridges confined to posterior margin ..... *Lasmigona*
LL. Ridges not confined to margin.
M. One prominent diagonal ridge ..... *Tritigonia*
MM. Beak sculpture prominent and extended; more than one diagonal ridge ..... *Plectomerus*
KK. Not as in K. above.
N. Shell with pink or purple nacre; epidermis usually dark.
O. Pseudocardinal teeth diagonal to longitudinal axis.
P. Shell smooth ..... *Proptera*
PP. Surface of shell irregular, with spines or pustules extending from umbo ..... *Arcidens*
OO. Pseudocardinal teeth form right angle with longitudinal axis; umbo not conspicuously inflated ..... *Lampsilis*
NN. Nacre of shell not pink or purple.
Q. Epidermis light in color with greenish rays.
R. Shell strongly inflated ..... *Lampsilis*
RR. Shell oval in outline, with little inflation; nacre porcelaneous ..... *Actinonaias*
QQ. Epidermis dark; umbo sculptured with concentric lines ..... *Uniomerus*

KEYS TO THE SPECIES OF UNIONIDAE IN DALLAS COUNTY

Genus ACTINONAIAS

Species ..... *Actinonaias carinata*

Genus AMBLEMA

A. Umbo inflated; beak sculpturing not pronounced ..... *Amblema perplicata*
AA. Umbo not inflated; beak sculpturing pronounced on good specimens ..... *Amblema costata*

Genus ANODONTA

A. Shell inflated; umbonal sculpture prominent ..... *Anodonta corpulenta*
AA. Shell laterally compressed; umbo greatly reduced ..... *Anodonta imbecillis*

Genus ARCIDENS

Species ..... *Arcidens confragosus*

Genus CARUNCULINA

Species ..... *Carunculina parva texasensis*

Genus FUSCONAIA

Species ..... *Fusconaia undata*

Genus LAMPSILIS

A. Nacre purple; epidermis very dark ..... *Lampsilis tampicoensis*
AA. Nacre not purple; epidermis usually light in color.
B. Shell conspicuously inflated; epidermis yellow to light brown.
C. No conspicuous rays ..... *Lampsilis anodontoides*
CC. Rays conspicuous ..... *Lampsilis hydiana*
BB. Shell not conspicuously inflated; umbo somewhat recessed into shell ..... *Lampsilis ventricosa*

Genus LEPTODEA

A. Epidermis light in color; not shiny in adult specimens; shell with wide posterior flare; nacre white to pink ..... *Leptodea fragilis*
AA. Epidermis dark, shell not flared; nacre purple ..... *Leptodea laevissima*

Genus LASMIGONA

Species ..... *Lasmigona costata*

Genus OBLIQUARIA

Species ..... *Obliquaria reflexa*

Genus OBOVARIA

Species ..... *Obovaria subrotunda*

Genus PLECTOMERUS

Species ..... *Plectomerus dombeyana*

Genus PLEUROBEMA

Species ..... *Pleurobema cordatum*

Genus PROPTERA

Species ..... *Proptera purpurata*

Genus QUADRULA

A. Shell with prominent pustules.
B. Pustules few, large, low, smooth, and not on umbo.
C. Posterior ridge prominent causing extension of posterior-ventral margin of shell ..... *Quadrula metanerva*
CC. Posterior ridge not prominent; posterior-ventral margin of shell not extended ..... *Quadrula pustulosa*
BB. Pustules that cover umbonal region small and numerous.
D. Pustules covering entire shell ..... *Quadrula quadrula speciosa*
DD. Pustules not covering marginal third of shell ..... *Quadrula quadrula forsheyi*
AA. Shell without pustules.
E. Epidermis very dark ..... *Quadrula petrina*
EE. Epidermis yellow to light brown ..... *Quadrula houstonensis*

Genus TRITIGONIA

Species ..... *Tritigonia verrucosa*

Genus TRUNCILLA

A. Height about 60-65 percent of length ..... *Truncilla donaciformis*
AA. Height about 75 percent of length ..... *Truncilla truncata*

Genus UNIOMERUS

Species ..... *Uniomerus tetralasmus*

Life History and Ecology

The life of a unionid after it leaves the parent, may be conveniently divided into four phases: (1) Glochidial stage during which the larval clam is a parasite upon a fish specific for the species of clam involved; (2) Early juvenile stage, during which the clam is less than 17 mm. long and often remains attached to a rock or some other solid object by means of a functional byssus; (3) Late juvenile stage, which usually coincides with the second year of life of the clam and continues until sexual maturity; (4) Adult stage, when the bivalve has attained sexual maturity. We know little regarding the glochidial and early juvenile stages of development. Young of all species, however, are relatively abundant in collections after they attain a length of about 2 cm. The papers of Lefevre & Curtis (1912) and of Surber (1912) are our chief sources of information on the glochidia of the Unionidae. Their findings are valid for Southwestern species; but it should be noted that a number of our species use cyprinid minnows rather than centrarchid fishes as their hosts during the parasitic glochidial stage. Isely (1911) called attention to the peculiarities of the early juvenile unionids, and my observations confirm his findings.

Glochidial Stage.—Glochidia of our Dallas County species survive only when encystment on a fish host occurs. This period, which lasts for about an average of six weeks, may extend over two or three months (Lefevre & Curtis, 1912).

Early Juvenile Stage.—We have found early juveniles for about one-third of our Dallas County species, but only on gravel shoals where the water is from 1 to 2 m. deep and the current swift. During this stage oxygen requirements are high, and temperature must remain fairly stable.

A few small diatoms were the only recognizable food materials found in the stomachs of the early juveniles. Possibly they feed primarily on nanno-plankters, and the diatoms were accidental. Some of the specimens lost their byssus before the end of this stage of development. Mortality is high because the fragile shells are often crushed by movement of rocks in the current. Baker (1928) says that these

early juveniles provide a source of food for such fish as shad and catfish.

Late Juvenile Stage.—This is the period of most rapid growth of the mollusk. In this stage, the young clam requires an abundant food supply (chiefly of zooplankters), much oxygen, and moderate water temperatures. While not as high as in preceding stages, the mortality in this stage is considerable, mainly because the young clam cannot adjust itself well to adverse changes in the environment. This seems to be true for all species studied.

The Adult Stage.—I have not found any gravid specimens less than 3 or 4 years old. Indeed, if we take the interruption-rings on the shell as representing annual growth rings, none in my collection was less than 5 years old. This assumption is contrary to the fact, however, for I noted that several species laid down good, solid interruption rings when removed from their natural habitat and placed in aquaria. We may well believe that undisturbed clams in this region of abrupt climatic changes sometimes lay down two good interruption rings per annum—especially mussels of the shallow-water creeks and sloughs.

Sexual maturity probably begins for most species at about thirty months. Lefevre & Curtis (1912) discovered that unionids fall into two breeding classes: the "long-term breeders" (which have eggs fertilized during late summer and retain embryos and glochidia in the marsupium until late spring or early summer of the following year) and the "short-term breeders" (which from time of fertilization of the ova retain embryos and glochidia in the marsupium for only 3 or 4 months, during the warm season.) All of our Dallas County clams fit well into these two patterns. Sexual dimorphism is pronounced in several of our species.

The adult clam has variable feeding habits. It apparently takes in everything small enough to pass the inhalent siphon. It takes into the alimentary canal all types of plankters, but thrives best when zooplankters are abundant. Allen (1914) noted that the clam apparently could shut off the flow of digestive juices when it had taken enough food, but the siphoning went on, as did also passage through the gut. In such case, undigested plankters were found in the rectum. I can confirm this last observation of Allen; some clams upon examination of the gut showed only chitinous frag-

ments of microcrustacea, while others showed the rectum filled with living, undamaged zooplankters.

The adult of most species has great resistance to adverse conditions such as drying, lack of oxygen, and lack of food.

Experiments were conducted to ascertain the specific oxygen requirements of several species of clams. While the experiments were not as well controlled as I wish, the results may be of some interest. Four individuals of different species were put into separate 6-litre battery-jar aquaria. An oxygen sample of the water was taken and then a thick layer of mineral oil was placed over the water in each jar. After an 8-hour interval another oxygen sample was taken. Dissolved O_2 was determined by the micro-Winkler method, and the readings converted to volumetric terms. In the 8-hour intervals *Anodonta imbecillis* used 13.8 cc. of oxygen; *Carunculina* 11.7 cc.; *Amblema perplicata* 24.6 cc.; and *Quadrula quadrula* 21.6 cc. All of my individuals were adults, and (with the exception of *Carunculina*) had about equal shell-surface areas. When the oxygen became completely exhausted in the jars, all four specimens closed tightly their siphons and shells. When fresh oxygen was again introduced, they all opened their shells slightly, as well as their siphons. *Carunculina* and *Anodonta imbecillis* did not move, but *Amblema perplicata* and *Q. quadrula* extended their feet slightly and oriented themselves so that their siphons were directly at the tube of the aerator. I then let the animals exhaust the added oxygen, and left the clams in the water without added oxygen for two weeks. *A. imbecillis* died after four days, as indicated by complete relaxation of the adductor muscles. The other 3 individuals survived to the end of the two weeks, and were then killed and weighed. Data on the 3 surviving individuals follow:

Species	Wt. of shell	Wet wt. of soft parts	Dry wt. of soft parts	Oxygen used per hour (calc.)
A. perplicata	128 gm.	28.2 gm.	9.0 gm.	3.1 cc.
Q. quadrula	105 gm.	21.1 gm.	6.1 gm.	2.7 cc.
Carunculina sp.	7 gm.	2.4 gm.	0.7 gm.	1.47 cc.

Carunculina used 2.1 cc. of oxygen per hour per gram of dry body weight—a rate of consumption far in excess of that of the other two species. *A. perplicata* used 0.34 cc. of O_2 per gram of dry body weight/per hour, and *Q. quadrula*, 0.44 cc. These two species are heavy-shelled clams with much

the same sort of habitat. They show a good correlation in the matter of oxygen consumption.

Our species of unionids usually burrow into the wet sand or mud of the bottom when the stream dries—but usually not until the bottom is exposed to the air. When the mud dries and hardens before they can burrow deeply, thousands of large clams exposed to the air and sun die. Fresh-water mussels in a shaded area, when the temperature is not extreme, may live for some time on the surface in an aestivated condition. I have records of such survival, for two months, of several species.

Occasional lateral migrations of the heavy-shelled clams have been noted. Clams imbedded in sand with the posterior end exposed, were found in shallow constrictions of Parson's Slough in only 6 inches of water. Here they had oxygen- and food requirements satisfied with a minimum of effort. When the air temperature rose to about 100° F., and the water in the shallow area became warm, the clams migrated to a quiet pool nearby, where the water was about 3 to 4 feet deep, and cool, owing to spring-seepage from gravel deposits. I have seen very little lateral migration by fragile-shelled slams; they move up or down in the upper eighteen inches of soft mud or sand. In hard clay bottoms these fragile clams erode pockets for themselves, and migrate only when their position is untenable.

The clams of Dallas County are usually infested more or less with hydrachnid mites. These mites usually cling to the tissues between the gills, or around the palps. Leeches (genus *Placobdella*) are also found around the gills. Although most students believe that these mites are true parasitic forms, I cannot fully share this view. If one notes their position and their apparent innocuousness to the clam, the idea grows that mites and mussels are commensals, the mites having their food brought to them by the clam's ciliary currents.

The adult clam usually lives in a community of plankton feeders, competing with minnows, sponges, and Bryozoa for food.

Bionomic Notes on Species of Unionidae

*[2]*Actinonaias carinata* (Barnes)

Unio carinatus Barnes, 1823.

Common name: "mucket." Largest specimen collected:

height 5 cm., length 8 cm. (Hereafter, height in cm. will be given first, followed by length in cm.; thus "5 x 8 cm.") Found only in the Elm Fork, Trinity River, in Dallas County, lying on a gravel shoal below the California Crossing dam, at a depth of one meter, in swift current. This species has a heavy, compressed shell, nacre porcelaneous. A long-term breeder.

[1]*Amblema costata* Raf.

Amblema costata Raf., 1820.

Common name: "3-ridge," or "little washboard." Largest specimen collected: 7 x 10 cm. Elm Fork of the Trinity River, and in Parson's Slough, a tributary of the Trinity. Found, partially imbedded, on hard sand bottom. Heavy-shelled, not abundant in Dallas County, a short-term breeder.

Amblema perplicata (Conrad)

Unio perplicatus, Conrad, 1841.

Common name: "blue-point." Largest specimen found: 8 x 10.5 cm. A corpulent, heavy-shelled form, exceeded in abundance only by species of the genera *Anodonta* and *Carunculina.* Elm Fork, Parson's Slough, and White Rock Creek, on and in all types of substrates, but seems to prefer a partially soft and sandy bottom with a good current. A short-term breeder.

Anodonta corpulenta Cooper

Anodonta corpulenta Cooper, 1834.

Common name: "stout-floater." Largest specimen found: 11 x 19 cm. An inflated, thin-shelled, toothless clam, the most abundant and widely distributed species in Dallas County. Strecker (1931) called all of these clams *Anodonta grandis* Say, and I have no doubt that both *Anodonta grandis* and *corpulenta* occur here. Distinction is difficult, however, the principal difference being that *grandis*—referred to in the button industry as the "floater"—is thicker-shelled and not so inflated as *corpulenta. Anodonta corpulenta* is a mud-loving species; although sometimes found on gravel or in sand, it is usually found in soft mud. A long-term breeder.

Anodonta imbecillis Say

Anodonta imbecillis Say, 1829.

Common name: "paper pond-shell." Largest specimen

*Note: [1]Not reported by Strecker (1931) for Dallas County.
[2]Not reported by Strecker (1931) for Trinity River.
[3]Not included in check list of Read & Oliver (1953) for Dallas County.

found: 5.5 x 9 cm. A very thin-shelled, toothless clam, with a much reduced umbo. Epidermis often green in color, the nacre often with a bluish tinge. This clam prefers a soft substrate and shallow water. While usually found near banks or in shallow coves, it has been found all over the bottom of Bachman Lake. Fairly abundant in Dallas County, in a variety of habitats. Baker (1928) says that this species is hermaphroditic, and is a long-term breeder.

Arcidens confragosus (Say)

Alasmodonta confragosa Say, 1829.

Common name: "rock pocketbook." Largest specimen found: 8 x 11.5 cm. A heavy-shelled specimen with peculiar beak sculpture. It seems to prefer a mixed sand-and-mud substrate in shallow water, where there is a fair current. Found only in Parson's Slough in the southwestern section of the County. The pallial line is indistinct, and the distal margin of the interior of the shell is of a contrasting maroon color. A long-term breeder.

Carunculina parva texasensis (Lea)

Unio texasensis Lea, 1857.

Common name: "lilliput shell." Largest specimen collected: 2.5 x 5 cm. This is the smallest species of our unionid clams. Widely distributed in Dallas County, on mud bottoms in shallow ponds or sluggish streams. It is often found lying in very shallow water around the margin of deeper ponds in the summer. Sexual dimorphism is noted in the shell of this species, although hermaphroditism is known to occur. Females have a small nodule, the caruncle, on each posterior mantle margin. The caruncle varies in size and color (red to white) with different seasons of the year. The male has a few papillae in a similar position. A long-term breeder.

Fusconaia undata (Barnes)

Unio undatus Barnes, 1823.

Common name: "pig-toe." Largest specimen found: 6 x 7 cm. A heavy-shelled species, rare in Dallas County, having been found imbedded in soft sand only in Parson's Slough. The species has a deep pallial scar beyond which the distal margin of the nacre is swollen. A short-term breeder.

Lampsilis anodontoides (Lea)

Unio anodontoides Lea, 1834.

Common name: "yellow sand-shell." Largest specimen found: 6.5 x 15 cm. A light colored, heavy-shelled species

with a white to rosy nacre. Not very abundant in Dallas County; found in Parson's Slough, and in the Elm Fork, usually imbedded in a soft sand substrate, but sometimes in the side of a tight mud bank. This species exhibits sexual dimorphism, is a long-term breeder, and is not known to be hermaphroditic.

Lampsilis hydiana (Lea)

Unio hydianus Lea, 1838.

Common name: "Southern fat mucket." Largest specimen collected: 5 x 9 cm. A heavy-shelled form. When in good condition, it has a yellow epidermis with green rays radiating from umbo to ventral margin. Relatively rare in Dallas County. I found it only in the Elm Fork, lying among pebbles on a gravel shoal, and on top of hard clay bottom in water up to 2 m. deep, never imbedded. A long-term breeder.

[2]*Lampsilis tampicoensis* (Lea)

Unio tampicoensis Lea, 1838.

Common name: "purply shell." Largest specimen collected: 6 x 10 cm. Our only *Lampsilis* with a purple nacre and a characteristic dark epidermis. It was found lying on hard bottom in Elm Fork, and in very soft mud in White Rock Creek. It prefers fairly swift current and moderately shallow water. While no data are available on breeding periods, it is probably, like other members of the genus *Lampsilis,* a long-term breeder.

[2]*Lamsilis ventricosa* (Barnes)

Unio ventricosus Barnes, 1823.

Common name: "pocketbook." Largest specimen collected: 4.5 x 6 cm. Very rare in Dallas County; found only in Parson's Slough, in mud, in water about a foot deep. Baker (1928) says that this form exhibits sexual dimorphism and that it is a long-term breeder.

Leptodea fragilis (Raf.)

Unio fragilis Raf., 1820.

Common name: "fragile paper-shell." Largest specimen collected: 10.5 x 16 cm. A fragile form with small compressed pseudocardinal teeth. Fairly abundant and widely distributed in Dallas County, usually deeply imbedded in soft sand, and also in muck. Not a very resistant species, it cannot survive more than a few hours' removal from water. A long-term breeder.

[2]*Leptodea laevissima* (Lea)

Symphynota laevissima Lea, 1830.

Common name: "paper-shell." Largest specimen found: 7.5 x 13 cm. This species, somewhat more durable than *fragilis,* has a dark, glossy epidermis and a purple nacre. Abundant, usually on a soft mud bottom, in the western shallows of White Rock Lake, but somewhat rare elsewhere in the County. A long-term breeder.

[2]*Lasmigona costata* (Raf.)

Alasmidonta costata Raf., 1820.

Common name: "fluted-shell." Largest specimen found: 6.5 x 12 cm. Heavy-shelled, with a slight greenish epidermis, this species has numerous characteristic parallel flutings on the dorsal posterior margin. Rare in Dallas County, found only on gravel bottom of Elm Fork. A long-term breeder.

Obliquaria reflexa (Raf.)

Obliquaria reflexa Raf., 1820.

Common name: "three horned warty-back." The largest specimen collected: 4 x 6 cm. Shell heavy with white nacre. The species has been found only in Elm Fork, where it is abundant, lying on gravel in water 1 to 2 m. deep, in a swift current. The shell is easily recognized by the single row of 3 or 4 large knobs on each valve. A short-term breeder.

[2]*Obovaria subrotunda* (Raf.)

Obliquaria subrotunda Raf., 1820.

Common name: "hickory nut." Largest specimen collected: 4.5 x 5.5 cm. This species has been taken only from the Elm Fork (on a hard substrate of sand and fine gravel) and is very rare there. A long-term breeder.

[3]*Plectomerus dombeyana* (Val.)

Unio dombeyana Valenciennes, 1827.

Common name: "bank climber." Largest specimen collected: 8.5 x 13.5 cm. Very rare in Dallas County; it has been taken only from Parson's Slough, imbedded in soft mud in shallow water near the bank. It is readily identified by its extensive shell-sculpture and cupreous nacre. I have no information on breeding habits.

[2]*Pleurobema cordatum* (Raf.)

Unio obliqua (Lam.), 1819 (Baker (1928)).

Common name: "Ohio River pig-toe." Largest specimen collected: 5.5 x 6.5 cm. Heavy-shelled, with an unusual triangulate appearance; the umbo of this species is subter-

minal. Rare in Dallas County, found only on a gravel shoal in about 1 m. of water in the Elm Fork. A short-term breeder.

Unio purpurata Lam., 1819.

Common name: "heel-splitter." Largest specimen collected: 12 x 19 cm. Abundant in the Elm Fork on gravel or hard clay. Not abundant in the rest of the county, but does occur in Parson's Slough. It becomes quite large and corpulent with age, in a relatively soft substrate of mud and sand. The shell is quite alate in younger specimens, but these alae erode in older individuals. Nacre is a deep purple. Apparently a long-term breeder; sexual dimorphism is not marked.

Quadrula houstonensis (Lea)

Unio houstonensis Lea, 1859.

No common name. Largest specimen collected: 4.5 x 5.5 cm. Not common in Dallas County; has been taken only from the Elm Fork, on a gravel bottom in about 1 m. of water. A short-term breeder.

[2]*Quadrula metanevra* (Raf.)

Obliquaria metanevra Raf., 1829.

Common name: "monkey-face." Largest specimen collected: 5.5 x 7 cm. Heavy-shelled; rare in the county, taken only from Elm Fork on a gravel substrate. Baker (1928) says that it is a large-river form, typically, and that it is a short-term breeder.

[3]*Quadrula petrina* (Gould)

Unio petrinus Gould, 1855.

No common name. Largest specimen collected: 5.5 x 6.5 cm. Rare in Dallas County; live specimens have been taken only from Elm Fork, where they were lying on a hard clay bottom; but many old, dead, eroded shells were taken along the main channel of the Trinity River. A short-term breeder.

Quadrula pustulosa (Lea)

Unio pustulosus Lea, 1831.

Common name: "pimple-back." Largest specimen collected: 5 x 5.5 cm. Not abundant in Dallas County. I have found it in considerable numbers only in the Elm Fork on a hard gravel substrate. Postules on this species are few, large, and elliptical. Occasional specimens are found that lack pustules. In the younger shells, it is hard to distinguish these from *Q. houstonensis.* A short-term breeder.

Quadrula quadrula forsheyi (Lea)

Unio forsheyi Lea, 1859.

Common name: "maple leaf." Largest specimen collected: 7 x 8.5 cm. Taken from Parson's Slough and from Elm Fork where it is relatively abundant, usually abundant in sand, in fairly deep water. A short-term breeder.

Quadrula quadrula speciosa (Lea)

Unio speciosus Lea, 1862.

No common name. Largest specimen collected: 6 x 6.5 cm. Very much like *forsheyi* except that rather sharp, pointed pustules cover the shell, extending to the ventral margin. More abundant in Dallas County than *forsheyi,* it occurs in Elm Fork, Parson's Slough, and White Rock Creek. It prefers sand substrate and does well in shallow water. A short-term breeder.

[1]*Truncilla donaciformis* (Lea)

Unio donaciformis Lea, 1828.

Common name: "fawn's foot." Largest specimen collected: 2.5 x 4.5 cm. A small wedge-shaped clam. This species is rare in the county. It has been found only in Elm Fork, imbedded in moderately loose sand. A long-term breeder.

Truncilla truncata Raf.

Truncilla truncata Raf., 1820.

Common name: "deer-toe." Largest specimen collected: 5.5 x 7 cm. A larger and less elongated species than *donaciformis;* fairly abundant in Elm Fork and Parson's Slough (where it occurred in soft mud.) It has also been taken occasionally on gravel beds and in sand. A long-term breeder.

[1]*Uniomerus tetralasmus* (Say)

Unio tetralasmus Say, 1830.

No common name. Largest specimen collected: 6 x 12 cm. An elongate, heavy-shelled species, abundant in Dallas County. It has been taken from Parson's Slough, and White Rock Creek; and was found to be the dominant form in a large farm-pond (about 4 acres). It has invariably been found imbedded in a mud bottom with some sand content. It seems to prefer quiet water. Baker (1928) says that this species characteristically digs down and survives drying of stream beds in the moist mud. I have found no gravid specimens. It seems probable, however, that it is a very short-term breeder.

Order TELEODESMACEA Dall

One family represented in Dallas County.

Family SPHAERIIDAE Dall, 1895

Small bivalves, less than 3 cm. in length. Two anterior and two posterior lateral teeth in right valve; one anterior and one posterior lateral tooth in left valve. Monoecious, producing no glochidial stage.

KEY TO THE GENERA OF THE FAMILY SPHAERIIDAE

A. Shell triangulate, inflated, and with terminal beaks ..... *Pisidium*
AA. Shell rounded or elliptical in outline; almost equipartite .....
  B. Rounded form, height greater than 80% of length ..... *Musculium*
  BB. Elongate form, height less than 80% of length.
    C. Shell white, translucent to opaque, and yellowish-brown ..... *Musculium*
    CC. Shell gray and translucent with distinct black mottling on inside of shell ..... *Eupera*

KEY TO THE SPECIES OF THE SPHAERIIDAE

Genus PISIDIUM

Species ..... *Pisidium compressum*

Genus MUSCULIUM

A. Rounded form, height more than 80% of length.
  B. Nepionic cap on umbo very small; shell heavy for size, and porcelaneous ..... *Musculium lacustre*
  BB. Nepionic cap on umbo large, shell fragile, white and translucent ..... *Musculium partumeium*
AA. Height less than 80% of length; elongate form; white or yellowish and translucent when young, becoming light brown with age ..... *Musculium transversum*

Genus EUPERA

Species ..... *Eupera singleyi*

Life History and Ecology

Sphaeriid bivalves are found in all of the sandy creeks of Dallas County, and in most of the mud or limestone creeks. Adults are found under a variety of conditions. They may be buried in sand, small gravel, or in mud. I have not found any that were more than six inches beneath the surface of the substrate. I often found them clamped onto algal filaments, or attached by a byssus to rocks or logs, often forming large colonies. These bivalves serve much as fish food. In one instance, I found the stomachs of two green sunfish, *Lepomis cyanellus* Raf., engorged with Sphaeriids of the genus *Musculium*. Baker (1928) lists a number of fish that eat sphaeriids; among them the bluegill, black bullhead catfish, and the common buffalo fish. These bivalves, so desirable as fish-food, seek protection by living under rocks, in little shallow coves, and within cans, bottles or old unionid shells. Often, with lowering of water, the shallow coves become separated by a sand bar from the channel, leaving great numbers of sphaeriids to perish as the pool dries. I once found 163 live *Musculium* imbedded in sand which filled a large eroded shell of *Lampsilis anodontoides*. Ability to resist dehydration is most marked in *Pisidium*,

with its thicker shell and smaller soft parts than have the other genera.

Feeding habits of the Sphaeriidae are relatively obscure. I have examined the stomachs of a number of individuals, and (as was the case with the early juvenile Naiades) I have not seen anything recognizable except a few small diatoms. Baker (1928) says that diatoms probably constitute their principal food; he suggests that they may also feed on detritus, like many other fresh-water invertebrates. I believe that diatoms are, at best, a minor part of their diet in this area. Probably nanno-plankters are utilized to a large extent. I have not seen any indication that zooplankters of any size are used. The Sphaeriidae have very large digestive glands dorsal to and somewhat surrounding the stomach, however. These glands are proportionately much larger in the Sphaeriidae than they are in the Unionidae. It is possible that zooplankters are digested quickly by powerful secretions of these glands, and thus are not to be found in laboratory examination of the specimens.

Breeding habits of the Sphaeriidae are much the same for all species. The species of *Musculium* have been found with young in all seasons during the past year. In each case the young were of variable size and apparently of different ages. In one instance, I removed 10 young bivalves from the marsupium of an inflated specimen of *Musculium partumeium*. The parent was six mm. long, and the largest offspring was two mm. long. The largest six of the ten survived for one week in a small aquarium, where they rested on the glass bottom, and occasionally moved about. In their normal environment they probably would have been quite capable of independent existence. I have occasionally found a live juvenile *Musculium* inside the closed but otherwise empty shell of an adult, in moist soil beneath rocks where a stream had dried. This may be one method by which the Sphaeriidae survive drying. If, as Gilmore (1917) suggested, the Musculia are short-lived, and can be classified as annuals or biannuals, that method of perpetuation may be significant. I found no young in *Pisidium* nor in *Eupera*. I believe that the young of these two genera are extruded from the parent while they are very small, as attested by the finding of many minute specimens living independently. Gilmore (1917) reports an individual of *Sphaerium* 9 mm. long with a young

bivalve 5 mm. long in its marsupium.

I found no mites or leeches in any of the Sphaeriidae examined; but did find several large, active cercariae (not further identified) in the livers of several *Musculium*.

Bionomic Notes on Species of Sphaeriidae

Eupera singleyi (Pilsbry)

No common name. Adults average about 6 mm. in length. Seldom imbedded in a substrate, but often found on rocks and logs, either attached by a byssus or with the shell clamped upon algal filaments. The shell is characteristically marked with black dots resembling fly-specks. Walker (1918) says that these black dots are caused by the attack of a parasitic infusorian. The species tends to be gregarious, forming small colonies.

Musculium lacustre (Mueller)

No common name. This is our largest species of Sphaeriidae in the county. Adults averaged 13 x 15 mm. Shell with a dark epidermis, rounded, inflated, and has a porcelaneous texture inside. It has been found only in Parson's Slough, imbedded in the upper two inches of the mud and sand substrate, and in overflow ponds of the Elm Fork. All individuals found were solitary, and none was found with well-developed young in the marsupium.

Musculium partumeium (Say)

Cyclas partumeia Say, 1822.

Common name: "finger-nail clam." This is another rounded form, not becoming as large and thick as *Musculium lacustre*. It is relatively rare in the county, and has been taken from mud in the hatchery-tanks near White Rock Creek, and from Turtle Creek. Shell usually yellowish-white and translucent. A number of young have been found in the marsupia of specimens, collected at all seasons of the year.

Musculium transversum (Say)

Cyclas transversa Say, 1829.

Also commonly called "finger-nail clam." By all odds the most abundant and widely distributed sphaeriid in Dallas County. It attains an average size of 9 x 13 mm., being somewhat more elongate than the other species of *Musculium*. I found it (usually imbedded in small gravel or in sand) in every creek examined. While large adults are seldom found, they tend to accumulate in large colonies in small

coves and under rocks. Many young have been taken from the marsupia of this species.

Pisidium compressum Prime

Pisidium compressum Prime, 1865.

No common name. These peculiar bivalves are usually about equal in height and length. Adults average 4 mm. in height and 4 mm. in length. Although small, they have a thick shell, and the soft parts are very minute. They are not widespread in Dallas County. I have found them abundant in Turtle Creek, imbedded in the gravel along with *M. transversum,* as well as imbedded in sand banks, where there was a good current, in Parson's Slough. To my knowledge the young of this species has not been observed thus far in Dallas County.

SUMMARY

Thirty species of the Unionidae are reported here. These include several new distribution-records for Dallas County, and for the Trinity River drainage. Pennak (1953) reports 44 species of unionids from Texas, apparently basing his report on an evaluation of Strecker's (1931) work. Strecker reported 59 species and subspecies for the State. In any case, it will be noted that Dallas County has a very diverse unionid population, probably not to be exceeded by any other area of the state. This is due, in large part, to the fact that in Dallas County almost every conceivable type of stream bottom is found. Many times, within a short distance in a given stream, various types of substrates are available. Furthermore, stocking of Lake Dallas in Denton County with fish from other parts of the country has probably contributed some species to the Trinity drainage since Strecker wrote his monograph in 1931. Also, in the southeastern part of Dallas County, conditions are good for fish that have migrated from east and southeast Texas, carrying glochidia of new species.

The listing of sphaeriids is believed to be fairly complete, although they are so small and devious in their ways, that new species distribution may be found from time to time. The sphaeriid population is not nearly so diverse in this part of the country, however, as it is in the northern part of the United States.

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The Parasites of Necturus

Joseph P. Harris, Jr.

The first note on parasites of *Necturus* was published in 1858 by Kneeland, who saw white ectoparasites upon the gills. Wright & Macallum (1887) described one of these white polystome ectoparasites as *Sphyranura osleri*. Wright (1880) reported the presence of the ciliate *Trichodina* (= *Kerona*). The cestode *Crepidobothrium lonnbergii* was described by Fuhrmann in 1895; LaRue (1909) was the first to report it from *Necturus* (in which it is common). Howard 1915) observed that *Necturus* is the host for the glochidium of *Simpsoniconcha* (quondam *Hemilastena*) *ambigua*; this is apparently the only fresh-water mussel in America which parasitizes a non-fish host. Arey studied the method of glochidial attachment on the gills of the *Necturus*, and made observations upon the method of healing of small wounds.

In all, some fifteen species of animals parasitic upon Necturus have been reported. It is probable that none is exclusively a parasite of Necturus, for nearly all have also been reported from other animals.

LIST OF THE PARASITES OF NECTURUS

Phylum Protozoa Goldfuss
Subphylum Plasmodroma Doflein
Class Mastigophora Diesing
Order Protomonadina Blochmann
Family Bodonidae Bütschli
Proteromonas Kunstler (= *Prowazekella* Alexeieff)
Order Polymastigina Blochmann
Family Trichomonadidae
Trichomonas Donné
Subphylum Ciliophora Doflein
Class Ciliata Perty
Order Peritricha Stein
Family Urceolariidae Stein
Trichodina pediculus (Müller) (= *Kerona pediculus*)
Phylum Platyhelminthes Gegenbaur
Class Trematoda Rudolphi
Subclass Monogenea Carus
Order Polyopisthocotylea Odhner
Family Polystomidae van Beneden
Sphyranura oligorchis Alvey
Sphyranura osleri Wright & Macallum
Sphyranura polyorchis Alvey
Family Allocreadiidae Odhner
Crepidostomum cooperi Hopkins
Crepidostomum farionis (O. F. Mueller) Hopkins.
Family Telorchiidae
Cercorchis necturi Perkins
Family Heterophyidae Odhner
Neochasmus umbellus Van Cleave & Mueller
Family Microphallidae (Ward) Travassos
Monocaecum baryurum Stafford