THE BIOLOGY OF THE GYRINIDAE AND HALIPLIDAE
OF KANSAS.

by

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Submitted to the Department of Entomology and the Faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the degree of Master of Arts.

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The Biology of the Gyrinidae and Halipilidae of Kansas.

Introduction.

Because of the very limited knowledge that we have concerning the habits of the North American Gyrinidae and Halipilidae, two small families of water beetles, it has seemed feasible to the writer to set down in this paper, a few observations and notes made by himself, and others, interested in these two groups. These observations are confined to the life and habits of four Kansas species, which include three species of Halipilidae and one of Gyrinidae.

To become familiar with water bugs, it is necessary that one have access to pools and ponds which contain aquatic life, and which do not dry up during the summer. In this respect the writer was very fortunate in having the excellent collecting grounds afforded by the vicinity of Lawrence.

The writer first became interested in aquatic beetles when studying under the direction of Dr. H.B. Hungerford. This paper is the result of about one and one-half year's work.

The keys to genera and species of Gyrinidae have been modeled after Robert's and Fall's keys; those of
Haliplidae after Robert's and Matheson's keys. All drawings are original.
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Review of literature on the biology of these families of Coleoptera.

The habits of the Gyrinidae and the Haliplidae vary widely. Even after a summer spent working entirely on the biology, I found upon going through all available literature that I had overlooked a number of important points. The little work that has been done in this country upon the natural history of the Gyrinidae and the Haliplidae consists only of scattered observations on various species. Following is a brief summary of the important works:

De Geer's (1774), "Mémoires sur les Insectes", contains some splendid plates, and considerable information on aquatic beetles.

Schlötte (1861-1872) published an important book "De Metamorphosae Eleutheratorum Observations", giving rather extensive and detailed descriptions of the larvae and pupae of several species. A little later Regimbart (1882) in "Ann. Soc. Ent. France", gave us an important paper containing biological material on water bugs, with very fine plates.

Wickham (1891-1893) says: "The preparatory stages of American beetles have been sadly neglected, in consequence, probably, of the difficulty of successfully carrying larvae to their full growth and through their
final transformation." He has contributed however considerable information regarding the natural history of *Dineutes assimilis* Aube.

The species of *Dineutes* and *Gyrinus* are subject to the attacks of parasites. They are destroyed in their pupal cells to an enormous extent by Chalcididae and by a larvae, *Brachinus janthinipennis* Dejean, concerning which Wickham in *The Canadian Entomologist* Vol. 26, 1894, p. 40 has the following to say:

"How the *Brachinus* gets into the cell of its host, whether brought as a young larvae clinging to that of *Dineutes* or deposited as an egg by the mother, is a mystery to me. When small it is more active than when larger, grows, and with advanced age becomes gradually more helpless. In any case the complete adaptation to parasitic habit is apparent in the whole structure—the soft, juicy body unprotected by chitinous scutes, the weak legs, quite useless for ambulatory purposes, and the lack of strong locomotive bristles. The appearance is almost that of some Hymenopteron, not at all resembling the strong raptorial larvae of *Adephaga* in general. I cannot believe larvae of all our American *Brachinus* live on *Dineutes*, but it is quite possible that they feed on the helpless pupa of such other *Adephaga* as frequent the damp spots favoured as habitations by these beetles."
In 1895 Miall published "The Natural History of Aquatic Insects" which reviewed the works of Swammerdam, Reaumur, Lyonnet and De Geer. He described representatives of the groups to which aquatic insects belong, and also the structural contrivances of aquatic insects. He figured the larva, pupa and adults of various insects.

Needham and Williamson (1907) published an important paper in the American Naturalist, "Observations on the Natural History of the Diving Beetles", which contains valuable information concerning the habits and adaptations of the Dytiscidae and Haliplidae. Matheson (1912) stands as an important contributor, dealing with the general biology of the Haliplidae. Brocher (1922) published a paper entitled "Observations Biologiques sur les Haliplides", in which he deals with the respiration of these insects.

Concerning the morphology of the Gyrinidae and the Haliplidae many important works have been published.
Ecology.

Regions studied.

The regions surveyed in connection with these studies on water beetles, include ponds in and around Lawrence, Kansas.

Cattail pool, as it is called, because of the cattails about it, is about fifteen feet wide and twenty-five feet long, and occupies a depression from which limestone has been taken. (Plate I, fig. 1). Another pool within a few yards of this, the Rock pool, though smaller, contains algae and various other water plants. (Plate I, fig. 2). Gyrinids and Haliplidae were taken from both pools. The water in both pools is clear, and makes a very good collecting place, until the middle of the summer at which time the pools dry up. Both pools are located southeast of Oak Hill cemetery.

Stubbs pond, an artificial pond covering perhaps half an acre, is located to the west of Lawrence, just outside the city limits. This pond has a mucky bottom consisting of deep silt. Its fine aquatic vegetation consists largely of algae, cattails and pond lilies. (Plate II, fig. 1). In this pond Haliplidae and Gyrinidae are very plentiful.

Dightman's crossing, on the Wakerusa creek, a
very muddy stream, five miles east of Lawrence, I visited frequently. (Plate II, fig. 2). Gyrimus parvus Say, G. analis Say, and Gyretes simnatus Lea. were found close to the banks where the water was quiet.

U.P. pond, another pond of much interest to this study is located under the Union Pacific tracks a mile north of the city. (Plate III, figs. 1 and 2). It is fed from the Kaw river by an underground stream which keeps it supplied continually with fresh water. The aquatic vegetation is extremely rich in algae, turning the waters green in midsummer. The water is clear, and the bottom is gravelly. The pond covers an area of about half an acre. Haliplidae were plentiful in this pond all summer. Gyrinidae were very scarce in the early part of the summer, but increased in numbers toward the end of the summer.

One of the largest bodies of water I visited was, Lake View, which is six miles from the city. (Plate IV, figs. 1 and 2). "This occupies an abandoned channel of the Kaw river, and is in fact, an "oxbow" lake. This strip of water is perhaps 150 yards wide and a mile long, fringed by willows along the sides and encroached upon at the ends by cattail, securing rush and other plants." *

I spent several days at different times during the
summer making a survey of water bugs, but neither
Gyrinids or Haliplids were ever taken.

All of these ponds and streams, are close at
hand and may be reached in a short time. I visited them
weekly throughout the season.

There were several other bodies of water which
were visited frequently, but they seemed to afford no
favorable collecting grounds.
Methods of collecting water beetles.

The majority of Haliplidae live near the water's edge, in the filamentous algae, or other vegetation. Because they are feeble swimmers these beetles may be easily captured by raking masses of aquatic vegetation on to the bank and catching them as they crawl out to regain the water.

Gyrinids on the contrary are extremely hard to take. They usually congregate in schools, varying in size, from a few up to hundreds. Usually they are some distance from the edge of the water, so to get them it is necessary to use a long-handled net or to wade out into the water. One must be very quiet, for they are easily frightened.

"An examination of the banks close to the collecting places, at the time of transformation, will afford good collecting because often the larval skin, pupal skin, and adult may be produced in the pupal cell at one time."*

Some of the species are attracted by arc lights during warm nights; I have collected Dineutes assimilis Aube, and D. emarginatus Say at lights.

To bring the material from the field to the laboratory successfully, i.e., to have the specimens alive and in good condition, it is best to have the containers filled with grass or aquatic vegetation rather than with

* The Natural History of Aquatic Insects, L.C. Miall.
water, since the continuous movement of the water keeps the insects almost constantly submerged, thus preventing their getting sufficient air.
Life histories and Biology.

A. Family Gyrinidae Aube 1838.

1. Systematic.

The family Gyrinidae is a very interesting and easily recognized group of beetles. They are oval or elliptical in form, somewhat flattened, and usually a brilliant bluish or bronze-black color. The fore legs are very long and rather slender; the middle and hind legs are short, broad, and very much flattened. The eyes are completely divided by the margins of the head, so that the beetle appears to have four eyes. The antennae are very short, and are inserted in little cavities in front of the eyes. Eight species of Gyrinidae occur in Kansas, three species of Dineutes, four species of Gyrinus and one of Gyrates. The last named species Gyrates simnatus LeConte was taken for the first time in the state in July 1922 by the writer.

The name Gyrinidae is founded upon the principal genus Gyrinus, derived from a Greek word meaning "a circle" and given to these insects because of their habit of moving in little circles upon the surface of the water. They do not swim as is commonly thought but glide or skate upon the surface film of the water in the same manner as do water spiders or water striders. They rarely dive beneath the surface, except when pursued, and then they carry, with them a small supply of air and stay but a short time.
Because of their whirling motion on the surface of the water they are popularly known as "whirligigs". Many of them when caught exude a milky fluid, having a disagreeable odor; in certain species the odor is that of ripe apples, which has resulted in their sometimes being called "apple bugs" or "mellow bugs"; they are also called "lucky bugs".

**Historical Review.** The beetles of the family Gyrinidae were first included under the genus Dytiscus, but were separated by Geoffroy under the name of Gyrimus, and finally divided into several distinct genera.

M. Erichson, considered the Gyrinids as a very natural group and distinct from all other groups of Coleoptera. He did not mention them in his Genera Dytiscorum, but later in the *Käfer der Mark Brandenburg*, placed them in a separate family under the name of Gyrinidae.

**Key to Genera.**

Scutellum visible ----------------------------- **Gyrimus Geoffroy**.

Scutellum not visible -----------------------------

Last ventral segment of abdomen

 elongate and conical ----------------------- **Gyretus Brulle**.

Last ventral segment of abdomen

 flattened and rounded at tip -------- **Dinutes MacLeay**.
Genus Gyrinus Geoffroy, 1762.

Original description of the genus: "Caracteres-
Echanorure procculaire penetrant entre les yeux au moins jusqu’au milieu de l’oeil qui est situe beaucoup plus en avant que l’inferieur; pronotum marque plus ou moins nettement d’un sillon median transversal et de deux sillons lateraux un peu courbes enS; elytres marques de dix series de points, les externes souvent enfoncees et canaliculees, les internes souvent obsoletes; propygidium coupe carrement ou tres obsoletement trilobe chez quelques especes. Couleur d’un noir plus ou moins bronze, ayant souvent des reflets bleus ou verdaceux, jamais de bordure jeune en dessus."

Genera Insectorum—P. Wytsman, Fasc. I—XI.

Description of genus. Our members of this genus are smaller, more narrow and more convex than those of the next. The species of this genus have eleven rows of punctures on each elytron, and an oval transverse figure limited by punctures near the tip. The legs are ferruginous, or testaceae. The scutellum is visible. The upper surface of the body is black or bronze, with a shining metallic gloss; the under surface shades from black to ferruginous. Because of their close resemblance, it is
very difficult to identify the species by descriptions, but they are easily separated by means of the male genitalia which will be taken up later in this paper.

Key to the Species of Gyrinus.

A. Scutellum finely, but distinctly carinate.
   size small, 4-4.5mm. ———— G. minutus
   Fabricius.

AA. Scutellum not carinate.

B. Body beneath black, sides and tip of
   ventral segments rufous, size
   larger, 6-6.75mm. ———— G. maculiventris
   LeConte.

BB. Body beneath entirely black, very
   convex form, coarse strial punctures,
   eleventh stria marginal throughout,
   rather small, 5-6mm. ———— G. parvus Say.

BBB. Body beneath black bronzed, form
   rather narrow, strial punctures not
   prominent, anal segment, conspicuous-
   ly rufous, size small, 5-6mm. ———— G. analis Say.

Gyrinus minutus Fabricius 1801.
"Length 4-4.5mm. Elongate oval, bluish black, not
highly polished, sides broadly bronzed; elytra with the
tip truncate, feebly rounded, outer angle somewhat distinct,
though rounded; rows composed of approximate bronzed punctures, the outer ones stronger than the inner; under surface, inflexed margins and legs ferruginous. Anterior ventral segments sometimes darker; mesosternum with a very deep median furrow. Scutellum finely but distinctly carinate."

Male genitalia.-- Color brown apically, paler basally; median lobe slightly flattened, nearly as wide apically as the lateral lobes, rounded narrowly with tip minutely notched. Dorsal and lateral parts chitinous. Lateral lobes flattened horizontally, narrow at base and gradually widening toward apex, with long hairs on the distal end. (Plate V, fig. 2).

Distribution.-- In North America it ranges entirely across the continent from Maine to Alaska. Very abundant about Lake Superior.

Gyrinus maculiventris LeConte 1868.


"Length 6-6.75 mm. More elongate than usual, black, highly polished, slightly iridescent; margins bronzed; punctures of elytra rows bronzed, well marked, approximate; tip more rounded than usual. Trunk dark piceous; abdomen with tip and lateral spots pale."

Male genitalia.-- Color dark brown to testaceous, paler basally; median lobe tapering to a narrow point, tip laterally compressed so as to be in a vertical plane. Dorsal and lateral parts chitinous. Lateral lobes with
apical half flattened horizontally, narrow at base and gradually widening to truncate apex, which bears long hairs. (Plate V, fig. 3).

**Distribution.**—New Jersey, Michigan, Illinois, Iowa, Minnesota, South Dakota, Manitoba, Aweme, Musavick, and Alberta. Abundant at Lake Superior.

A northern species of moderate size and rather narrow form, occurs in Canada; it is at once recognizable by the bright rufous sides of the ventral segments. Mr. J. B. Wallis of Winnipeg, Manitoba, has collected a dozen or more specimens among thousands of *G. maculiventris*. He sent them to Mr. H. C. Fall who agreed that they were freaks. Wallis says "the male genitalia shows differences from typical *maculiventris.*" A specimen of this malformation of *G. maculiventris* is in the writer's collection; it is a female collected by Mr. J. B. Wallis.

**Gyrinus parvus** Say 1834.


"Length 5-6 mm. Body robust, black, highly polished; head with two indented, oblique lines between and before the eyes; thorax with the impressed lines very distinct; elytra with very distinct, well impressed series of punctures, the intervals not at all impressed; tips obtusely rounded; feet honey-yellow."

**Male genitalia.**—Color light brown apically,
-19-
darker basally; median lobe keeled, one-half as wide apically as the lateral lobes, tip narrowly rounded. Dorsal and lateral parts chitinous. Apical half of lateral lobes flattened horizontally, narrow at base and gradually widening to truncate apex, which bears long hairs on the tip. (Plate V, fig.1).

Distribution.—Pennsylvania, Kansas, Texas, California, and Mexico.

**Gyrinus analis** Say 1823.


"Length 5-6mm. Body beneath impunctured and tinged with piceous. Black slightly bronzed, elytra with punctured striae; thorax with a transverse indented line. Front beneath the eyes with two impressed dots; labrum at tip and palpi at base ciliated with white hairs; mouth beneath piceous; labial palpi testaceous, blackish at tip. Thorax with a transverse indented line rather before the middle not attaining to the lateral margins, and a short oblique line on each side behind it curving towards the lateral edge; scutel distinct, subtriangular. Elytra with about eleven distinct narrow striae of punctures, interstitial lines depressed, each elytran very obtusely rounded at tip. Poststernum impunctured, feet rufous, caudal segment testaceous."

**Male genitalia.**—Color light brown apically, reddish or yellowish brown basally; median lobe with apical one-third narrowing and nearly parallel, less than
half as wide as the lateral lobes, the tip narrowly rounded. Dorsal and lateral parts chitinous. Lateral lobes with apical one-third flattened horizontally, narrow at base and not increasing much in width toward apex, with very long hairs. (Plate V, fig.4). 

Distribution.—This is the most widely distributed species of Gyrinus; it occurs from Nova Scotia to Kansas and south to Georgia and Louisiana.

*Genus Dineutus* MacLeay 1825.


*Original description of the genus:* "Caracteres.—Forme ovale, peu convexe, déprimée sur les et au sommet; suture de l'apistome bien marquée; labre transversal, plus ou moins arrondi; échancrure preoculaire ne penetrant pas entre les yeux qui sont assez exactement superposées, l'inferieur ur/peu plus gros; pronotum ayant le bord postérieur bisinue, avec le milieu en forme de lobe arrondi ou subanguleux qui s'avance sur la region scutellaire; elytres minces sur les bords, a sommet généralement arrondi, quelquefois tronque ou meme echancrée avec les angles plus ou moins saillants, l'épipleure large, se terminant vers les deux tiers du bord externe de l'elytre ou il determine une sinuosité plus ou moins accusée."

*Genera Insectorum—P. Wytsman Fasc. I-XI*
Description of genus—The species of this genus are of larger size than those of the other two, and less convex in form. Elytra marked with nine, slightly impressed, almost invisible striae. Scutellum is invisible. Labrum rounded in front and ciliated. Mesosternum is sparsely but coarsely punctured in front. In males the front tarsi are moderately dilated, and clothed beneath with feathery papillae densely arranged in transverse lines, forming an elongated narrow brush; the front thighs of the male are dilated near the knee, on the anterior margin, into a more or less developed tooth, varying somewhat in form. The hind margin of the elytra is not toothed, nor strongly serrate.

Key to the Species of Dinutes.

A. Size large, 12-16 mm.; surface black, very shining, elytra with bronzed vitta-------------------------D. vittatus Aube.

AA. Size medium, 10-11 mm.; surface black, slightly bronzed sutural angles broadly rounded, distinct sharp femoral tooth--------------------------D. emarginatus Say.

AAA. Size medium, 10-11 mm.; surface black, strongly bronzed, sutural angles feebly produced, femoral tooth absent------------------------D. assimilis Aube.
Dinocrates vittatus Aube 1838.

Insectorum species novae Halae, 1824, XXIV, 624 pp. 2pl.

"Length 12-15.5 mm.; breadth 8-10 mm. Size large, regularly oval, feebly convex; surface black, very shining, obsolescely punctate, striae faint, more evident at sides; a submarginal bronze vitta extends across the thorax and nearly to apex of the elytra; lateral margins of elytra not sinuate, depressions not deep, sutural angles broadly rounded; under surface dark brown or pitchy, middle and posterior tibiae and tarsi paler; anterior tibiae sinuate, apex truncate, or very slightly oblique, exterior apical angle rectangular; femora without tooth, punctures (six males, seven females) not deep or closely placed."

Male genitalia—Color dark reddish or yellowish brown; median lobe large, flattened and pointed at tip. Dorsal and lateral parts chitinous. Apical half of lateral lobes slightly flattened horizontally, narrow at base and gradually widening to truncate apex, which bears long hairs, extending laterally one-third the entire length. (Plate V, fig. 5).

Distribution—North, Middle, and South Atlantic States, Indian Territory, Mexico (one specimen U. S. Nat. Mus.).

This species is readily recognized because of its large size, very shining appearance and bronzed vitta.
Dineutes marginatus Say 1823.

"Length 10-11 mm.; breadth 6-7 mm. Size moderate, rather broadly oval, moderately convex; surface, not very shining, somewhat bronzed, punctures and stripes faint; lateral margins of elytra in male not, in female slightly sinuate at exterior apical angles, depressions not deep, sartorial angles broadly rounded; under surface black, very shining and slightly bronzed; middle and posterior legs, tip of ultimate and sides of abdominal segments testaceous; anterior tibiae cylindrical at basal third, then rather suddenly broadened on inner margin in male, on outer margin in female, and continued nearly parallel to apex; apex truncate; exterior apical angle rectangular; femora with a distinct, sharp tooth, punctures (seven males, eight females) rather deep, not closely placed."

Male genitalia—Color reddish or yellowish brown; median lobe gradually acuminate from base to tip. Dorsal and lateral parts chitinous. Lateral lobes slightly flattened, narrow at base, not widening greatly toward rounded apex, which bears long hairs, extending laterally one-fourth the entire length. (Plate V, fig. 6).

Distribution—North and Middle Atlantic States; Virginia.
Dineutes assimiles Aube 1838.

Spec.: Gen., VI, 1838, p. 776.

"Length 10-11 mm.; breadth 5.5-6 mm. Size moderate, oblong oval, distinctly convex; surface black, strongly bronzed, not deeply punctures; striae usually feebly marked; lateral margins of elytra in female not sinuate, apices feebly sinuate, slightly dehiscent at suture and not strongly depressed, sutural angles feebly produced; in female the lateral margins of the elytra and apices more strongly sinuate and dehiscent at suture, sutural angles produced; under surface black, more or less tinged with brown, very shining, middle and posterior legs testaceous; anterior tibiae regularly widening from base to apex; apex truncate, exterior apical angle rectangular, scarcely or not at all produced; femora without tooth, punctures (seven males, eight females) shallow and not closely placed.

Male genitalia—Color light brown to dull yellow-brown; median lobe tubular, drawn to a sharp point. Dorsal and lateral parts chitinuous. Lateral lobes flattened apically, narrow at base and gradually widening toward rounded apex, which bears long hairs extending laterally one-third the entire length. (Plate V, fig. 7).

Distribution—North, Middle, and South Atlantic States; New Mexico, Colorado, Minnesota, Michigan and Dakota's.
Genus Gyretes Brulle 1854.


Original description of the genus— "Caractères—Les caractères de ce genre sont a peu prés les mêmes que ceux des Crectochilus; la principale différence consiste dans l'absence de l'écusson qui est complètement invisible. L'ouverture precculaire penetre a peine entre les yeux qui sont assez exactement superposés; les hanches intermédiaires sont triangulaires et obliques, les postérieures également obliques sont beaucoup plus développées et leur portion déprimée occupe plus des quatre cinquièmes de leur étendue; la forme du corps est très convexe et souvent même très comprimée sur les bords."

Genera Insectorum—P. Wytseman, Fasc. I—XI.

Description of genus— The one representative of this genus greatly resembles Gyinus. Body elongate-oval, very convex, dark bronzed, very shining; sides of thorax and elytra densely punctured and pubescent. Scutellum is lacking. The last ventral segment of abdomen elongate and conical.

Gyretes simus Brulle 1852.


"1. simus, elongate-ovalis, valde convexus, nigro-aeneus nitidissimus, parce obsolete punctulatus, thoracis elytrorumque marginibus punctatis, cinereo

Male genitalia—Color reddish or yellowish-brown, paler basally: median lobe large, flattened and pointed at tip. Dorsal and lateral parts chitinose. Apical one-third of lateral lobes slightly flattened horizontally, narrow at base and gradually widening toward rounded apex, which bears long hairs, extending laterally one-fourth the entire length. (Plate V, fig. 8).

Distribution—California, Texas and Kansas.

2. Life history.

General Notes. These beetles are for the most part very gregarious. They are generally found on the surface of quiet water. All are predacious. As far as we know, all forms place their elongate white eggs upon the under side of aquatic plants. Wickham has contributed considerable to the biology of Dineutes assimilis Aube. The writer has not succeeded in rearing any species in this family.

Habitat. The Gyriidae are generally found on the surface of quiet water. They may be taken however in flowing streams usually near the banks in debris, moss, etc., or in protected places where the water flows the
slowest. Some of the species crawl out of the water on to logs, stones, or other objects, where they bask in the sunlight.

**Hibernation.** From the collecting done it may be presumed that they overwinter as adults. On warm days through the winter the writer has observed them skating around on the surface of the water.

**Oviposition.** The eggs are white, cylindrical, rounded at both ends, and are laid in parallel rows end to end upon the underside of aquatic plants. (Plate VI, fig. 5 and 6). The principal egg-laying months are April, May and June, although the eggs of many species may be found throughout the summer.

**Incubation.** The egg stage lasts eight or ten days. The eggs grow darker, and at one end the red eyes, the legs, the head, etc., of the larvae are visible through the shell.

**Hatching.** These beetles split the egg shell longitudinally upon hatching. They usually hatch in the water, then swim about until they find some easily obtained food.

**Behavior.** The new-larvae upon first appearing are whitish in color, except for the reddish pigment of the ocular areas, they are long, narrow, and much flattened. Soon the chitinized portions of the body darken. Each abdominal segment is furnished with a pair of tracheal gills, and there is an additional pair at the
caudal end of the body. Because of the elongated form of the body and the prominent tracheal gills the larvae resemble a small centipede. (Plate VI, fig. 3).

Food habits. The larvae are carnivorous, and cannibalistic as well. The young feed upon small organisms (entomostracans, etc.). Failing these, they will eat the tender parts of submerged plants. The full-grown larva is a very greedy feeder, eating almost anything it can overcome or that is fed to it. With jaws gaping it lies in wait for its prey; as a rule its position is half in the water and half out, the caudal end being out. When any prey is near at hand the larva makes a quick dart at it and inserts its mandibles just back of the head. After puncturing the prey with its sharp mandibles the larva sucks the contents into the mouth.

Pupation. Wickham says: "When the larva is full grown it leaves the water and burrows into the moist earth, where it molds a cell slightly larger than the pupa to be formed, or it may spin a gray, paper-like cocoon attached to some object near the water." The pupa state of the species, according to limited observations, lasts about a month. The pupa are so well hidden that few have ever seen them.

Structural adaptations. The wings and wing covers of the Gyrinidae are similar to those of other beetles, but the legs are very peculiar. The third pair
are broad and shaped like paddles. They can make a powerful backward stroke upon the water with the broad side, and can be drawn up again edgewise with greatly lessened resistance. The effectiveness of the paddle is aided by the long stiff hairs which fringe it, and especially by the peculiar form of the tarsal joints. These are expanded, and so articulated that the pivot upon which they turn brings them near together. (Plate VII, fig. 2). It is very hard to study the action of the fore limb with the swift darting movements of the Cyarinidae, but it would seem that the power of sudden extension or collapse must be of great practical service. (Plate VII, fig. 3). The middle legs are also expanded, but in a less degree. The fore legs are adapted for seizing and holding prey. (Plate VII, fig. 1). In the male the tarsal joints are dilated, and bear a great number of circular organs, commonly called suckers, which, it is believed, are used in copulation. The elytra are held in place by a snap-like arrangement of the episternum and the wing cover. (Plate VIII, w.f.). The antennae have a very peculiar shape. (Plate IX,). The basal joint is small, the second larger, the third considerably larger, like a second antennae outside the other; the remaining part of the shaft is club-shaped and indistinctly jointed. The tip is provided with pits and hairs, and is probably highly sensitive. The peculiar form of the Cyarinid-antennae is probably a means of keeping it dry.*

*See page 30.
The shape of the body is oval, convex above and flat beneath. The head is sunk in the thorax. The compound eyes are divided completely by the sides of the head into upper and lower parts, both rounded, so that one serves for vision into the air and the other into the water.

Gyrinidae have been observed making a squeaking noise. This sound is produced by rubbing the under side of the wing-covers against the end of the body; it is probably a call to other beetles of the same species. They always make this sound before taking flight.

Concerning the flying habits of D. assimilis Aube, Harry B. Weiss - in the Canadian Entomologist, Vol. XLVI, No. 1, 1914, p. 33 has the following to say:

"The actions of Dicnutes assimilis Aube, which is also quite common in New Jersey, were somewhat interesting. These beetles, when liberated three or four feet from the water, scrambled back with difficulty owing to the character of their legs, which were not meant for locomotion on land."

"At nine or ten feet from the water, after trying awkwardly to walk back, they rose to a height of ten or twelve feet and flew towards the pond, both with and against a slight breeze. At 75 feet from the water,"

"*" In some aquatic beetles the antennae are furnished with an auricle at their, which like the lid of a box, shuts them in when unemployed, and protects them from the water." Kirby and Spence. Vol. III, p. 516 (1826)."
they walked in all directions and then rose in irregular circles to a height of 30 feet and flew to the pond.

"On several occasions, when a brisk wind was blowing from the direction of the water, they were carried inland in spite of heroic attempts to fly against it. When liberated at a quarter of a mile from the water, after an aimless existence on the ground for half an hour, they rose in irregular widening spirals to a height of fifty feet and flew off in direction of the water. It is not known whether these specimens ever reached the pond, inasmuch as trees obstructed the view. Nevertheless they started in the correct direction even against a slight breeze."

Description of stages of Dinocetes assimilis Aube.

Wickham, Bull. Lab. of Nat. Hist. Iowa,


Dinocetes assimilis Aube.

"Color of larva dirty yellow-white, the meso- and metathorax and dorsal portion of abdomen light slaty-blue. The head, especially the mouth parts, and the pro-thorax are tinged with reddish-yellow. Eyes black. The only distinct markings of any kind consist of two dark brown lines on the prothorax, one curved, sub-basal, the other shorter, basal.

"Form, fusiform, not, or only very slightly flattened dorso-ventrally. Entire length 25mm., of which 3mm. belongs to the abdominal appendages."
"Head subquadrate, somewhat narrowed anteriorly and posteriorly, a V-shaped mark between the eyes. Frontal margin (corresponding to labrum, but not separated by a distinct suture) with three teeth, the middle one larger and rounded, the lateral ones smaller and pointed.

"Eyes on a raised black spot, posterior to the antennae. The appearance is of six ocelli, of which four are situated on the upper surface of the head, while the two larger ones are rather anterior and inferior to them in position.

"Antennae inserted immediately behind the base of the mandibles, on a tubercle, four-jointed, the first joint short and stout, the second long, third and fourth shorter, the fourth being shorter than the third. There are no bristles.

"Mandibles curved, acute, moderately stout and without teeth, the inner margin showing only a slight roughening even under a one-fifth objective.

"Maxillae very stout and heavy. The first joint is long and heavy, the second joint heavy but much shorter, having three appendages; internally a long slender tooth, notched at tip, externally a long four-jointed palpus of which the first joint is short and the remaining three longer but nearly equal among themselves, though the second is the longest, and between these two appendages is situated a third, two-jointed one. The only bristles visible are two in number and situated at base.
of this last-mentioned appendage.

"Mentum. I think I am correct in describing as this small and covered at base by a lobe of the under surface of the head. The palpi are very long, three-jointed, the basal joint stout, the remaining ones more slender. It is possible that what I have described as the basal joint may be a supporting piece, like that found in the larva of Ommus (Horn, Trans. Am. Ent. Soc. VII, p.33).

"Prothorax narrowed in front and having on the dorsal surface a cornaceous scute, the posterior margin of which is bounded by a dark brown line. Disk convex, sides nearly straight, base and apex slightly sinuate.

"Mesothorax somewhat broader than prothorax, narrowing anteriorly from a point quite near the base.

"Metathorax similar to mesothorax. There are no bristles of any size on any of the thoracic rings so far as I can discover.

"Abdomen very long, the segments 1 to 8 approximately equal in length. Each of these bears, near the posterior angle, a long white filament or process, which, when the larva is curled in its cell is applied close to the body. In the water they presumably move about quite freely. The ninth segment is smaller and bears a pair of these appendages on each side; between and inferior to these appendages is borne a small additional segment which in turn is surmounted by a smaller one, armed at tip with four long curved hooks.
"Spiracles cannot be found. It is quite possible that true stigmata do not exist and that the filaments form the only external respiratory organs. This is rendered more likely from the fact that each filament is again covered by much smaller ones visible only under high powers of the microscope.

"Legs with prominent conical coxae, femora a trifle shorter, tibiae about half the length of the femora, tarsal pieces a little longer and bearing two nearly straight equal claws. The coxae are slightly bristled, the other joints have all strong spines on the outer edge.

"The pupa is 8 mm. in length, yellowish in color and the eyes are nearly black. The abdomen and nearly the entire dorsal surface are brown. It is much more quiescent than usual with the coleopterous larvae, and I have never seen more than the faintest perceptible movement of the abdomen. It is preyed upon in its cell by two different parasites—one the larva of the Brachinus * and the other a minute Hymenopterous insect of the family Chalcididae. A specimen which was about to disclose the perfect insect increased in length and the limbs became more free.

"Several specimens of larva and pupae were found in their cells or "cocoons" along the bank of the Wapsipinicon River near Independence, Iowa, during the last of August and beginning of September. The larvae,

* See page 35.
on coming out of the water, repair to the under surface of a stone or a board, close enough to the water’s edge to insure continued dampness, and there construct an oval cell of earth, without any admixture of silk so far as I can find. These cells are not simple excavations or earth beneath the stone, but are built upon it like the cells of some of our mud-wasps and are not very unlike them in shape. A cell in my possession measures 12 mm. in long diameter and 8 mm. across outside. In it the larvae lies curled somewhat in the form of a letter C until changing into a pupa which rests upon its back a position also assumed by the perfect insect when it is at last disclosed. Escape seems to be made by forcing out one of the cell as nearly all the empty ones I saw were broken in that fashion."

*Brachinus janthinipennis DeJean.*

"Color of living larva clear white with a dark dorsal line caused by the internal organs showing through. Mouth parts castaneous.

"Form short and thick, cylindrical, tapering at the ends. Length, 9 mm.

"Head small, sides rounded.

"Prothorax broader than the head, margins crenated, separated from the disk by an impressed line. Surface very convex.

"Meso-and metathorax shorter and narrower than
prothorax. Abdomen broader than prothorax, the segments bulging considerably, bristled at the sides beneath.

Legs in the form of an elongate cone, the joints regularly decreasing in diameter from base to tip. There are no true claws, but on three of the legs I can make out, with a three-fourths objective, two diverging bristles near the tip of the tarsal joint which may be the homologue of the claws. As the possession of two claws has been looked upon as characterizing the larvae of Adephaga, this is an important point.

The larva shows to a remarkable degree, the profound modifications which a change of habit may bring about. Belonging to a family the larvae of which are mostly active and strong, living by rapine and murder, the larva of Brachinus is a parasite on insects of its own, is subject to many degradations of structure brought about by this habit. Living in the cells or "cocoons" of Dicentas assimilis Aube, where it is perhaps brought as a very young larva clinging to its host, it is without need of hard chitinious covering to protect it from enemies or strong limbs to bear it in search of prey. Its covering is consequently soft and yielding, resembling rather that of a Hymenopterous larva than a Carabid, the legs become mere props and seem not to be used in drawing the body along when the insect makes the little progress of which it is capable. The abdomen is unwieldy in size and the long caudal processes so
often seen in this family are reduced to mere tubercles. The ambulatory bristles are weak. The mouth parts are minute and it is to be regretted that the scanty material does not permit of dissections which ought to be made. Transformation to the pupal state takes place in the cell of the host. The pupa is white in color, 7 mm. in length, the posterior tarsi exceeding the tip of the abdomen. The antennae are passed under the anterior and middle legs, the tips meeting at the point of origin of the posterior tarsi. The posterior legs are covered as far as this point by the wing-pad.

"Two of these larvae were found in the cells of Dineutes assimilis Aube feeding on the pupae and sucking the juices. One of these, perhaps on account of the partial decomposition of the Dineutes pupa on which it was originally feeding, consented to complete its growth on a pupa of Tropisternus glaber which I killed and opened for it. Taken on the first of September, the change to pupa was made on the seventh, the perfect insect appearing on the sixteenth. The larva had a curious habit when disturbed of lifting the fore part of the body so that all the feet were in the air—much after the attitude taken by Sphinx larvae—and maintaining this position for some minutes."
B. Family Haliplidae Aube 1838.

1. Systematic.

The Haliplidae are among the most beautiful of aquatic Coleoptera. These little beetles are small and oval, more or less pointed at each end, and very convex. In color they are light-brownish yellow. The wing-covers bear rows of punctures, and are marked with black spots (or spots connected by lines) - a prominent characteristic of the family. The antennae are ten-segmented, glabrous and filiform, and are inserted on the front between the eyes; the legs are slender, not fitted for vigorous swimming; the hind coxae are furnished with broad plates, which conceal the posterior legs at their basal half and from three to six ventral segments. Eleven species of Haliplidae occur in Kansas, six species of Haliplus and five of Peltodytes.

The name Haliplidae is derived from the Greek and means "sailing the sea." Although aquatic in habit, the adult Haliplids are poor swimmers. They usually occur in numbers.

Historical Review. The Haliplidae as a distinct group was recognized by C.G. Thomson (Skand. Col., I 1859, p. 11.) and separated from the Dytiscidae and Carabidae as a distinct family. Since then some workers have regarded them as a tribe or subfamily of the Dytiscidae.
Key to Genera.

A. Pronotum lacking basal spots; (Plate X), elytral rows of punctures irregular; the last segment of the palpi small and awl-shaped —————————— Haliphus Latreille.

AA. Pronotum with two rounded basal spots; (Plate XI), elytral rows of punctures on basal third more or less irregular; the last segment of the palpi longer than the third segment and conical — Peltodytes Regimbart.

Genus Haliphus Latreille 1802.

Description of genus. The members of this genus are a little smaller than those of Peltodytes. Maxillae are more elongate and narrow. Terminal segment of the palpi subulate is shorter than the preceding one; sensory pits are few and scattered. Submentum, large trilobed, median lobe is entire. Mentum large. Pronotum strongly narrowed in front, truncate, convex above and widest at base, lacking basal spots. Elytral rows of punctures regular; interstices of elytra punctate. Posterior coxae conceals the first three segments of the abdomen. First tarsal joint longer than the fourth; claws small; hind tarsi as long as or longer than the tibiae.
Key to the Species of Haliplus.

A. Species entirely rufous, black markings absent species not exceeding 2.5mm.——*H. concolor* LeConte.

AA. Species not entirely rufous, black markings always present.

B. Species, not exceeding 3mm.

C. Apices of elytra strongly sinuate ———*H. borealis* LeConte.

CC. Apices of elytra not strongly sinuate.

D. Pronotum with a rounded rufous spot on its anterior margin, elytra with well defined black spots, apices obliquely truncate ———*H. deceitus* Matheson.

EE. Species, none less than 3.5mm. long.

E. Pronotum with a large, oval, black spot on anterior margin —*H. triopsis* Say.

EE. Pronotum immaculate—apex of pronotum finely margined each side obsolete at middle.

G. Prothorax broad, elytral spots large, usually unconnected, sutural stripe broad, the portion in front of the median
spot always extending
to the first row of
large punctures, apices
of elytra not serrate —— H.fascicatus

GG. Prothorax narrow, elytral
spots smaller, connected
by a fine black lines,
sutural stripe narrow,
never reaching first row
of large punctures, apices
of elytra serrate —— H.commemus

Haliplus concolor LeConte 1852.

"Species entirely rufous. Length 2.5mm.
Head sparsely punctate, the punctures very small;
labrum truncate, the anterior margin with a row of fine
setae.
"Pronotum with a pair of small, basal dark areas,
punctate, the disc sparsely so; punctures on the sides
and front smaller than those of the base. Prosternal
coxae rounded behind, punctate, reaching the fourth segment
of the abdomen; abdominal segments shining, smooth, a few
scattered punctures being present.

"Each elytron with ten rows of punctures of the
same color as the elytra; punctures not so deeply impressed
towards the tip; intervals with a few small punctures; apices of elytra rounded, not sinuate."

**Distribution**—Colorado River (LeConte); Texas (Brownsville, H.F. Wickham).

**Type**—In the Museum of Comparative Zoology, Cambridge, Mass. Described originally by LeConte from one specimen from the Colorado River.

**Haliplu$ borealis** LeConte 1850.

Lake Superior, Agassiz and Cabot, 1850, p.212.

"General color pale yellow to rufous with black markings on elytra. Length 2.5-3mm.

"Head punctate, infuscate to black on vertex; labrum rounded at the sides, slightly emarginate, a row of small setae on the anterior margin; antennae pale yellow.

"Pronotum without basal impressions, punctate except on the disc, the basal punctures largest. Prosternal ridge margined, convex longitudinally and laterally, punctate. Abdominal segments smooth and shining, punctate along their posterior margins. Posterior coxae punctate, rounded posteriorly, reaching the fourth segment of the abdomen.

"Each elytron with ten rows of black punctures, the intervals with but few small, scattered punctures. Apices of elytra strongly sinuate! This latter character is probably the most specific and easily used for identification.
Male genitalia—Median lobe a flattened, curved body; with tip curved; the basal part expanded with the lateral lobes articulated to dorsal edge. Lateral lobes asymmetrical, right one short and broad, with hairs on the distal end; left lobe longer and narrower, with a rounded tip, inner surface and tip covered with long fine hairs. (Plate XII, Fig.1).

Distribution—Lake Superior (LeConte); Indiana (LaPorte Co., Blatchley); Iowa (Iowa City, H.P. Wickham); Wis. (Dane Co., W.S. Marshall).

Type—In the Museum of Comparative Zoology, Cambridge, Mass.

Haliplus decentus Matheson 1912.


" General color pale yellow with darker spots on elytra and pronotum. Length 3mm.

" Head punctate; labrum emarginate, rounded at the sides, a row of setae on its anterior margin; antennae pale yellow.

" Pronotum pale yellow with a rounded rufous spot on its margin, punctate, the disc sparsely so. Prosternal ridge margined, not grooved, convex laterally and longitudinally, sharply declivous in front. Abdominal segments smooth, shining, each with a row of punctures on its posterior edge. Posterior coxae punctate, rounded behind, reaching the fourth segment of the abdomen.
Elytra with well-defined black spots; each with ten rows of shallow punctures of the same color as the elytra; intervals with fairly well defined rows of small punctures; apices obliquely truncate, not sinuate, denticulate.

This species is readily separated from H. borealis Lec. by the apices of the elytra not being sinuate.

Described from two specimens from Texas. From the collection of the Michigan Agricultural College, East Lansing, Mich."

**Distribution**—Texas and Kansas.

**Type**—In the Entomological collection of Cornell University, Ithaca, N.Y. Paratype in the collection of Michigan Agricultural College, East Lansing, Mich.

*Haliplus triopes* Say 1825.


General color pale yellow to reddish-yellow with black markings on pronotum and elytra. Length 3.75–4.25 mm.

Head punctate except a small area on the middle of vertex; eyes circular in outline; labrum slightly emarginate, a row of setae on the anterior margin, rounded at the sides; antennae reddish-yellow to pale yellow.

Thorax pale yellow; pronotum with an oval black spot on its anterior margin, strongly punctate except a linear transverse area on disc; paired basal impressions
wanting. Prosternal ridge margined, convex transversely and longitudinally, sharply declivous in front, sides nearly straight, slightly constricted in the region of the prothoracic legs, punctate. Abdominal segments smooth and shining, punctate at thier apices. Legs pale yellow; posterior coxae punctate, rounded posteriorly, reaching the fourth segment of the abdomen.

"Elytra with large, well-defined black spots and margins. There is a great variation in these markings, the spots on one elytron differing considerably from that of the other of the same insect. Each elytron has ten rows of large punctures of the same color as elytra; intervals, each with a fairly well-defined row of small punctures; apices of elytra obliquely truncate, slightly denticulate."

Male genitalia—Median lobe a flattened and exceedingly curved body; with the tip decidedly curved; the basal part expanded, with the lateral lobes articulated to dorsal edge. Lateral lobes asymmetrical, right one short broad and triangular, with hairs on the distal end; left lobe very long and narrow, with a pointed tip, inner surface and tip covered with long fine hairs. (Plate XII, fig.2).

Distribution—Maine and Ontario west to Wisconsin and Colorado, south to Georgia and New Mexico.

_Haliplus fasciatus_ Aube 1838.

Species des Col., VI, 1838, p.30.

"General color rufous to pale yellow with black
spots and margins on elytra. Length 4-4.5mm.

"Head punctate except a small area on vertex; eyes nearly circular in outline; labrum slightly emarginate at the sides, a row of setae on its anterior margin; antennae rufous.

"Thorax rufous to pale yellow; pronotum strongly punctate except a linear transverse area across the disc; punctuation stronger at the base than in front or at sides; paired basal impressions wanting. Prosternal ridge margined, convex transversely and longitudinally, sharply declivous in front, sides straight, slightly widening in front, punctate. Abdominal segments smooth and shining; third segment at sides, fourth and fifth each with a row of punctures along posterior margins; the last segment triangular in outline, punctate at tip and sides. Legs rufous to pale yellow; posterior coxae strongly punctate, rounded posteriorly, reaching the fourth segment of the abdomen.

"Elytra with large well-defined black spots and margins. These markings are fairly constant in this species as compared with other species in this genus. Each elytron has ten rows of large punctures of the same color as the elytra; each interval with a well defined row of small punctures; apical margins of elytra not denticulate."

**Distribution**—Mass (Amherst); New York (Esopus, one specimen); Pa.; Georgia (Spring Creek, Decatur Co., J.C. Bradley); Texas (Dallas).
Halipus con. exus Matheson 1912.

"Color pale yellow, rarely rufous, with black spots and margins on elytra. Length 4 mm.

"Head punctate except a small area on vertex; eyes nearly circular in outline; labrum emarginate, rounded at the sides, a row of fine setae on anterior margin; antennae testaceous.

"Thorax entirely pale yellow, rarely rufous; pronotum punctate except a linear transverse area on disc, the punctuation stronger at base than at sides and front; punctures of same color as thorax; paired basal impressions wanting; prosternal ridge margined, convex transversely and longitudinally, not grooved, sharply declivous in front, sides slightly constricted in region of prothoracic legs, widening again anteriorly. Abdominal segments smooth and shining, the last one triangular in outline and punctate at apex and sides, the base impunctate; the remaining segments except the third, each with a row of punctures on posterior margin. Legs pale yellow, posterior coxae punctate, rounded posteriorly, extending to the fourth segment of abdomen.

"Elytra with black spots on margins more or less connected by fine lines, the spots and margins not so large and more connected than in H. fascicatus Aube. The sutural stripe never reaches the first row of large punctures in
front of the median black spot as it always does in fasciatus and this makes one of the most available characters for separating these closely allied species. Each elytron has ten rows of shallow punctures of the same color as elytra; intervals with fairly well defined rows of small punctures; margins of elytra not sinuate before the apex, denticulate."

**Male genitalia**—Median lobe a large flattened curved body; the basal part expanded, with the lateral lobes articulated to dorsal edge. Lateral lobes asymmetrical, right one short and broad, with hairs on inner surface near distal end; left lobe longer and narrower, with slender tip, inner surface and tip covered with long fine hairs. (Plate XII, fig. 3).

**Distribution**—Canada (Nova Scotia); Mass (Amherst); New York (Ithaca); Michigan (Lansing); Illinois (Lake Forest).

**Type**—In the entomological collection of Cornell University, Ithaca, N.Y. Two paratypes in the writer's collection.
Genus Peltodytes Regimbart 1878.

Description of genus—The members of this genus are a little larger and more robust than those of Haliplus. Maxillae are more compressed and stouter. Terminal segment of the palp is conical, longer than preceding one; sensory pits numerous. Submentum, large trilobed, median lobe is emarginate. Mentum small. Pronotum strongly narrowed in front, truncate, convex above and widest at base, with two small round impressed black spots. Elytral rows of punctures on basal third more or less irregular; interstices of elytra impunctate. Posterior coxae conceals all but the segment of the abdomen. First tarsal joint longer than the fourth; claws small; hind tarsi shorter than the tibiae.

"Cnemidotus Illiger (1802) has been used for this genus but as has been pointed out by Regimbart (1878) it is an absolute synonym of Haliplus Laterille. Illiger (1802) in his genus Cnemidotus included only species which are congeneric with Haliplus Laterille (1802). Erichson (Gen.Dyt., 1832, p.48) under Gen.16 Cnemidotus Illiger cites Dytiscus caesus Daft., Dytiscus caesus Daft., is not congeneric with the species included in Cnemidotus by Illiger and Erichson's description of the genus does not apply to Cnemidotus in this sense of Illiger (= Haliplus Laterille).

"Regimbart (Ann.Soc.Ent.Fr., 1878, p.457) points out that Cnemidotus Erichson is not synonymous with Cnemidotus Illiger (=Haliplus Laterille) and proposes the name Peltodytes for Cnemidotus Erichson but failed to
mention the included species. As Erichson mentioned only one species in his Chnemidotus namely Dytiscus caesus duft., this species must stand as the type of the genus Peltodytes Regimbart."


Key to the Species of Peltodytes.

A. Femora of posterior legs entirely dark brown or rufous.

B. Median spot of elytra free, not coalescent on suture, subhumeral spot narrow, black sutural margin lacking-------------------P. sexmaculatus Roberts.

BB. Median spot of elytra barely touching sutural margin, elytral spots smaller, distinct, punctures of apical half of elytra small, irregularly arranged -------P. pedunculatus Blatchley.

AA. Femora of posterior legs never entirely dark brown or rufous.

C. Posterior femora ringed with yellow at distal ends.

D. Vertex of pronotum immaculate, hind coxal plates distinctly angulate at apex ----------------------------P. 12punctatus Say.
DD. Vertex of pronotum with a prominent black spot, hind coxal plates slightly angulate ————P. edentulus

GC. Posterior femora entirely yellow ——— P. litoralis

LeConte.

Matheson.

Peltodytes sexmaculatus Roberts 1913.

Journal N.Y. Ent. Soc. XXI, 1913, p. 117.

"Oval, greenish yellow, spots round, well separated.

"Size: length 3⅔ mm.; width 2⅔ mm.

"Head narrow between the eyes; eyes large, round, prominent; antennae pale yellow; finely, evenly punctured with the punctures slightly finer on vertex.

"Pronotum finely, evenly punctured except a small discal space impunctate; punctures scarcely larger than those of the head with a few coarser ones placed in the small black basal spots.

"Elytra elongate oval, eleven striate, with the fourth stria interrupted antemedianly; apices, viewed from above, subsulcate the exterior angle being quite sharp and slightly produced with the interior rectangular; striae composed of coarse punctures, blackened, except those of the 10th and 11th striae, gradually reduced in size towards the apex, but not confused; maculate with six round spots on each elytron, moderate in size and placed as follows: one antemedian, two below this one at about the median line, the exterior sublateral and the
interior subsutural, three below these forming a small triangle; base and suture narrowly margined with black, from suture to humerus and from base to apex.

" Under side color of upper.

" Prosternal process broadest at base, strongly constricted just beyond the front coxae, very little broader at apex than at point of constriction, margined at the sides and apex, the side margin basally being somewhat thickened; confluenfly punctured and wrinkled between the margins.

" Mid-metasternum margined, slightly impressed along the margins interiorly, margins nearly parallel and somewhat thickened between the middle coxae, confluenfly punctured at base and with a few fine punctures near the margins.

" Hind coxal wings with small, evenly placed, not deep punctures; apices evidently subangulate.

" Posterior leg with the femora dark brown basally, deepening to almost black apically, and with the apex of tibia black.

" Last abdominal segment shining, very finely rugose.

" Male front and middle tarsi with the first and second joints slightly thickened and feebly produced."

Distribution— Galena, Kansas (E. Crumb); Brownsville, Tex. (H. F. Wickham); Missouri, Texas and Mass. (U. S. Nat. Mus.)
Type—Male and female types from Covington, La. (George Coverdale) in the collection of Roberts.

Feltodytes pedunculatus Blatchley, 1910.
Coleoptera of Indiana 1910, p. 204.

"General color pale yellow with black spots on pronotum and markings on elytra. Length 3.5 mm.

"Head closely and finely punctate; labrum not emarginate, a row of fine setae along its anterior margin, rounded at sides; antennae pale yellow; eyes nearly circular in outline.

"Pronotum with two basal black spots, punctate; punctures of base larger than those of sides or front. Prosternal ridge margined, not grooved, nearly flat, punctate, sides slightly constricted in region of prothoracic legs, widening anteriorly, steeply declivous in front. Legs pale yellow except femora of hind legs are black; posterior coxae attaining the last segment of abdomen. Last segment of abdomen triangular in outline, impunctate.

"Elytra, each with ten rows of black punctures; an irregular, interrupted row of large punctures between the third and fourth rows; punctures of apical half of elytra smaller, irregularly arranged but not so numerous as in muticus Lee.; apical margins sinuate-truncate.

"This species is closely related to muticus Lee., and it may prove only a variety when the distribution of
the species is more fully known."

Roberts adds:

"pedunculatus, have the sutural margin broad before the median spot, occupying the whole of the sutural interval, and narrow below it. While the median spot may not perhaps be called coalescent with the sutural border it touches the margin, and there is a subhumeral spot.

"The apices of the elytra are feebly sinuate and slightly oblique. The apices of hind coxal plates are subangulate and the last abdominal segment smooth and shining. The posterior femora is very dark brown. The prosternal process is feebly sulcate, not greatly constricted."

**Male genitalia**—Median lobe a flattened and exceedingly curved body; with tip decidedly curved; the basal part expanded, with the lateral lobes articulated to dorsal edge. Lateral lobes asymmetrical, right one short and broad; left lobe longer and narrower, with a rounded tip. (Plate XIII, fig.4).

**Distribution**—New York (Ithaca); Mich. (Lansing); Ind. (Laporte; Marshall, Fountain, Marion and Laurence Co.'s; Blatchley, 1910); Ga. (Spring Creek, Decatur Co., J.C. Bradley); La. (Covington, H.F. Wickham); Texas (Brownsville, H.F. Wickham).
Feltodytes dodecimpunctatus Say 1825.

"General color pale yellow to reddish-yellow with black markings on pronotum and elytra. Length 3.5-4mm.

"Head punctate; labrum not emarginate; a row of setae on its anterior margin; antennae testaceous.

"Pronotum with two basal spots, punctate, punctures of same color as pronotum; punctures of front and sides smaller than those of base. Prosternal ridge margined, grooved; constricted in the region of the pro-thoracic legs, widening anteriorly, punctate, steeply declivous in front. Posterior coxae angulate on hind margin; punctate; reaching the last segment of abdomen. Last abdominal segment triangular in outline, impunctate except on apical margin.

"Legs pale yellow except the femora of the hind legs which are dark brown ringed with yellow at their distal ends.

"Elytra, each with ten rows of punctures; intervals with a few scattered punctures; black spots and margins. Apical margins of elytra strongly sinuate-truncate."

Male genitalia—Median lobe flattened curved body, deeply grooved along the ventral side, with a membranous tongue covering the basal three-fourths of groove; the basal part expanded, with lateral lobes articulated to dorsal edge. Lateral lobes asymmetrical, right one short and broad; left lobe longer and narrower with a round tip.
Distribution—Canada (Ont. & Que., H.F. Wickham); New York (Poughkeepsie, Flushing, L.I., Ithaca); Indiana (Blatchley, 1910); Ill. (Lake Forest, J.G. Needham); Wis. (Dane Co., Wm. S. Marshall); Pa. (South Western, Hamilton, 1895); Kentucky.

**Peltodytes gréntulus** LeConte 1863.

*New Species of N.A. Col., I., 1863, p. 21.*

"General color pale yellow with black markings on the head, thorax and elytra. Length 3.5-4 mm.

"Head testaceous with a large crescent-shaped black spot on vertex in front of the black spot; labrum not emarginate, a row of small setae on anterior margin; antennae testaceous; eyes nearly circular in outline.

"Pronotum with a pair of black basal spots; punctate; punctures on sides and front smaller than on the base; disc sparsely punctate; punctures of same color as pronotum. Prosternal ridge margined, punctate, sides constricted in region of prothoracic legs, widening anteriorly, sharply declivous in front. Legs pale yellow except femora of posterior legs which are brown or black ringed with yellow at thigh distal ends. Posterior coxae reaching the last segment of abdomen, punctate, not or only very slightly angulate on their posterior margins; last abdominal segment triangular in outline, sparsely punctate."
"Elytra with ten rows of punctures, the anterior part of outer two rows of same color as elytra, the others black; between the third and fourth rows is a partial row interrupted by the anterior black spot; apical margins sinuate-truncate."

**Male genitalia**—Median lobe a flattened curved body, deeply grooved along the ventral side; the basal part expanded, with lateral lobes articulated to dorsal edge. Lateral lobes asymmetrical, right one short, broad and triangular; left lobe longer and narrower with a round tip. (Plate XIII, Fig. 1).

**Distribution**—Ont.; Mass. (Amherst); New York (Ithaca, Golden Pike); Mich. (Lansing); Indiana (Lake Laporte, Marshall and Fountain Co’s., Blatchley, 1910); Ill. (Lake Forest, J. G. Needham, Beach, Ill.); Iowa (Iowa City, H. F. Wickham); Wis. (Dane Co., H. F. Wickham and Wm. S. Marshall); Kansas (LeConte).

**Type**—In the Museum of Comparative Zoology, Cambridge, Mass.

*Peltodytes litoralis Matheson 1912.*


"General color pale yellow to reddish yellow with black markings on elytra and prothorax. Length 3.5 mm.

"Head pale yellow, punctate except on vertex; eyes large, protruding, strongly convex, circular in outline; labrum scarcely emarginate, a row of small setae
along anterior margin, rounded at the sides; antennae pale yellow.

"Pronotum pale yellow with two basal black spots, punctate, the punctures smaller on front and sides; disc sparsely punctate. Prosternal ridge strongly marginated, grooved, sparsely punctate, steeply declivious in front. Legs pale yellow to rufous; posterior coxae punctate, subangulate on their hind margins, reaching the last segment of the abdomen.

"Each elytron with ten rows of punctures; the anterior part of the outer two rows of the same color as the elytra, the others black; the rows 1, 2, 8, 9 and 10 of small punctures, the outer rows of much larger punctures; an interrupted row of black punctures between the third and fourth rows.

"Described from 5 specimens."

Male genitalia—Median lobe a flattened curved body; the basal part expanded, the lateral lobes articulated to dorsal edge. Lateral lobes asymmetrical, right one short, broad and slender tip, left lobe longer, about as wide as median lobe, with a pointed tip. (Plate XIII, fig. 2).

Distribution—Texas (Dallas); Kansas (Douglas Co., 900 ft. elevation).

2. Life history.

General Notes. This small family of beetles has been neglected, although the commoner species are widely distributed, abundant and easily collected. They live in water about the margins of lakes, ponds and pools or streams where they may be noted crawling over filamentous algae and other aquatic plants. The writer has succeeded in rearing three species.

The adult Haliplid is chiefly herbivorous, feeding mostly on lower plant forms, such as algae, which it seems to devour eagerly. I have observed P. edentulus LeC., P. litoralis Math., P. 12 punctata Say, and Haliplus triopsis Say, feeding greedily on the contents of Hornwort and other filamentous algae.

Habitat. The most common habitat of the Haliplidae is within the confines of some little pool which, as the season progresses, becomes filled with algae and aquatic vegetation. A number of the species may be taken in flowing streams usually near the banks in debris, moss, etc., or in protected places where the water flows slowly. They are most abundant in pools which are fed from outside source, and which do not dry up during the summer.

Hibernation. A few Haliplidae have been found hibernating as adults. It is difficult to determine where and how all of them spend their winter, but a number of the species have been found buried in the mud at the bottom of ponds; others seek aquatic vegetation as there.
is and overwinter there.

Method of rearing. The best method of acquainting oneself with the immature stages, is to isolate, according to species, adults, which lay eggs in captivity. Newly hatched larvae are thus easily obtained. The most suitable aquarium for such work is a small stander dish.

Fresh water and filamentous algae should be supplied to the young larvae every day, so that conditions are as natural as possible. It is necessary to use pond water for such work, as hydrant water, being filled with chemicals, will kill both the larvae and the adults.

The larvae, when full-grown, begin to grow restless and try to crawl out. When the time for pupation has arrived, they rapidly burrow down and form pupal cells. Moist earth seems to be the best substance for the terrarium and an inch or so depth will suffice. If not too deep, the larva will often make its cell next to the glass container where observations may be made.

Oviposition. The eggs are laid in two ways; the species of Feltodytes attach their eggs to the strands of filamentous algae (Plate VI, fig. 4), while those of Haliphus place their eggs within the dead stems of algae. The female cuts an opening with her mandibles and then deposits several eggs within the cell through this opening. The principal egg-laying months are April, May and June, although the eggs of many species may be found during the entire summer.
Incubation. The egg stage lasts four to six days depending upon the weather conditions. The eggs swell considerably as the young embryo continues its growth within. The red eye spots appear on about the third or fourth day.

Hatching. The larva breaks its way out by means of a longitudinal split through the anterior end of the egg.

Behavior. The larva lives in the same places as the adults. When first appearing they are whitish in color, except for the reddish pigment of the ocular areas; they are composed of slender segments, each of which, except the head is furnished on the back with many long jointed spines. (Plate VI, fig. 2). Food habits. The larva is herbivorous. The young feed eagerly on filamentous algae. The full-grown larvae continues feeding on algae, more excessively now than in the earlier stages. It is very interesting to watch these long-spined larva grasp a strand of algae, and by means of their fore legs, push it backward; by puncturing the cell with its sharp mandibles the larva sucks the contents into its mouth.

Pupation. The Haliplid larva only have two molts, which last about one month. Most of its life is spent in the third instar or mature larval stage. When the larvae are full grown they begin entering the soil and mold a cell slightly larger than the pupa to be formed.
Method of respiration. As shown by Schiödt the spines on the larvae contain tracheae which undoubtedly function for the securing of an air supply from the oxygen in the water. (Plate VI, fig. 1).

Concerning the respiration of the adult, Matheson in Journal N.Y. Ent. Soc. Vol. XX, 1912, p. 179-181, has the following to say:

"Their method of respiration is rather unique and nothing like it has been described so far as I know. The elytra are firmly held in place not only by the groovings in the pleura but also by the knoblike structures on the anterior outer ends of the posterior coxae. These knoblike structures fit closely into socket-like depressions of the elytra. At first I was led to suppose that these insects secured their air supply as in the Dytiscidae, by breaking the surface film with the tip of the abdomen and carrying an air supply under the elytra. I was led to this belief from seeing many of them with an air bubble attached to the posterior end of the body. But as the elytra are rather firmly held in place by the knoblike structures it seemed doubtful if these beetles could open the tips of the elytra and not at the same time allow the entrance of water. However on close observation it was seen that the air supply was carried under the broad coxal plates, at the posterior end of which an air bubble is usually found. As the femora move back and forth through this air supply I could not quite
determine how the air reached the spiracles. On examining beetles from which the elytra were removed it was soon seen how the air supply became available. Leading from the anterior end of the posterior coxa is a narrow groove in the pleurum. This widens at first, then narrows and finally divides into two branches. One branch passes backwards and opens directly near the second abdominal spiracle. This air supply reaches all the abdominal spiracles. The other branch passes forward and conveys an air supply into a large depression in which are located the first abdominal and meta-thoracic spiracles. These spiracles are much enlarged. The first abdominal spiracle is very large, oval in outline and is almost closed by long, fine setae. This condition of the enlargement of the first abdominal spiracles is in marked contrast to that found in the Dytiscidae. The meso-thoracic spiracle is small and probably functions to some extent as air can reach it. Thus these beetles carry their air supply under the elytra but obtain it by way of the coxal plates and lateral grooves leading under the elytra. These grooves are lined with fine short setae, all pointing towards the entrance and prevent the ingress of water."

**Structural adaptations**—The head fits closely into the prothorax, and the elytra are closely applied to the sides of the body and to each other on the middorsal line. The prosternum has been developed into a deep ridge into which the head fits, and has become so fused as to almost hide the meso-sternum. The elytra
fit very closely to the sides of the body and their bases meet the margin of the pronotum closely and finely, making an almost water-tight and smooth junction. The scutellum is lacking. Posteriorly, the elytra are held in place by the knoblike prolongations of the posterior coxae. (Plate XIV). The antennae are glabrous, and filiform. (Plate XV), and each lies in a small groove directly below the eyes; the eyes are very prominent. The outline of the body is rounded. The shape of the body is deep and narrow, and is very well fitted for movement through the water, but lacks the means of fast swimming.

The swimming efficiency is very poor as compared with that of the Gyrinidae. The posterior coxae have a remarkable plate-like development. By this means the hind legs are moved in only one plane and their efficiency as swimming, is lessened considerably. There is a development of long fringes of hair on the tarsi of all the legs and on the first and second pairs of legs. These fringes are supported to some extent by short, stiff setae. (Plate XVI).

Description of stages.

**Peltodytes 12 punctata Say.**

The egg—Brownish in color, broadly oval. Length 0.5mm., width 0.2mm. The eggs are attached to the stems of aquatic plants, hornwort. Hatching occurs in the early part of the spring, early part of April and May. Egg laying begins about two weeks later and continues
nearly all summer. The average time for the hatching of the eggs is about four to five days depending upon the weather conditions. From eggs laid Aug. 22, 1922, the first larvae emerged Aug. 25. The larvae break their way out by a longitudinal split through the end of the egg.

**First instar.** Length including the caudal setae 1.6mm.; caudal setae 0.3mm. Width at thorax 0.3mm. Head very prominent. Eyes each of six ocelli arranged in two horizontal rows on prominent projections on the lateral aspect of the head. Antennae two segmented, with a terminal spine, the proximal segment the longer. Thorax consists of three segments, abdomen of nine. Each segment except the last, provided with four long, jointed spines, two dorsal and two lateral. The last abdominal segment possesses two long caudal setae. The caudal setae are two jointed, the second segment is short and fine. The dorsal and lateral setae are two jointed, the second joint long and slender. The first pair of legs are short and modified into grasping organs. The second and third pairs of legs are long and fitted for walking over filamentous algae. Each leg consists of five segments and a single claw. The claw bears a short basal spine. Spiracles are absent.

**Second instar.** The first molt takes place about nine days after hatching. There is not much change to be noted except an increase in size, in the length and in the number of the joints of the spines covering the
body. Length 3 mm.; caudal setae 1 mm. The antennae are now three segmented with a terminal spine. The first joint is short and inconspicuous. Each segment except the last is furnished with spines as described for the first instar only they are much longer and each one consists of many more joints. The caudal setae are now four jointed. The dorsal and lateral spines are now about 1.5 mm. in length and seven segmented. Spiracles are absent. The second instar occupies on the average about eight days.

**Third instar.** The mature larvae—The second molt occurs ten to twelve days after the first. The larvae is now in its last stage. This stage lasts from fourteen to sixteen days, depending largely upon the food supply. Length 6 mm.; caudal setae 4 mm. The antennae are now four segmented with a terminal spine. Ocelli six, placed on a prominent lateral elevation. The larva consists of twelve segments. Each segment except the first and the last have spines arranged as in the preceding instar. The prothoracic segment now has six jointed spines, two lateral and four dorsal. The extra two spines develop during the second instar and appear at the time of the second molt. The two extra spines are smaller and only eleven jointed. The mesothoracic spines and other spines vary in the number of segments, all are about the same length 2 mm. long. At the side of the first joint of each spine are two short, stout,
lateral spines. The last segment has two dorsal spines and only the reduced basal segment of the lateral spines. Spiracles are absent.

**Pupation.** When the larvae become full grown they leave the water and seek damp soil in which to pupate. They begin to burrow into the soil about seven to eight days after the second molt or third instar. They begin immediately to hollow out a small cavity within which they transform. The pupal period lasts about two to three weeks.

**Pupae.** Length 4mm. entirely white and remains so except for the eyes, until the time when it emerges as an adult. The pupae lies on its back in its pupal case, and the spines on its back keep it from coming in contact with the soil. The head lies curved under the prothorax and between the fore legs. The ten spines on the pronotum long, curved and unjointed, prevent the anterior end of the pupae from touching the soil in its pupal case. The abdomen of eight segments bears on its dorsal surface four long, unjointed spines, two dorsal and two lateral. These long curved spines prevent the tender abdomen from touching the soil. The ventral surface of the abdomen is smooth. The caudal end of the pupae is provided with a number of very short spines. Now there are present nine spiracles, two thoracic and seven abdominal.

**Adult.** The time required for the change to the
adult is about three to four weeks after pupation. The adult upon emerging is at first very soft and colorless except for the dark eyes. The adult beetle requires about a week to attain its full color and leave the pupal chamber. From egg to adult nine weeks were required. In this rearing the adults emerged Oct. 28, 1922, about nine weeks after the eggs were laid.

*Peltodytes edentulus* LeConte.

The egg. Brownish in color, broadly oval, with roughened markings and a small knob on its anterior end. Length 4.5mm., width 2.2 mm. The eggs are attached to the stems of aquatic plants, hornwort. Mating, egg-laying, hatching, etc., is practically the same as *P. 12 punctata* Say. From eggs laid Aug. 28, 1922, the first larvae appeared Sept. 1.

The first and second instars are about identical with *P. 12 punctata* so it will be unnecessary to discuss them.

Third instar. The mature larvae-The larvae differ here a little from the above species. The second molt occurs ten to twelve days after the first. This stage lasts about 12 days, depending upon the food supply. Length 6mm., caudal setae 4mm. The antennae four segmented with a terminal spine. Coelli six, placed on a prominent lateral elevation. The dorsal and lateral spines are arranged like those in *P. 12 punctata*. The proximal segment of each dorsal spine is very short.
In P.edentulus the lateral spine is short. The last segment has two dorsal spines and only the reduced basal segment of the lateral spines. Spiracles are absent.

**Pupation**—The time of pupation, pupal case and length of pupal period are identical with that found in P.12 punctata.

**Pupae**—Length 4mm. entirely white and remains so except for the eyes, until when it emerges as an adult. The head lies curved under the prothorax and between the fore legs. Pronotum has ten long, curved unjointed spines, four on the anterior, two on each lateral and two on the posterior margins. There spines prevent the anterior end of the pupae from touching the soil in its pupal case. The abdomen of eight segments bears on its dorsal surface four, long, unjointed spines, two dorsal and two lateral. Between the dorsal spines are two shorter, small spines present on each segment except the last two. These long curved spines prevent the tender abdomen from touching the soil. The ventral surface of the abdomen is smooth. The pupae lies on its back in its pupal case, and the spines, on its back keep it from coming in contact with the soil. The caudal end of the pupae is also provided with a few short spines. There are present nine spiracles, two thoracic and seven abdominal.
Adult. The time required for the change to the adult is about three to four weeks after pupation. The adult upon emerging is at first very soft and colorless except for the dark eyes. The adult beetle requires about three to four days to attain its full color and leave the pupal chamber. The adults in my rearing emerged Nov. 5, 1922. From egg to adult, ten weeks were required.

**Feltodytes literalis Matheson.**

The egg. Brownish in color, broadly oval. Length 0.5 mm., width 0.2. From eggs laid April 7, 1923, the first larvae emerged April 15.

The first and second instars are about identical with *P. lespunctata* so it will be unnecessary to discuss them.

**Third instar.** The mature larvae—The second molt occurs nine to ten days after the first. The second molt occurred on April 27, 1923. This stage lasts from nine to ten days, depending upon the food supply. Length 8 mm., caudal setae 4 mm. The antennae are now four segmented with a terminal spine. Ocelli six placed on a prominent lateral elevation. The larva consists of twelve segments. Each segment except the first and the last have spines arranged as in the preceding instar. The prothoracic segment now has six, jointed spines, two lateral and four dorsal. The extra two spines
develop during the second instar and appear fourteen segmented. The mesothoracic spines and other spines vary in the number of joints, all are about the same length 4mm. long; at the sides of the first joint of each spine are two short prominent, stout lateral spines. The segment has two dorsal spines and only the reduced basal segment of the lateral spines. Spiracles are absent.

Unfortunately at the time of writing, May 9, 1923, the larvae just began entering the soil.
The Male genitalia used as Specific characters.

The male genitalia has for a long time been used in various groups of insects for specific determination. Species once separated in this way, may be easily identified later on by the color, form, size, sculpturing, etc. After a little practice one is able to separate species by these characters alone. Among the species of Gyrimus and Dineutes the most accurate ways of determining a species is by the genitalia. The external appearance is practically the same in all the species, making it very difficult to separate them by any other means than by the genitalia.

European workers who have published valuable works on the male genitalia are: Regimbart, James Edwards, Frank Balfour Browne, Dr. Sharp and F. Muir in 1912 published a very valuable joint paper on "The comparative anatomy of the male genital tube in Coleoptera", Trans. Ent. Soc. of London, 1912, Part III.

In recent years it has been shown that a close study of the male genitalia affords great help to the systematist.

Chris. H. Roberts in his paper on " The Species of Dineutes of America North of Mexico, in Trans. Am. Ent. Soc., Vol. 22, 1895, Pl. VI. illustrates the male genitalia, but he did not use it in his descriptions.
He has failed to add the fine hairs which occur at the distal end of the lateral lobes, and it is by the location of these hairs on the distal ends of the lateral lobes that the genera of Gyrimus and Dineutes may be readily separated by the casual observer.

In the genus Dineutes the hairs on the distal ends of the lateral lobes extend down the outside of the lobes for about a fourth of the length of the genitalia; in the genus Gyrimus however the hairs are found only on the distal ends of the lateral lobes, not extending down the sides as in Dineutes; in the genus Gyretes the hairs extend down the side of the lateral lobes as in Dineutes, but as the representatives of the species of Gyretes are considerably smaller than Dineutes, one has no trouble in separating these two genera.

Mr. H. C. Fall monographed the genus Gyrimus of North America, Trans. Am. Ent. Soc. XLVII, p. 269-306, 1922. He has illustrated all forms and has, like Roberts, omitted the fine hairs on the distal ends of the lateral lobes. He thinks that there are a few species which can never certainly be recognized in any other way, than by the genitalia, and I agree with him absolutely.

The genitalia of Gyrimus is a cornaceous body consisting of a median and a pair of lateral lobes.
found between the dorsal and ventral surfaces of the last abdominal segment; for a short distance from its base, it is somewhat oval in form and parallel to the long axis of the body, but its parts are abruptly and obliquely bent upwards to follow the curve of the last ventral segment. The lateral lobes, the form of which does not vary in any marked degree in the several species, have the basal half of their inner faces excavated for the reception of the basal half of the median lobe; their apical half is flattened and blade-like, and their apices are fringed with long hairs. The form of the median lobe is various, and peculiar to the respective species.

Edwards is the only author who used the form of the genitalia as a specific character, but he failed to make use of his discovery. The genitalia with its "accessory" or lateral lobes readily separates all our Kansas species. (Plate V.)

The genitalia in the Haliplids are of a peculiar structure, and although, in the different species the form differs considerably, they are, within a genus similar.

The genitalia consists of a median lobe, and two lateral lobes; the whole apparatus is bilaterally asymmetrical and flattened from side to side. The two lateral-lobes differ from one another, one being .
as Edwards describes it," merely a conus scale, usually oblong or subtriangular with a rounded apex." The shape of this "scale" varies somewhat in the different species, but there is a small tuft of a few stiff hairs near the apex.

The other lobe varies greatly in shape, being quadrilateral in some species and triangular in others. The side of the lobe running up from the angle of attachment is somewhat cut off and is always, fringed for at least part of the length with stiff hairs. At the extremity of the lobe there is usually a tuft of stiff hairs, which Edwards described as a "long curved spine."

In the genus Haliplus small tufts of stiff hair occur on both lateral lobes, whereas in Peltodytes the small tufts of hair are entirely lacking. The absence and presence of these hairs, and their location on the lateral lobes, and the shape of the median and lateral lobes make it possible to separate with ease the various species by this means.

The median lobe is a peculiar structure, in that it is asymmetrical. It is a strongly chitinous organ into which the ejaculatory duct passes, this tube opens about half way back along the organ; the opening is protected by an elongate, chitinous tongue.
which lies along the side of the main lobe.

In some species, on the right side of the median lobe, there is a membrane which Browne calls the "hood". It arises behind the apex of the main lobe, and varies considerably in extent. It may sometimes nearly reach the base of the median lobe, and may stand up merely as a flat membranous structure. In some species this hood is reduced to a minute lobe, and in others it is entirely absent.

The process of removing genitalia is very simple, and with properly softened specimens, may with very little practice be removed with little or no injury to the specimen. In cases where fresh not specimens could/be had, special methods had to be resorted to, in order not to destroy the specimen. Dried specimens were either relaxed in a relaxing jar or placed in water and there allowed to soak for some time depending upon the specimen. When properly relaxed the genitalia were taken out. By gently slitting open the last ventral segment of the abdomen, the genitalia were thus easily obtained. In some specimens the abdomen was torn off; with such, after removing the genitalia, the abdomen could be stuck back on again. The genitalia was placed in water for a time, then run through a series of alcohols, preferably four, 50, 75, 85 and absolute (100), and finally xylol, then mounted on a slide with balsam.
The necessary equipment for doing such work is a good dissecting binocular—which leaves the hands free for dissecting—a pair of fine needles, with the tips curved, and a pair of fine forceps.

To the writer's knowledge, no work on the male genitalia of Haliplidae has been published in the United States; all works heretofore published treated of European species worked out by European. The most valuable papers are Frank Balfour Browne's "The British species of Haliplus, Ann. & Mag. N. Hist. Series," 8, Vol.XV. p. 97-124; and Dr. Sharp and F. Muir on "The comparative anatomy of the male genital tube in Coleoptera", Trans. Ent. Soc. of London, 1912, Part III.

The drawings presented here were made with a projection microscope (and all drawn to the same scale). This paper is only on the Haliplidae and Gyrinidae of Kansas, therefore there still remains the task, for someone, of working up the genitalia outside of Kansas.
Summary

A. Gyriinidae

The Gyriinidae of Kansas number eight species which are included in three genera. The following table gives the distribution of the species among the genera.

<table>
<thead>
<tr>
<th>Genus</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gyrima</td>
<td>4</td>
</tr>
<tr>
<td>2. Dinutes</td>
<td>3</td>
</tr>
<tr>
<td>3. Gyretes</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

1. Adults

The common species of Gyrima and Dinutes are widely distributed locally. They feed upon small flies, beetles and other insects that fall into the water. They do not swim as is commonly thought, but glide or skate over the surface film of the water, in much the same manner as do water striders, the hind legs being the chief organs of locomotion. The hind legs are fringed with long stiff hairs. When descending under the water they carry with them a bubble of air at the end of the abdomen. Mating begins in the early spring. The eggs are laid in parallel rows end to end upon the under side of aquatic plants.
2. Larvae

The larval mouth parts are adapted for feeding on small organisms. The larvae are carnivorous and cannibalistic as well, feeding on almost anything they can overcome. Their air supply is obtained by means of a pair of lateral tracheal gills on each abdominal segment, and an additional pair, at the caudal end of the body. The larvae leaves the water and either spins a gray paper-like cocoon, attaching it to some object near the water, or it may pupate in the soil in a small earthen cell. The pupal stage lasts about a month. The number of generations a year is not known, although it is thought that there is probably more than one brood a year.

B. Halipliidae

The Halipliidae of Kansas number eleven species which are included in two genera. The following table gives the distribution of the species among the genera.

<table>
<thead>
<tr>
<th>Genus</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Haliplus</td>
<td>6</td>
</tr>
<tr>
<td>2. Peltodytes</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
</tr>
</tbody>
</table>

1. Adults

The commoner species of Haliplus and Peltodytes are widely distributed locally. They feed almost exclusively on filamentous algae. They are poor
swimmers, the hind legs being the chief organs of locomotion. The hind legs are fringed with long stiff hairs. These beetles secure their air supply by way of the posterior anal plates and lateral grooves leading under the elytra. The metathoracic and first abdominal spiracles are very large. Mating begins in the early spring and the principal egg-laying months are April, May and June. The species of Peltodytes attach their eggs to the strands of filamentous algae, while those of Haliplus place their eggs within the dead stems of algae.

2. Larva-

The larva have three instars—two molts. They feed eagerly on filamentous algae. The larval mouth-parts are especially adapted for feeding on algae, the first pair of legs being modified into grasping organs. In Peltodytes the air supply is obtained by numerous, long, jointed, tracheal spines. In Haliplus, however, the air supply is thought to be obtained through two thoracic and seven abdominal spiracles. The larval life lasts about four weeks. The larva when full grown begin entering the damp soil and mold a cell slightly larger than the pupa to be formed. The pupal stage lasts about three or four weeks. There are probably two generations a year.
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PLATE I.

Fig. 1. Cattail pool.

Fig. 2. Rock pool.
PLATE II.

Fig. 1. Stubbs pond.

Fig. 2. Dightman's crossing.
PLATE III.

Fig. 1. U.P. pond west side of bridge.

Fig. 2. U.P. pond east side of the bridge.
PLATE IV

Fig. 1. Lake View looking west.

Fig. 2. Lake View looking east.
PLATE V.

Fig. 1. Male genitalia of G. parous Say.
Fig. 2. " " " G. minutus Fabricius.
Fig. 3. " " " G. maculiventris LeConte.
Fig. 4. " " " G. analis Say.
Fig. 5. " " " D. vittatus Aube.
Fig. 6. " " " D. emarginatus Say.
Fig. 7. " " " D. assimilis Aube.
Fig. 8. " " " Gyretes simnatus LeConte.
PLATE VI.

Fig. 1. Portion of a lateral spine of larva of P. edentulus LeConte, showing the trachea.

Fig. 2. First instar, larva of P.12 punctata Say.

Fig. 3. First instar, larva of D. assimilis Aube.

Fig. 4. Eggs of P. litoralis Matheson, attached to horn wort.

Fig. 5. Egg of D. assimilis Aube, showing markings.

Fig. 6. Eggs of D. assimilis on the under side of leaf, showing various stages in development, first, those before development has started, second, those with eye spots showing through, and lastly those showing the longitudinal split after the eggs have hatched.
PLATE VII.

Fig. 1. Middle leg of D. assimilis Aube.
Fig. 2. Hind leg of D. assimilis Aube.
Fig. 3. Anterior leg of D. assimilis Aube.
Fig. 4. Labium of D. vittatus Aube.

lp. labial palpi.

m. mentum.

sm. submentum.

Fig. 5. Mandible of D. vittatus Aube.

Fig. 6. Dorsal view of maxilla of D. vittatus Aube.

lc. lacinia.

mp. maxillary palpi.

pl. palpifer.

st. stipes.

c. cardio.
PLATE VIII.

Ventral view of D. assimilis Aube.

sm. submentum.
gu. gula.
ge. gena.
e. eye.
pr. prosternum.
c. coxa.
ep. episternum.
em. epimeron.
inf. inflexed pronotum.
ms. mesosternum.
mt. metasternum
ap. antecoxal piece.
tr. trochanter.
wf. wing fastening device.
inf.c. inflexed side of elytra.
Fig. 1. Antennae of G. analis Say.
Fig. 2. Antennae of D. minutus Fabricius.
Fig. 3. Antennae of G. maculiventris LeConte.
Fig. 4. Antennae of G. parous Say.
Fig. 5. Antennae of Gyrates simuatus LeConte.
Fig. 6. Antennae of D. emarginatus Say.
Fig. 7. Antennae of D. assimilis Aube.
Fig. 8. Antennae of D. vittatus Aube.
PLATE X.

Dorsal view of Malipplus triopsis Say.
PLATE XI.

Dorsal view of Peltodytes 12 punctata Say.
PLATE XII.

Fig. 1. Male genitalia of H. borealis LeConte.

Fig. 2. " " " H. triopsis Say.

Fig. 3. " " " H. connexus Matheson.
PLATE XIII.

Fig. 1. Male genitalia of P. edentulus LeConte.

Fig. 2. " " " P. litoralis Matheson.

Fig. 3. " " " P. 13punctata Say.

Fig. 4. " " " P. pedunculatus Blatchley.
PLATE XIV.
Ventral view of Haliplus spp.
m. mentum.
em. submentum.
gu. gula.
c. eye.
inf. inflexed pronotum.
pr. prosternum.
c. coxa.
mt. metasternum.
ap. antecoxal piece.
pc. posterior coxa.
ms. mesosternum.
ep. episternum.
em. epimeron.
PLATE XV.

Fig. 1. Antennae of P. litoralis Matheson.
Fig. 2. Antennae of P. 12punctata Say.
Fig. 3. Antennae of P. edentulus LeConte.
Fig. 4. Antennae of P. pedunculatus Blatchley.
Fig. 5. Antennae of H. triopsis Say.
Fig. 6. Antennae of H. borealis LeConte.
Fig. 7. Antennae of H. fasciatus Aube.
Fig. 8. Antennae of H. comexus Matheson.
PLATE XVI.

Fig. 1. Anterior leg of P. pedunculatus Blatchley.
Fig. 2. Middle leg of P. pedunculatus Blatchley.
Fig. 3. Hind leg of P. pedunculatus Blatchley.
Fig. 4. Labium of P. pedunculatus Blatchley.
  lp. labial palpi.
  m. mentum.
  sm. submentum.

Fig. 5. Mandible of P. pedunculatus Blatchley.

Fig. 6. Dorsal view of maxilla of P. pedunculatus Blatchley.
  mp. maxillary palpi.
  lc. lacinia.
  sg. subgalea.
  mu. muscle of maxilla.
  ca. cardo.
  pl. palpifer.
  st. stipes.