

Studies on a Family of Beetles.
The Carabidae.

Geo. C. Wheeler.

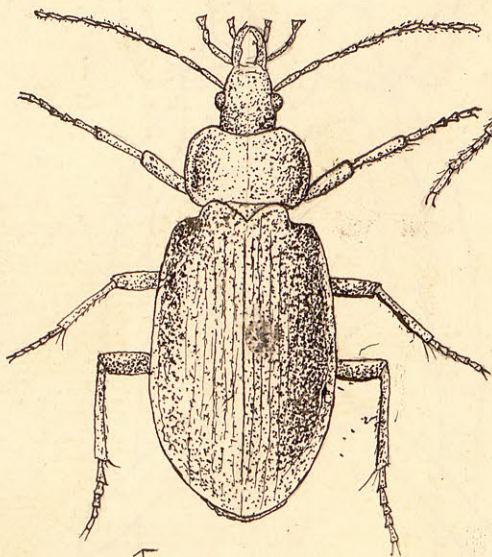


Fig. 1

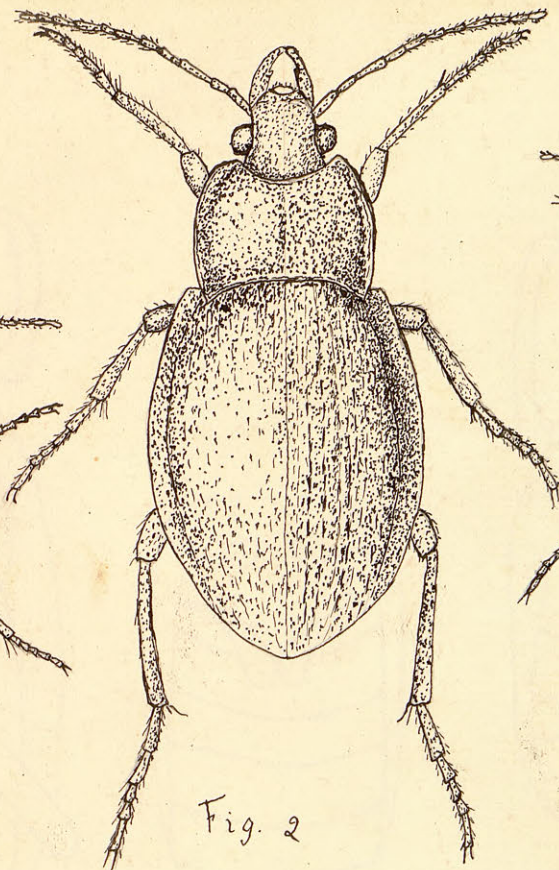


Fig. 2

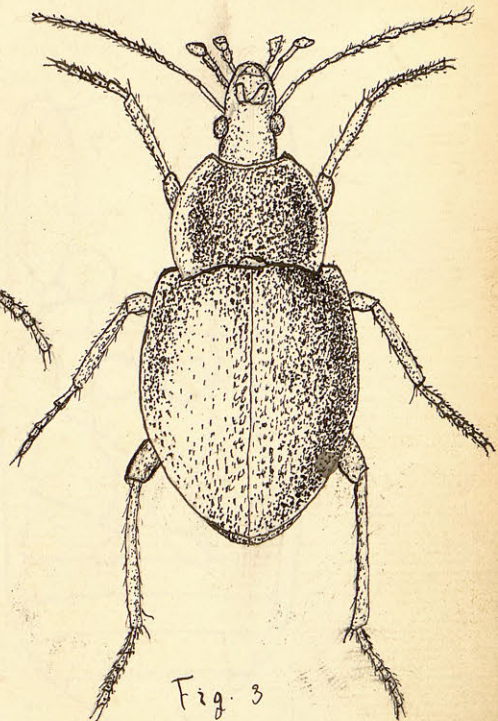


Fig. 3

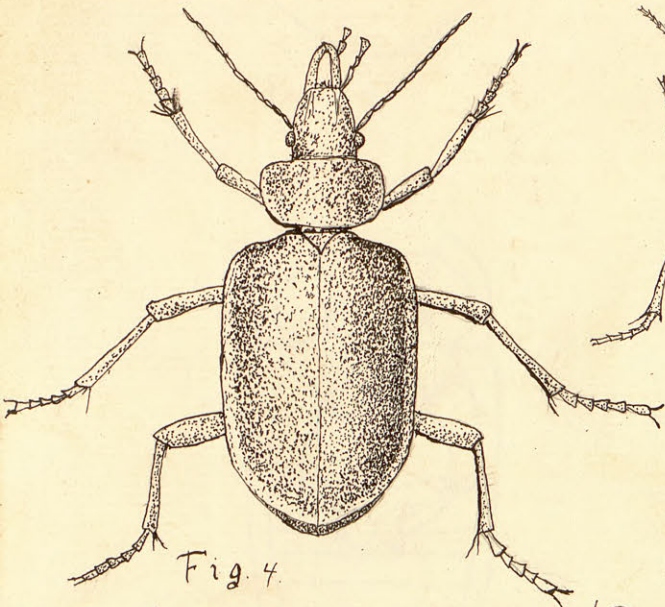


Fig. 4

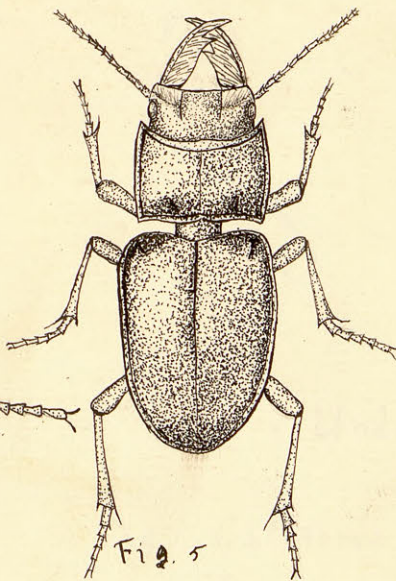


Fig. 5

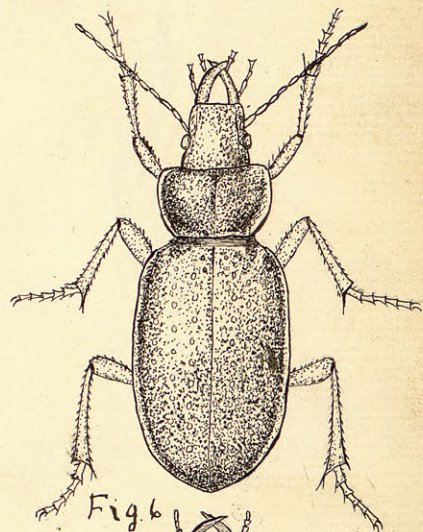


Fig. 6

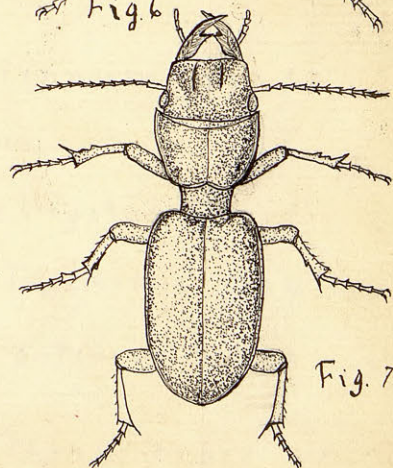


Fig. 7

- Fig. 1 *Calosoma externum*. (Say)
 " 2 *Carabus serratus*. (After B.S. Kimball.)
 " 3 *Cychrus elevatus*. (Fab.)
 " 4 *Calosoma scrutator*. (Fab.)
 " 5 *Pasimachus elongatus*. (Lec.)
 " 6 *Calosoma calidum*. (Fab.)
 " 7 *Scarites subterraneus*. (Fab.)

Plate II

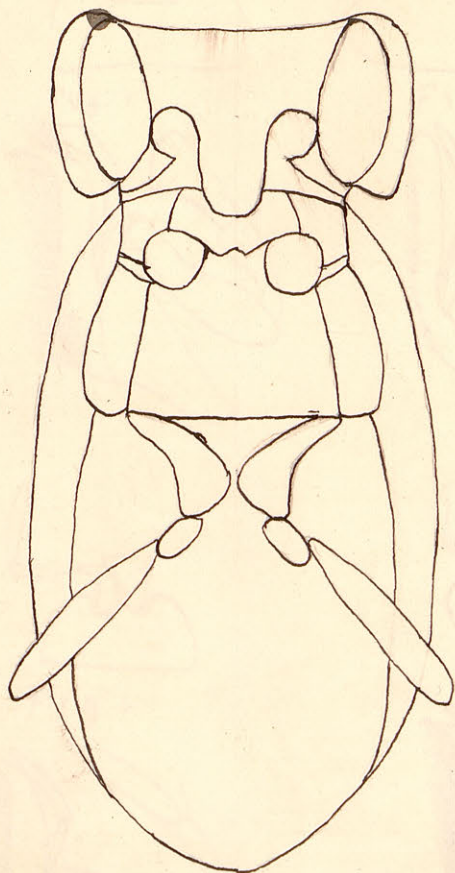


Fig. 1

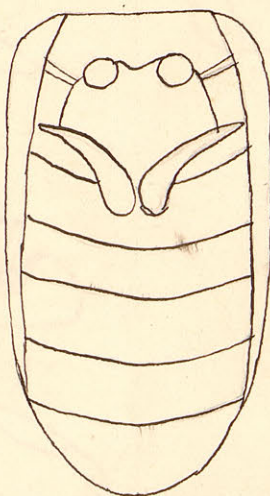


Fig. 2

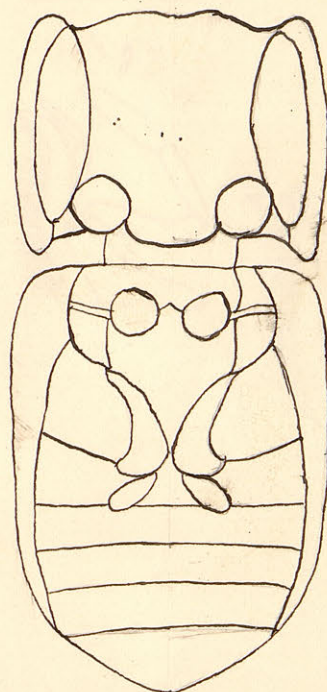


Fig. 3



Fig. 5



Fig. 6

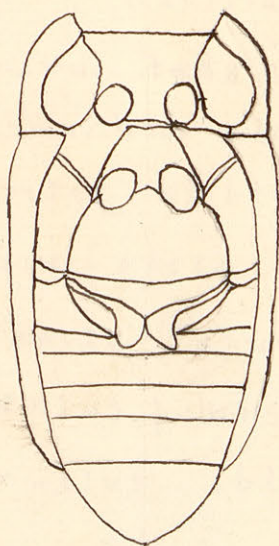
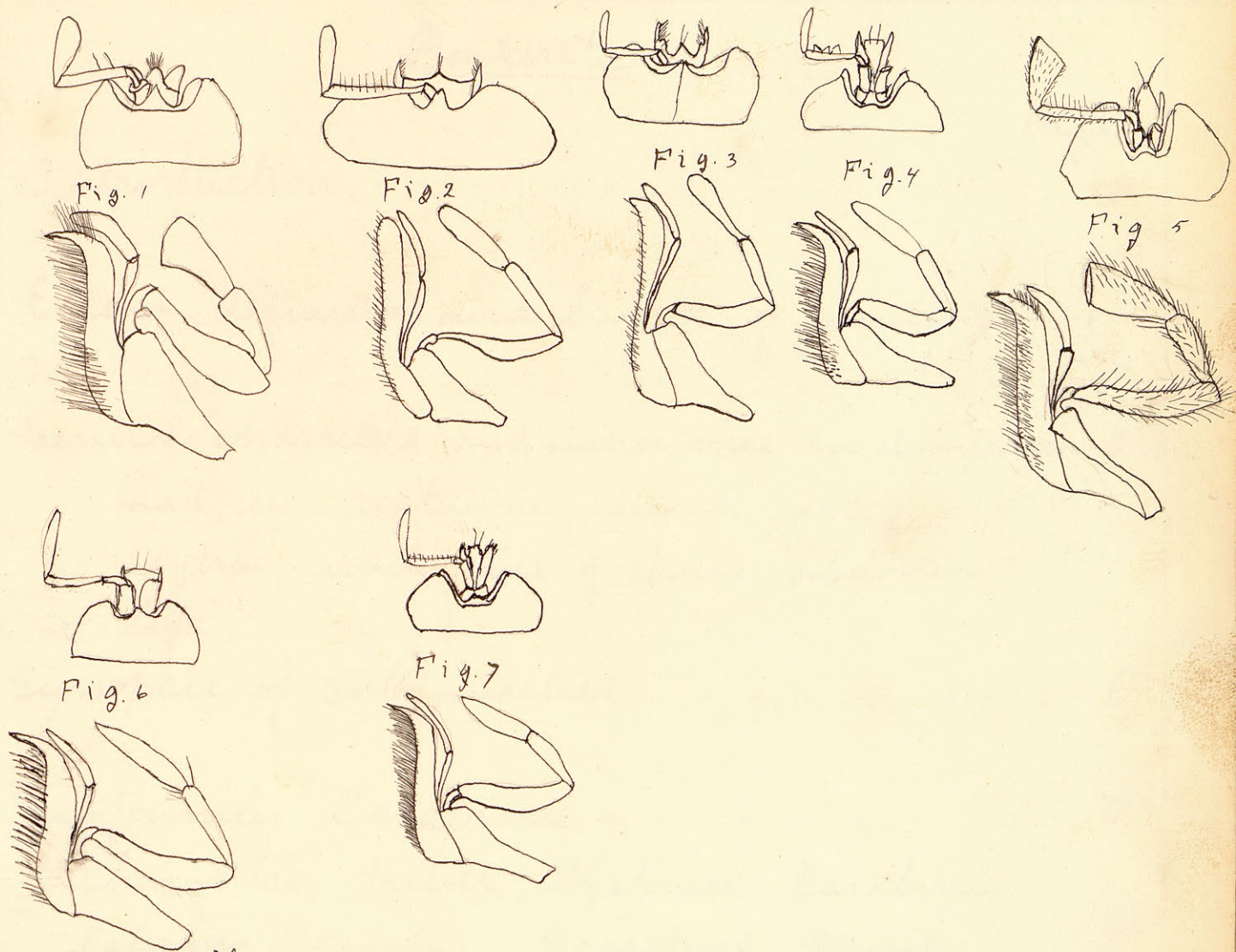


Fig. 4

Under Sides

- Fig. 1 *Calosoma externum* (Say)
 " 2 *Pterostichus*.
 " 3 *Pasimachus elongatus* (Lec)
 " 4 *Harpalus caliginosus* (Say)
 " 5 Extremity of anterior tibia of *Calosoma*
 " 6 Extremity of anterior tibia of *Pasimachus*.



Maxilla, mentum and its appendages.

- 1 *Canabus taedatus* (Fab.)
- 2 *Psimachus elongatus* (Lec.)
- 3 *Scarites subterraneus* (Fab.)
- 4 *Amara obesa* (Say)
- 5 *Galenita janus* (Fab.)
- 6 *Chlaenius pennsylvanicus* (Say)
- 7 *Harpalus oblitus* (Lec.)

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General predaceous character, larvae

Rummaging ground beetle, *Calosoma* species,

Paeimachus, *cutivorus* lion, *Sebia*,

Harpalus, *Helminthomorpha*, *Galerita*,

Brachynus, *Callida*, *Pterostichus*,

asphidoglossa, *subangulata*.

Conclusion 22

The following paper is the result of my studies upon the family of beetles commonly known as the ground beetles, or the Carabidae of scientific entomologists.

My study has been comparatively very limited and no attempt has been made to make an exhaustive treatise of the subject. It would require much longer time and more space than the paper will cover. In treating the subject those characters have been emphasized which seem of most primary importance, and the genera and species studied specially and to which the most time has been given are those which in my mind are the best types of the family and its subdivisions, a part of the drawings presented are taken from the result of studies of my own specimens and such as are not are taken from the plates which Mr. Geo. H. Horn prepared as the results of his dissections in the study of this family. Some have also been taken from the dissections of C. V. Riley and others.

The family Carabidae is a

very extensive one and the limits are not easy to define. It is one of the adepnagous series of coleoptera of which six families are represented in our fauna. The series may be easily recognized by the predaceous mouth parts, slender antennae, five jointed tarsi, and the structure of the first abdominal segment, which is only visible at the sides being divided by the posterior coxa.

The last character is an important one and runs through the whole series. The Cicindelidae immediately precedes the Carabidae and differ in the position of the antennae, they being inserted on the front above the base of the mandibles in the Cicindelidae and between the base of the mandible and the eye in the Carabidae. The Staphylinidae is a very nearly related family on the other side but are aquatic in their habits and have the posterior coxa fixed and almost the whole abdomen covered by large plates.

The Carabidae family as already stated is a very large one,

our fauna having seventy one genera represented according to Seoute and Horn in their classification of North American coleoptera. The species also are very numerous some 1100 North American species being described.

They are essentially a predaceous family throughout with a very few exceptions. Some species of *Amara*, *Gabrus*, and *Harpalus* have been observed to use vegetable food also.

The head is usually oval sometimes very broad as in the *Pasimachus*, or elongate as in the *Cychrus*. The head has setae which from their constancy in position are important characters from a systematic point of view. They seem to be special organs of touch. The supra-orbital setae may be one or two in number, being entirely absent in the subfamily *Pseudomorphinae*.

When only one is present it is never front of the middle of the eye.

The eyes are oval in shape and in some rare cases are entirely absent;

the antennae are eleven jointed, filiform, setaceous, or moniliform, and are inserted under a frontal ridge. The form is of little use in classification, the extent and kind of pubescence being of the most value. It is only used in separating tribes however as there are so many exceptions among genera and species. The maxilla has the outer lobe palpi-form, and usually biarticulate; the inner lobe is curved, acute and usually ciliate or with spines. [See Plates for different forms] It is of some importance in generic classification and the palpi are used in tribal separation. The mentum is emarginate and often has a tooth at the bottom of the emargination. The labial palpi resemble the maxillary in the terminal joint and its variation is of considerable importance in classification of genera: the last joint may be shorter, equal to or longer than the penultimate; the scutellum is small and triangular

in shape, and may be entirely wanting as in *Amophron*. The form of the elytra, whether truncate, sinuate, and whether the base is margined or not is quite a valuable character especially in *Staphylinidae*; the sculpture varies from nine striae in the normal to less or many more as in the *Lycinus* which has from twelve to fifteen.

The anterior coxal cavities are always closed with the exception of a few of the *Carabinae*; the side pieces of the mesosternum, the episterna and epimera, serve to divide the family. In the *Carabinae* the epimera is large and reaches the coxal cavity and in the other two subfamilies it is usually very narrow and does not reach the cavity.

There are always six abdominal segments, the first visible only at the sides. The legs are adapted to running, and vary in the anterior tibia with regard to its emargination and the position of the tibial spurs. The tarsi are five jointed and vary

sexually giving an important character in the classification of genera. The claws may be dentate, serrate or pectinate and are used to some extent in separating genera; they are simple in most cases however.

Dr. G. H. Sauer gives the following divisions of the family.

- 1 Middle coxal cavities not entirely closed by the sterna, the epimeron of the mesosternum attaining the coxa.
 Carabinae
- 2 Middle coxal cavities entirely enclosed, the epimeron not attaining the coxa.
 - a. Head without antennal grooves and with distinct supra-orbital setae; ambulatorial setae of abdomen usually well developed.
 Harpalinae
 - b. Head with distinct antennal grooves beneath and without distinct supra-orbital setae; ambulatorial setae of abdomen fumble or wanting Pseudomorphinae

Subfamily Carabinae.

In this subfamily the spinuron of the mesosternum reaches the coxal cavities so that the sterna does not completely enclose them. The head has either one or two supra-orbital setae. In most cases the prothorax has two punctures on the sides. The tibial spurs may be both apical or one may be back from the end of the tibia. The form of the anterior tibia varies from entire to emarginate or obliquely grooved. Few general characters apply to the whole subfamily. It is subdivided into tribes of which ten are represented in our fauna. The genera are so specialized that it is necessary to make a large number of tribes, many having only one genus. I shall speak of but three tribes, those which I have specially studied and which are representative tribes of the subfamily, viz. the Cychnini, the Carabini and the Psephenini.

The tribe Cychnini contains

two genera, the *Lychrus* and the *Nomarectus*. [*Lychrus elevatus*, plate I] The antennae are slender, first four joints glabrous in the *Lychrus* and the first two in the *Nomarectus*. The labrum is deeply bifurcate and the mandibles are long and slender, and acute at the tip. The home of the *Lychrus* is in moist woods under stones and rubbish and snails form their principal food. The *Nomarectus* are quite rare, and the species are not so numerous. They are found in woods on the Atlantic slope.

The tribe *Carabini* contains two genera, the *Carabus* and the *Calosoma* [See plate I] where many of our common ground beetles belong. In our fauna the *Calosoma* species are more numerous but in Europe the *Carabus* is represented by more species.

The antennae of this tribe is slender, with four basal joints glabrous. In the *Calosoma* the third joint is compressed which is the distinguishing feature between the them and the *Carabus*. They have a setigerous puncture

on the side of the prothorax and one near the anterior angle; the mandibles are stout, curved, acute at the tip, and without a setigerous puncture in the scrobe; the anterior tibia broaden toward the tip and have a slight groove within. In the males the anterior tarsi are dilated and pubescent. Twenty six species of *Calosoma* are described by Seoute. He divides them into three general divisions on the basis of the number of tarsi dilated in the male.

First, — joints 1-4 hairy beneath, Second — joints 1-2 hairy beneath, third — joints 1-3 hairy beneath. The first division contains our common black species, *Calosoma externum* (Say.) and the *Calosoma scrutator* (Fabr.) a beautiful gold green species. The third division contains by far the greater number of species some of which are black, some bronzed, and some but slightly bronzed with rows of coppery dots on the elytra. The fiery hunter, *Calosoma calidum* (Fabr.) belongs to this division. [See plate I]

The tribe Scarabini comes last in

the classification of of the subfamily Carabinae. The antennae are inserted under a frontal plate and have a variable number of glabrous joints. The eyes are small and near the mouth in the Clivinae; the head varies in form and has one supra-orbital setae in the Scarites and two in the Clivinae; the mentum is deeply emarginate and toothed; the thorax varies in form but seldom has hind angles prominent and in the Scarites has one puncture in the hinder angle and in the Clivinae has two on the sides. The legs are stout and fossorial in character; the anterior femora are very stout. The tribe is subdivided into two groups by Horn as follows.—

- 1 Basal joint of antennae long, mentum broad concealing at the sides the base of the maxillae; head with one supra-orbital setigerous puncture; thorax with one puncture at hind angle.
..... Scarites.

- 2 Basal joint of antennae not elongated; base of maxillae not covered by the mentum; head with two supra-orbital setigerous punctures, sides of thorax with two.

Clivinae

Of the group Scarites there are two genera represented, the Pasimachus and the Scarites, [Supl. I] separated as follows by Horn.

- 1 Hind angles of thorax distinct. Elytra with humeral carina of a variable length. Maxillae very obtuse at tip

Pasimachus

2 Hind angles of thorax wanting; Elytra without humeral carina. Maxillae slightly hooked at tip.

Scarites.

The *Pasimachus elongatus* (Sec.) [Supl. I+II] is a large black shiny beetle about an inch long with a blue band running around the elytra, and having a very broad head and strong curved mandibles. There are eleven species described by Secante of which two have the elytra obtusely rounded

behind, the *P. strenuus* (See) and *P. sublaevis*, (Beauv.) and the remaining have the elytra subacute behind. The *P. californicus* (Chd) is a large species and differs from the *P. elongatus* in being larger and broader and having a very short humeral carina.

The genus *Scarites* are similar in form to the *Pasimachus* but are somewhat narrower and the hinder angles of the prothorax are rounded instead of acute [See plate I]

But two species are described, *Scarites subterraneus* and *S. substriatus* ()

The group *Elivinae* contains many small species and are difficult of dissection. The genus *ardistomus* have no internal plica in the elytra, thus showing an affinity with the *Harpalinae*

Subfamily Harpalinae.

This subfamily have the coxal cavities of the meso-sternum entirely closed by the sterna, the epimera not extending to the coxae. [See plate II] The head has setigerous

over the eyes and the thorax has setae at the sides or posterior angles or both places. The anterior tibia are always emarginate or sinuate obliquely within and the inner spur is remote from the apex.

The family is divided into two sections by Dr. Horn as follows

1 Head with two supra-orbital punctures.

- - - - - Harpalinae Bisetosae.

2 Head with one supra-orbital puncture.

- - - - - Harpalinae Unisetosae.

This is a small character but is invariable and Horn says he has never observed a single exception.

If two setae are present, the anterior is to the front of the eye and close to the margin and the posterior is opposite the posterior margin of the eye and somewhat more remote. When only one is present it is a little to the front or opposite to the middle line of the eye.

The subfamily has three well marked types, the *Opterostichus*, *Lebia*, and the *Harpalus*, around and between which

the other tribes and genera are grouped.
[See plates]

Only a few of the typical genera will be considered. The *Bisetosae* contain the larger number of genera, seventeen tribes are represented in our fauna. The presence or absence of an internal elytral plica is used as a character to separate some of the tribes. Those having the plica are generally terrestrial in their habits while the greater part without the plica are strong flyers. The tribe *Pterostichini* is a representative tribe having the plica. It contains the genera *Myas*, *Pterostichus*, *Evarthus*, *Amara*, and *Loxandrus* according to Horn in his treatise on the genera of the *Carabidae* in Vol. IX - Transactions of the American Entomological Society. The tribe has been much worked on by entomologists and has been greatly confused. The following are some of the characters as given by Horn.

They have a distinct frontal ridge under which the antennae arise; antennae have three

basal joints glabrous. Head constricted behind the eyes except in *amara*. Maxillae ciliate or spinulose within, with hook at tip, palpi variable in structure. Elytra narrowly inflexed and interrupted by an internal plica. Prosternum not prolonged at tip. Mesosternum oblique or vertical in front, separating coxa rather widely, the spinera narrow and often wider internally than externally. Metasternum has spinera always distinct and posterior coxae contiguous. Middle and posterior tibia deeply emarginate, the inner spur situated at the summit of the emargination. The anterior tarsi of the male have three joints rather broadly dilated and squamulose beneath [but plates for characters of some tribes and genera]

The tribe *Platyrini* contains the very common and well known genus *Platyrus*. Seoute describes 82 North American species of *Platyrus*. The tribe *Lebini* contains the genus *Lebia*, one of the types of the *Harpalinae* subfamily. It is a large tribe and Horn after long study states

that he is unable to divide it satisfactorily. Below are some of principle characters of the tribe from his description.

Antennae slender, arising under a slight frontal ridge, three joints usually glabrous although sometimes two or four. Eyes rather round or oval, moderately prominent and narrowly separated from the mouth beneath. Maxillae slender hooked at tip ciliate or spinulose within, outer lobe biarticulate, palpi variable from slender to securiform. Thorax variable in form, sides distinctly margined and with a setae at the sides and at the basal angle. Elytra truncate at tip in a variable manner, the margin acute, entire and narrowly inflexed without internal plica, the base margined. Posterior coxae contiguous. Legs usually slender and not very long, tibia slender, the terminal spurs moderate or short, rarely long, simple, rarely finely serrulate along their margin.

Twenty one genera are known to our fauna.

The section *Arctosae* is much

smaller than the Biserotae, having only about a third as many tribes and the genera even less numerous in proportion. The presence of only one supra-orbital setae characterizes the section and there is also a tendency to lose the setae at the hind angle of the thorax. Some of the tribes have the elytral plica present as in the preceding section and in about the same proportion. There are six tribes represented in our fauna. The tribe

Brachynini contains the genus *Brachynus* in our fauna. The species have not been separated in a satisfactory manner. They are found in damp places under logs and stones and often in colonies. One species have the elytra blue and the legs, thorax and head yellow. They are commonly called Bombardier beetles from the fact that they eject a fluid from the anus as a means of defense.

The tribe Harpalinae has a large number of genera and is a difficult tribe to study. I shall not attempt to give a detailed scientific description. [See plates for characters]

They contain a large number of our dusky ground beetles of which the most common perhaps is the *Harpalus caliginosus* (Fabr) commonly known as the dusky ground beetle, a species about an inch long.

The tribe is divided into three series on the tarsal characters of the male, and one of these divisions is again divided giving four groups: the Eupleti, Glypti, Harpali, and the Anisodachyli. The Harpali is the largest group, having eight genera in our fauna. The *Harpalus* about which the other genera are grouped has the palpi normal, and the anterior and middle tarsi of the male dilated and biserially squamulose beneath and fourth joint emarginate or sub-bilobed. The tarsi are slender in the female. The first joint of the posterior tarsi is never longer than the next two together. The elytra are marked with one dorsal puncture or more. [See plates]

The subfamily Pseudomorphinae have the middle coxal cavities enclosed by the central pieces of the meso and meta sternum. The head has no supra-

-orbital setae and has grooves beneath of variable extent for the antennae. The legs are short, contractile, tarsi slender and rigid. They are a very abnormal form of the Carabidae. Only four North American species are described and specimens are so rare that Dr. Horn was unable to get native species for dissection and so used an Australian species.

As stated in the beginning of this paper the Carabidae are a predaceous family with but few exceptions and are most voracious feeders especially the larval forms. They get their name ground beetles from their being so common on the ground under stones rubbish etc. They are easily recognized as a rule by their black color and the rapidity with which they move. They are some green, blue and brown species and some spotted, all are nocturnal in their habits and are thus safer from birds. With the coming of night they sally forth and begin their search for food among insect life of other kinds.

The larvae are usually found in the same places as the beetles but are more shy and seldom seen. They are long bodied and have sharp mandibles and the caudal extremity is usually provided with two bristlelike appendages. Like the beetle they are predaceous and devour a large number of the egg and larval form of noxious insects. The family is undoubtedly of great service in keeping down injurious insects.

The Rummaging ground beetle (*Calosoma scrutator* [Fabr]) is especially fond of caterpillars and has been known to climb trees in search of them and has been observed to feed greedily on the forest tent caterpillar. It has also been observed to feed upon the Rocky mountain locust, (*Calopterus spretus*). Where the young had collected. The *Calosoma externum* (Say), *C. Wilcoxii* (Luc) *Harpalus caliginosus* (Fabr), *H. pennsylvanicus* (De Geer) *Elaphrus ruscarius* (Say) and *Pasimachus punctulatus* (Hald.) have also been observed to feed upon them in the same places. These same beetles with the addition of the *Calosoma*

calidum (Fabr.) and *annua angustata* (Say). Riley observed preying greedily upon the army worm, *Locusta undulata*. The larvae of the *Cabrona calidum* is called the cut-worm lion. It will seize a cutworm much larger than itself and hang to it until it is dead and then suck out the juices. The beetles also prey on the canker worm and the larvae of the Colorado potato beetle.

R.R. Mhler reports the black bellied *Scia*, (*Scia atriventris*) (Say.) which is only about half as large as the *Scia grandis* (Fentz) as preying on the larvae of the potato beetle. The *Scia grandis* according to M.T. Glover devours large numbers of the potato beetle and Riley observed this *Scia* to be very plentiful in the Missouri bottoms devouring both eggs and larvae of the potato beetle. The Kansas Bombardier beetle, (*Brachinus Kansanus* [See]) which very much resembles the *Scia grandis* has been observed to attack the potato beetle by Thos. Wells of Manhattan. Two *Harpalus* larvae have been observed to prey on the eggs of the Rocky mountain locust and it is probable that all carabidous larvae devour their eggs. The *Paeonachus elongatus* is

another enemy of the potatoe beetle.

The cotton worm of the south is preyed upon by the following carabids and perhaps more — *Hellomorphia laticornis* (Dej) *H. texana* (Lee) *Galerita atripes* (Lee), *Brachinus* species, *Callida decora* (Fab) *Loxandrus lucens* (Chd) *Pterostichus sayi* (Bulle) *Selenophorus lucens* (Lee.) The subangular ground beetle, *Aspidoglossa subangulata* (Chd.) has been observed by Walsh preying on the plum curculio and the larval of another ground beetle, probably *Harpalus pennsylvanicus*, (Dej) has been observed devouring the curculio also.

These specific cases of the predaceous character of this family and of the the kind of insects preyed upon are only a few examples but will serve to establish their usefulness in destroying noxious insects. They are the friends of the agriculturist and fruit grower and pains should be taken to foster them as far as possible.