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THE CLASSIFICATION OF THE RHYNCHOPHOROUS COLEOPTERA.*

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At the meeting of the Academy held in Washington, Jan., 1867, I had the honor to offer some remarks† upon the systematic value of the great complex of Coleopterous insects known as Rhynchophora.

It was my intention, as then stated, to follow the memoir just mentioned with another, in which the classification of the Rhynchophora and separation into families should be discussed, in the hope of developing a more satisfactory system of arrangement than had been thus far obtained.

Circumstances have prevented me from following this particular line of investigation to a definite result, until within a short time, though it has frequently occupied my attention for brief intervals. The time, however, has not been altogether lost, for I found that, with each return to the investigation, I obtained an additional, though small insight into the constitution of this complex, which has been the subject of repeated efforts by the most laborious and successful students of entomology in Europe.

* Read before the National Academy of Sciences, Washington, April 21, 1874.

† Am. Jour. Science and Arts, xliv, July, 1867.

The bases of the classification of the Rhynchophora which have been proposed are briefly these:

I. Schonherr* treated the great mass of these insects (excluding only the Scolytidæ), as constituting a single family, divided as follows: —

A. Antennæ not geniculate; antennal grooves wanting; . ORTHOCERI.
Bruchides, Anthribides, Camarotides, Attelabides, Rhinomacerides, Ithycerides, Apionides, Rhamphides, Brenthides, Cylades, Ulocerides, Oxyrhynchides.

B. Antennæ geniculate; grooves almost always distinct; GONATOCERI.

a. Rostrum short, deformed, antennæ subterminal; *Brachyrhynchi.*

*Antennal grooves extending below the eyes; Brachycerides, Entimides, Pachyrhynchides, Brachyderides, Cleonides, Molytides, Byrsopides (the last with the rostrum received in aprosternal excavation).

** Antennal grooves directed towards the eye;
Phyllobiides, Cyclomides, Otiorhynchides.

b. Beak cylindrical, slender, antennæ inserted far behind the tip: Erirhinides, Cholides, Cryptorhynchides, Cionides, Rhynchophorides, Conoderides, Cossonides, Dryophthorides. *Mecorhynchi.*

In the gradual progress of the work this last legion, the Mecorhynchi, were divided into Synmerides, having the front coxæ contiguous, and Apostasimerides, having them distant.

The distinctions between the tribes above mentioned were founded mostly on insignificant and evanescent modifications in the form of the beak and antennæ; so that with the immense mass of genera and species described, it became quite impossible to determine either from the work itself.

II. Although the faults found with this artificial system were neither few nor vaguely expressed, yet it was not until the progress (1863) of his admirable work on the Genera of Coleoptera by my deceased friend Prof. Lacordaire required this immense labor to be done over again, that any attempt was made at a new arrangement; the system of Lacordaire was essentially this:

The series was divided into six families; Curculionidæ, Bruchidæ, Anthribidæ, Brenthidæ, Uloceridæ and Scolytidæ. Of these the Bruchidæ were recognized as having scarcely any relations

* Genera et Species Curculionidum, Paris, 1833-1844.

with the other families, and pertaining rather to the Chrysomelidæ, with which they have since been associated by most authors.

The Bruchidæ and Anthribidæ were characterized by having a distinct labrum; the Scolytidæ by the compressed and dentate tibiæ, while the Brenthidæ were separated rather by form than by any distinct structural character.

The Curculionidæ were then divided according to the size of the mentum, into

I. Mentum closing the buccal space, and concealing the maxillæ ADELOGNATHI.
Eyes rounded, prothoracic lobes indistinct, . . *Cyclophthalmes.*
Eyes large, depressed, transverse, narrowed below, prothoracic lobes well marked, ... *Oxyophthalmes.*
II. Mentum smaller, maxillæ visible . . . . . PHANEROGNATHI.
A. Front coxæ contiguous or nearly so, . . . *Synmerides.*
a. Pygidium covered by the elytra; claws not appendiculate.
Metasternum short; episterna narrow;
Gular peduncle wanting:
Gular peduncle distinct:
Metasternum long; episterna rather wide:
Antennæ geniculate:
Antennæ straight.
b. Pygidium exposed, *or* claws appendiculate:
Ventral segments not angulated at the sides:
" " angulated:
B. Front coxæ separated by the prosternum, which is frequently channelled for the reception of the beak, . *Apostasimerides.*
a. Oral organs normal. Club of antennæ annulated; 3d joint of tarsi bilobed.
Mesothoracic epimera not ascending:
" " ascending.
b. Oral organs abnormal; 1st joint of antennal club usually very large, corneous, 3d joint of tarsi rarely bilobed.
Pygidium exposed.
" covered by elytra.

Each of these divisions contains several tribes differentiated by characters of smaller importance, and not unfrequently indefinite.

III. The next attempt at a general classification was made by Mr. H. Jekel.* This excellent author recognized with great clearness, and defined with tolerable precision, the following eight

* Annales Ent. Soc. France, 1864, p. 537. Ins. Saundersiana, 155 sqq., 1860.

principal types among the Rhynchophora: Bruchides, Anthribides, Attelabides, Curculionides, Calandrides, Cossonides, Scolytides and Brenthides. The last cited memoir is occupied chiefly with a further development of the classification of the largest of these, the Curculionides proper, and in it he proceeds to separate as sub-families* Brachycerides, Byrsopides and Amycterides, epigeal forms in which the tarsi are not dilated, and not furnished with brush-like hairs beneath. Having thus isolated them the great mass remaining is divided into

Body dissimilar in form ♂, ♀, narrower in ♂	PLATYGNES.
Beak similar in both sexes	*Homorhines.*
Beak dissimilar	*Heterorhines.*
Body nearly or quite of the same form ♂ ♀ :	
Pygidium covered by the elytra, body pollinose or pubescent	ISOGYNES.
Pygidium exposed or covered; body squamose, etc.	METRIOGYNES.
Pygidium covered	*Cryptopyges.*
Pygidium exposed	*Gymnopyges.*

The principal types contained in each of these three grand divisions are then characterized in a very clear manner; but for a proper understanding of this system, a vast improvement on all that preceded, the reader must refer to the original memoir. In developing the arrangement of the tribes represented in our fauna, I shall be largely indebted to the views expressed in this most valuable memoir of Mr. Jekel.

There remain to be mentioned two faunal contributions to the history of this subject:

1. A series of remarks by Mr. Suffrian,† in which the German species of several genera, not before carefully studied, are more fully elucidated, and various criticisms upon Schönherr's system made.‡ The necessity of a more careful study of the tibiæ and tarsi, almost neglected by Schönherr is insisted on, and an arrangement of the German genera in groups upon these characters is given.

2. That most admirable work of Prof. C. G. Thomson,§ to

* Mr. Jekel gives to the anomalous groups this subordinate position, rather, as he says "pour ne pas heurter les idées généralement admises," than in accordance with his own views, which would lead him to regard them as I have done, as genuine families.

† Bermerkungen über einige deutsche Rüsselkäfer: Stettin, Ent. Zeitsch. i–ix.

‡ See specially *op. cit.*, 1847, 157.

§ Skandinaviens Coleoptera, vii, Lund, 1865.

which no entomologist ever refers without finding original material by which he can profit; a remarkable instance of the good results to be obtained by a careful and intelligent study of a very limited fauna. The Rhynchophorous series is divided as follows:

Segments of the abdomen immovable, 2d and 3d nearly equal
ISOTOMA.
Bruchidæ, Anthribidæ (including Urodon), Rhinomaceridæ, Attelabidæ.
Abdomen with the 1st and 2d segments connate, the remaining three movable, the 2d usually much longer than the 3d . ANISOTOMA.
Apionidæ, Curculionidæ, Cossonidæ (including Calandra), Tomicidæ.

From a survey of the different schemes of arrangement which have been thus briefly reviewed, it is evident that while the principal types of the Rhynchophorous series, and the main divisions of the great family Curculionidæ have been clearly perceived, the attempts to define these important forms have failed in a greater or less degree, on account of the want of proper subordination in the characters made use of: all of them natural, all of them important, though in a less degree than supposed by the expounder of each particular system.

To supplement the memoirs above referred to, there came in more recent times the beginning of a systematic study of our species of Curculionidæ by Dr. George H. Horn, a careful and conscientious study of the Calandridæ and Cossonidæ and of some Mecorhynch genera of the United States.* In the introductory remarks he observes:—

"One character is mentioned in the following pages that appears to have escaped notice. In most if not all of the genera of *Mecorhynques*, the males have eight and the females seven dorsal abdominal segments. The *Calandrides* and *Cossonides* appear not to possess this character, as also all the *Brachyrhynques* which I have had time to examine."

The value of this original observation of Dr. Horn is very great, but the limitation which he has placed upon it, though correct as regards the Calandride and Cossonide types, is erroneous as regards the Brachyrhyncs, which have the abdominal sexual characters precisely as in the genera in which he first observed them. So too have the Brenthidæ, and all the anomalous sub-families of Curculi-

*Contributions to a Knowledge of the Curculionidæ of the United States. Proc. Am. Philosophical Soc. 1873, 407.

onidæ in the Jekelian system. It appears therefore that this peculiarity of structure is of much more importance than was supposed by Dr. Horn, and that it must in reality be the defining character for the division of the Rhynchophora into primary series, of more than family value. I therefore prepared a series of dissections of each of the well recognized Rhynchophorous types within my reach, and have come to the conclusion that they may be arranged in three sets, each of which has a corresponding value to the individual series of normal Coleoptera (*e.g.* Adephaga, Clavicornia, Lamellicornia, etc.); and upon subordinate characters (some of which have been already employed in the classifications above mentioned, though in an empirical manner) into families as follows.

Series 1. HAPLOGASTRA.

Abdomen alike in both sexes; dorsal segments 7, coriaceous, with the exception of the 7th which forms the pygidium, and which is small and corneous; ventral segments not prolonged upwards into a sharp edge; elytra without lateral fold on the inner surface, epipleuræ usually distinct, antennæ straight, 11-jointed. Ungues usually bifid or toothed, rarely (Rhinomacer) simple; Front coxæ conical, prominent, prosternum very short in front of the coxæ. The beak varies in length and thickness, but not according to sex, so far as I know: the front coxæ are contiguous, except in one genus of Rhynchitidæ (Pterocolus); the ventral sutures of the abdomen are straight. The mandibles and tibiæ vary in form, and furnish convenient characters for division into families:—

A. Ventral segments nearly equal in length; epipleural indistinct; tibial spurs small; claws simple (always ?). Mandibles simple, flat; labrum distinct . . . . . Rhinomaceridæ.

B. Ventral segments diminishing in length; epipleuræ distinct; labrum wanting; claws bifid, or appendiculate

Mandibles flat, toothed on each side; tibial spurs small Rhynchitidæ.

Mandibles stout, pincer shaped, tibial spurs large Attelabidæ.

The affinities of this series are in an ascending direction with the rostrated Heteromera (Oedemeridæ and Pythidæ); this is indicated by the softer tissues in Rhinomaceridæ, and certain Rhynchitidæ, and also by the presence of a labrum in the former. In a descending direction the Attelabidæ lead to the true Curculionidæ,

and the Rhynchitidæ to the Belidæ, the last family in the third series of Rhynchophora.

The habits of the species of this series are peculiar, and quite different from those of the next series, and indicate as is wisely observed by Lacordaire,* for the care of their progeny, an industry which appears here for the first time in the family. I cannot describe the results of this instinctive or intelligent industry better than by condensing the account of the author just cited, referable however to European species.

1. Rhinomaceridæ. The European species deposits the eggs in the male flowers of *Pinus maritimus*, the development of which is thus prevented. I may be allowed to observe that this synthetic genus, the nearest approach in the Rhynchophora to the lower Heteromera, and therefore the representative of old forms, clings to an old and synthetic type of vegetation.

2. Rhynchitidæ. Some of the species of Rhynchites roll leaves in the manner of the next family. Others deposit their eggs in young fruit, the kernel of which is eaten by the larva; others again place the eggs in the undeveloped buds of trees, which are thus destroyed.

3. Attelabidæ. In the spring the females roll up the leaves of trees, and deposit in each an egg. After emerging from the egg the young larvæ eat the inside layer of the case which covers them, which they probably leave at a later period, when their growth is complete, to perfect their metamorphosis under ground.

These three families are of small extent, and but little need be said regarding their classification.

RHINOMACERIDÆ.

This family is represented in our fauna by two species, one on each slope of the continent, and is easily recognized by the depressed, curved and acute mandibles, and distinct labrum. The pygidium is covered by the elytra, which are punctured without any appearance of striæ. On the inner face there is no trace of a lateral fold: the epipleuræ are indistinct.

ATTELABIDÆ.

Four species of Attelabus on the Atlantic slope are the only representatives thus far known in our fauna. The beak is stouter

*Gen. Col. vi, 543.

than in the preceding family, and the mandibles thicker and stronger. The epipleuræ are quite distinct, and there is no trace of a lateral fold on the inner face of the elytra. The pygidium is not covered by the elytra, and is impressed along its upper margin for the reception of the apical edge of the elytra.* The tibiæ are armed with large spurs.

RHYNCHITIDÆ.

The peculiar form of the mandibles requires the separation of these genera as a distinct family. The teeth on the inner side are well developed as usual, but in addition, the apex is prolonged outwards into an acute process, behind which is another large tooth.†

The front coxæ are usually contiguous, large and conical, in one genus (Pterocolus) widely separated. The pygidium is either exposed (Rhynchites, Pterocolus) or covered by the elytra (Eugnamptus, Auletes). The epipleuræ are narrow, but distinct, and on the inner face of the elytra remote from the margin may be seen a short straight fold, the homologue of the well defined fold which limits the lateral groove for the reception of the side margin of the ventral segments observed in all the following families.

SERIES II. ALLOGASTRA.

Abdomen dissimilar in the two sexes; dorsal segments 1–6 coriaceous or membranous, 7th large, corneous, undivided in ♀, divided into two in ♂; ventral segments prolonged upwards forming a sharp edge, fitting into a corresponding groove on the inner face of the elytra, which are without epipleuræ.

The beak and oral organs vary greatly in form, as do also the antennæ, the tarsi, the ungues, and the position of the coxæ; the 1st and 2d ventral segments are most frequently connate, and the 3d is always shorter than the 2d; the 5th is longer than the 4th.

The following families seem to be indicated by the material I have examined:—

A. Antennæ with a solid annulated club:
  a. Tarsi narrow:
    Gular margin very prominent; mentum retracted;

* Compare in this relation the curious notch in the front part of the pygidium of Anthribidæ, for the reception of the sutural angles of the elytra.

† This character was first observed by Thomson, who observes (Sk. Col. vii, 28) concerning his tribe Rhynchitina, "mandibulæ depressæ, extus excisæ, intus dentatæ."

Prosternum not excavated; . . . . . AMYCTERIDÆ.
Prosternum excavated: . . . . . BYRSOPIDÆ.
Gular margin not prominent, mentum large, concealing the mandibles, which are not scarred at tip BRACHYCERIDÆ.
b. Tarsi dilated, usually with a brush of hair beneath:
Mandibles with deciduous tip, leaving a scar OTIORHYNCHIDÆ.
Mandibles simple, usually pincer-shaped. . CURCULIONIDÆ.
B. Antennæ with 11 separate joints. . . . BRENTHIDÆ.

Concerning Amycteridæ and Brachyceridæ, but little need be said. They are very peculiar and easily recognized forms, not represented in our fauna.

The first is Australian; the antennæ are slender, and geniculated; the beak short and stout, deeply emarginate at tip, alike in both sexes; the buccal opening is very large, and the cavity is filled almost completely by the mandibles, which are convex, hairy on the greater part of the front surface, deflexed, deeply concave beneath; the gular margin is thickened and prominent, so that a deep cavity is seen between the gula and the mandibles, in which the mentum and oral organs are concealed from view; the eyes are small and nearly round in some, narrowed beneath in others. The front coxæ are contiguous, the prosternum very short; the elytra are connate and extend far over the flanks, so that the side pieces both of the meso- and metathorax are concealed. The dorsal segments of the abdomen are membranous, except the last which is very large, corneous, and convex, more so in ♂ than in ♀, in the former it is truncate behind, exposing a semicircular 8th segment, from under which protrudes (Psalidura) a very powerful and complex genital armature, consisting of a large pair of forceps, conical obtuse, punctured and hairy, under which and seen only from below is a pair of transverse, thin, polished, corneous plates, also meeting on the median line; between them and the forceps is a large deep cavity. The ventral segments are scarcely less singular; the 1st and 2d segments large, flat, connate, united by a sinuate suture; 3d and 4th very short, separated by deeply excavated straight sutures, 5th much larger, in ♂ very deeply and semicircularly excavated, almost to the base, with a tuft of stiff bristles each side at the front edge of the excavation; in the ♀ this segment is flat, and meets the last dorsal at tip in the usual manner; on the sides the lateral upward extension of the 5th ventral is very large, but the spiracle is visible; the extension of the 4th and 3d segments

are much smaller, and imbricated upon the 5th and 4th respectively; the side margin of the 1st and 2d is very narrow, and the side pieces of the metasternum are scarcely visible. The elytra are connate, with the lateral groove of the inner face narrow and sharply defined, becoming broader and indefinite at the posterior fourth; on the inner face are seen eight rows of punctures, corresponding to ridges of tubercles on the back. The tarsi are 4-jointed, narrow, or at least the 3d joint not wider than the others, deeply grooved beneath; the tibiæ are truncate, without spurs, the front pair a little incurved at tip in both sexes. Claws simple, not contiguous.

The genera of this family are stated by Mr. Jekel,* to differ by the form of the eyes, some being Cyclophthalmes, others Oxyophthalmes; also in the antennal grooves, some being Obliquiscrobes, others Lateriscrobes. The vestiture of the under surface of the tarsi varies in different genera; in Psalidura they are spongy sericeous beneath, in others ciliate or spinous.

In other genera, the sexual characters are less remarkable than in Psalidura, and will be found to consist chiefly in the division of the last dorsal segment into two, as in the other families of the series.

The Brachyceridæ are restricted to Africa and the neighboring parts of Europe and Asia. They are stout insects, with ventricose elytra, suddenly deflexed behind, and extending far upon the flanks, like the first tribes of Tenebrionidæ, which they also resemble in the large mentum, flat, filling the whole of the buccal cavity. The beak is short and stout, thicker at the extremity, alike in both sexes; the antennal grooves are wanting (Episus); or deep and directed downwards, almost confluent in the gular region (Brachycerus, Microcerus). The antennæ are short, straight or feebly geniculate, scape forming less than $\frac{1}{3}$ the length; joints of the funiculus 7, rather short, club solid, obconical, truncate or subacuminate at tip. Eyes rounded or transverse and acuminate at the lower end. Mandibles stout, short, more prominent in Brachycerus, where they have the lower margin more produced into a cutting edge: the front surface is rough and somewhat angular, but without any trace of the rounded scar seen in Otiorhynchidæ. The scutellum is scarcely visible; the elytra, as above mentioned, are ventricose, irregularly tuberculate or costate, very

* Ann. Ent. Soc. France, 1864, 544.

much extended on the flanks, so as to cover the side pieces of the meso- and metathorax; greatly deflexed behind. The lateral groove of the inner face is deep and narrow, becoming wider and obsolete behind. The dorsal segments are membranous, except the last, which is corneous, and divided in ♂ into two as in Curculionidæ. The ventral segments are separated by deep sutures, of which the 1st is sinuate; the 3d and 4th segments are shorter than the others: the lateral extension upwards is narrow; and but slightly wider behind. The front coxæ are contiguous, prominent and subconical, the tibiæ are not dilated, the spurs are small, fixed, projecting inwards, the tarsi 4-jointed, narrow, setose and feebly concave beneath (Brachycerus); pubescent, concave and emarginate beneath (Microcerus); claws large, simple, distant.

BYRSOPIDÆ.

The third of the anomalous families has a more general distribution, and is represented in our fauna by the genus Thecesternus, which forms a separate tribe, distinguished from the other tribes by the prosternal groove for the reception of the beak not extended as far as the front coxæ.

These insects are epigeal, rough and dull colored, with the elytra widely embracing the flanks, but not strongly deflexed behind, concealing the side pieces of the trunk. The beak is very short, not thickened at tip, nor emarginate at the middle; the antennal grooves descend perpendicularly and form a gular constriction: the antennæ are unusually short, imperfectly geniculate, the scape as long as the 1st and 2d joints of the funiculus; the club elongate oval, pointed, distinctly annulated. Eyes transverse, pointed beneath.* Mandibles stout, short, front surface curved and roughly punctured; mentum very small, not placed on a gular peduncle; maxillæ exposed. Prothorax widely lobed in front at the sides, so as to conceal the eyes, when the head is deflexed; deeply excavated beneath for the reception of the beak, cavity closed behind in Thecesternus by a triangular plate of the prosternum, but by the front coxæ in the other genera; coxæ small, globose, contiguous. Elytra connate, widely extended on the flanks, declivous behind, rough; lateral groove of inner face

*Jekel, l. c. 1864, 543, describes the group as being *Adelognathes cyclophthalmes*: Lacordaire (Gen. Col. vi, 293 sqq.) places them in Phanerognathes, and describes the eyes as acuminate below, in which he is correct.

narrow, and well defined; scutellum not visible; humeri in Thecesternus prolonged forwards, so as to extend along the sides of the prothorax. Dorsal segments membranous, last one large, corneous, divided into two in ♂: ventral segments unequal, 1st and 2d very large, more closely connected, suture arcuated: 3d and 4th short, sutures deep, 5th as long as the two preceding; lateral extension moderately wide, wider behind, pygidium articulating with both 4th and 5th ventrals. Legs slender, tibiæ truncate, spurs small, tarsi 4–jointed, narrow, setose beneath.

Several species of Thecesternus are found in the interior regions of the continent, from Illinois to Utah, under dried buffalo excrement, and similar objects.—*To be concluded.*

OBSERVATIONS ON DROSERA FILIFORMIS.

BY WM. M. CANBY.

Some observations on the power of the insect-trapping "thread leaved sundew" to bend its leaves partly or wholly about its prey, may serve to supplement the interesting notes of Mrs. Mary Treat recorded in the December number of the American Naturalist. They were made about the middle of last August during a day's botanical excursion in the vicinity of "Pleasant Mills," New Jersey, and were suggested by Mr. Darwin in the following memoranda:

(1.) "Put a small atom of crushed fly on a leaf of *Drosera filiformis* near the apex and observe whether the solid leaf itself, after twenty-four hours or so, curls over the fly."

(2.) "Rub roughly with the point of a fine needle half a dozen times a few glands, and observe whether they become inflected after a few minutes, or more probably after a few hours."

The place selected for the experiments was the edge of a cranberry meadow exposed during the whole day to the sun, and yet protected by higher ground and trees from the wind, which otherwise might have prevented successful results by blowing and entangling the leaves together. Hundreds of the plants were here growing, most of their leaves being fully extended, while others were yet unfolding from their circinate vernation. At 7