GEOTRUPES OF BOREAL AMERICA.

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My attention was directed to this well known genus by the elaborate monograph of H. Jekel, published a short time since in the Annals of the Entomological Society of France (Series IV, Vol. V, pp. 513 et seq), in which all the species known to him have been more fully described, and characters for their subgeneric division more fully detailed than in any preceding work. Many new distinctions have been pointed out, which, though subject to some and even important variation, are none the less useful in enabling the establishment of a certain number of groups around which, with a large series, all the aberrant forms may be readily arranged.

As regards our own species, the characters given for their subgeneric division have long been known, though never published by any American entomologists, still to Jekel must be given the credit of so elaborating his observations as to make the study of this genus a matter of easy accomplishment.

In no other genus has tradition so completely controlled specific names as in this, and specimens have been scattered over our own and foreign countries with names far from correct, while under a single name, individuals of different species have been found associated with no other points of resemblance save that of color.

The names of Mr. Say have become purely traditional, as his typical collection has been totally destroyed and but few if any specimens named by him remain. With this fact before us it appears proper, with the able work of Jekel, to fix definitely the names of Say and others, so that in future, trouble may be avoided. The determination of our own species in this work has been a matter of special argument, and, though all American cabinets will be thrown into confusion, it is none the less proper that these determinations should be adopted.*

* The species formerly known in our cabinets as *Blackburnii*, will be fouud in the subsequent pages as *semiopacus*, while the former name is applied to that known as *excrementi*. As the change affects our most prominent species, it would be well for those who may be interested in the matter, to refer to the work of Jekel, where the reasons for the change will be found.

Our species may be divided into four subgeneric groups, characterized as follows:—

Thorax dissimilar anteriorly in the two sexes.
Elytra connate; body apterous, metasternum short.....**Mycotrupes** Lec.
Thorax similar ♂ ♀; elytra free.
Antennæ with the second joint of club normal. Apical tooth of anterior tibia prolonged internally in ♂, simple ♀.
Middle tarsus ♂ short, thick.....**Onychotrupes** Jekel.
Middle tarsus ♂ normal.....**Cnemotrupes** Jekel.
Antennæ with the second joint of club truncate or emarginate, so as to be hidden at some point when the club is closed.
Apical tooth of anterior tibia similar ♂ ♀.....**Anoplotrupes** Jekel.

Mycotrupes Lec.

This subgenus forms a very natural transition between the two *Chelotrupes* Jekel and *Thorectes* Mulsant, agreeing with both in the connate elytra and short metasternum, though differing from either in the form of the thorax. In the male the thorax has a broad transverse excavation, the females have a very well marked longitudinal grove with a shallow excavation on each side. The thorax is strongly sinuous at base and without margin. The head of the male is strongly tuberculate, and in one specimen prolonged into a horn. The elytra are not striate but ornamented with small granules in a manner similar to some of our species of *Canthon*. The anterior tibia has the apical tooth prolonged internally ♂; the middle tarsus is normal ♂ ♀, though longer in the ♂.

But one species is known in this group, *retusus* Lec. (Proc. Acad. 1866, p. 381,) long known under the same name, though unpublished, by MacLeay, and distributed in some European collections by Major Leconte as *fungivorus*. It was unknown to Jekel, who thought it might possibly be synonymous with the *opacus* of Haldeman. It may be readily distinguished from any other *Geotrupes* by the characters above given, and the more easily from our own species by its short metasternum and connate elytra. It is found in our southern states feeding in fungi or under dried animal matter.

Onychotrupes Jekel.

Several of our largest and most prominent species enter into this subgenus. It is characterized by a great thickening of the middle tarsus. The first four joints are shorter than broad (♂), the last bevery thick, with the two claws also much thickened and suddenly re-

curved, extending as far back as the third and even second joint. In the females the same tarsi are thickened, less so however than in the males. The internal apical spine of the middle tibia equals in length the first four joints of the tarsus, in both sexes.

This subgenus has been divided into two groups, 1st, head tuberculate, thorax margined posteriorly, 2nd, head not tuberculate, thorax without posterior margin. These characters are subject to great variation, though in the first group the head is never so smooth and the margin so nearly absent in any one specimen as to require its position in the second group. In the second group, though the thorax may have a distinct margin behind, the head is never tuberculate. The posterior thoracic margin is defined by a well marked line, and the thorax is said to be immarginate when this line is absent or replaced by a few distant punctures only. Individuals occur in *semiopacus* in which the margin is quite distinct. These two groups have a different appearance. The first more or less metallic or shining, the striæ punctured in a greater or less degree. The second group contains species more or less opaque, with the dorsal striæ entirely impunctured.

In the first group Jekel mentions three species as occuring in our territory, *splendidus* Fab., *Starkii* Jekel, *miarophagus* (Say) Jekel, in the second, *semiopacus* Jekel and *Melsheimeri* Jekel; one other in each group is mentioned as possibly occurring in our territory.

With *splendidus* Fab. as a starting point in the first group, the other two species will be compared and their value determined.

G. splendidus Fab.—In every collection I have examined, this species has been found with the correct name, though as varieties of the same were to be found several of the other species whose color happened to be more brilliant than common. When of typical form and color, there can be no trouble in recognizing this species, though it varies in color through all the shades from brilliant metallic green to a dark bronze, and in size from .46 to .68 inch.*

Before considering the varieties of *splendidus*, better results would be produced by reviewing the differences between it and *miarophagus* Jekel.

G. miarophagus is defined as a "very large *splendidus*, of which the color above is violet or purple, sometimes bronze, generally moderately brilliant but not metallic, always darker and duller beneath." The

* These and all subsequent measurements will be considered as having been made from the anterior thoracic margin to the apex of the elytra.

remainder of the description affords nothing more definite. In fact, it is said to be merely a little broader and more massive, and with rather less convex elytra. In a small series or from a series collected in two remote portions of our country, individuals will be found capable of definition as veritable *miarophagus*. In large series, however, these vanish and varieties of all shades of color and almost every degree of convexity appear. I cannot but consider this species a variety of *splendidus*, inseparable by any well defined characters.

Starkii, which Jekel places between the two above mentioned, will be considered hereafter. It does not belong to the group, in my opinion, and reasons will be given when the *Anoplotrupes* are considered.

The races may be defined as follows :—

a. **splendidus**, brilliant metallic green, very shining. Elytra deeply striate, with well defined, crenate punctures; interstices very convex.

β. **miarophagus**, violet, purple or aeneous, not metallic. Elytra striate, punctures scarcely crenate; interstices moderately convex.

γ. **mixtus** (Harris in coll. Leconte), purple, bronze, almost black, less shining than either the above forms, rather larger and more robust. Elytra faintly striate, punctures small, not crenate; interstices flat, scarcely elevated.

In the large series at my disposal, specimens can be arranged in a circle without the possibility of defining distinct species, though the differences between a typical *splendidus* and a nearly smooth *mixtus* are very great.

The second group of this subgenus is represented in the Monograph of Jekel by two species in our territories, *semiopacus* and *Melsheimeri*. *Semiopacus* Jekel has been distributed through the cabinets of this country under the name *Blackburnii*, and has been known as such in all our collections of reference. To Jekel is due the credit of recognizing the true species of Fabricius, and placing our most common species under a separate name. It may be readily known by the absence to a greater or less degree of the marginal line at the base of the thorax, the smooth, unarmed head, with striate elytra, striæ not punctate, interstices flat, smooth. Specimens occasionally occur in which the marginal line at base of thorax is complete, though never so well marked as in the most poorly-marked species of the preceding group. *Melsheimeri* differs too slightly from *semiopacus* to be considered distinct. Specimens agreeing in all particulars with his description are before me, and as his specimen was a female (by far the most variable sex in all the species), I have less hesitancy in uniting them.

CNEMOTRUPES Jekel.

In this subgenus the middle tarsi are normal in both sexes. The joints are more or less cylindrical, and much longer than broad; the first three joints equal the longest spur of the same tibia. The claws are less thickened than in the preceding group, and not abruptly recurved upon the tarsal joints.*

The species of temperate and intertropical America form two groups, best defined by the form of the anterior coxæ and the sinuosity of the posterior thoracic margin.

Those of our own country are again divided into two sub-groups. In the first the spine of the anterior tibia of the male is short and robust, not equaling half the length of the external apical tooth. In the second group the spine is slender as in the female, nearly equaling the length of the external apical tooth. To the first division belong *Blackburnii* Fab. and *conicollis* Jekel.

The former is our smallest species, and varies considerably in every particular, though at all times preserving the characters of the subgenus and group to which it belongs. A form occurs, rather abundantly, in which the thorax is much more convex longitudinally and transversely, the elytra are also rather more convex. It has considerable resemblance to a small bronzed *miarophagus;* as a variety I would propose the name *Jekelii.* The elytra are also more deeply striate and punctured than in the typical form. It cannot be regarded as a distinct species, numerous individuals show a variation towards the original type.

Conicollis Jekel has not been seen by me. It appears distinct from *Blackburnii.* Its name suggests the only important difference between it and the preceding species. In order that it may be recognized if found, the original description is inserted :—

"CONICOLLIS Jekel. Ovatus, supra æneo-brunneus, infra subviolaceo-piceus, epipleuris angustis violaceis; antennis rufis clava fulva; clypeo semi-circulari marginato tuberculo obtuso; thorace longiore et angustiore, subconico, lateribus haud rotundato nec ampliato, dorso obsolete laxe—lateribus evidenter sat dense—punctato, cum foveola parum impressa punctulata; scutello transverso subtriangulari; elytris mox ultra medium subparallelis, apice latius subtrun-

* Care should be used in the determination of the specific names of females. The comparative length of the spur and tarsal joints, though readily perceived, may at times cause erroneous results, as from various accidental circumstances the spur may be broken, or the tarsus itself may be thicker than usual. It is therefore better to consider, at the same time, the relative breadth and length of the joints.

cato-rotundatis, striis punctatis angustis, interstitiis tenuiter concinneque transversim rugulosis.—Long. 13; lat. 8 mill., ♂."

The second group is again divided into polished species with deeply striate elytra and with a yellow antennal club, and those which are opaque, elytra finely striate and antennal club sooty.

Egeriei Germar and *Lecontei* Jekel constitute the first sub-group.

Egeriei has the elytra deeply sculptured and deeply crenato-punctate, forming in this respect the most rugose of our species. In the typical forms the epistome is rounded, in the females it is frequently more prolonged and becomes almost triangular, forming the species *Lecontei*, itself founded on a unique female. A well defined series before me, gathered from all parts of our country, show the elongation of the epistome to be merely an accident or variation and not by any means a permanent character. The females more particularly are subject to this variation. In fact, among all the specimens at my disposal I am unable to find a single male with this and other characters sufficiently marked to enable it to enter this variety. *Egeriei* has been known in some cabinets, native as well as foreign, as *exaratus* Dej.

The second sub-group contains *Haldemani*, *opacus* and *Chevrolati*. In regard to the first species Jekel has been singularly unfortunate, as Haldeman's type corresponds exactly with his description of *Haldemani*. Specimens from Texas are large and robust, and much more convex than those from more northern regions. *Haldemani* and *Chevrolati* have both been founded on unique specimens, and though I have seen representatives of each in a series, it is impossible to tell where one begins and the other ends.

ANOPLOTRUPES Jekel.

The *Geotrupes* of this subgenus are characterized by a truncation of the second joint of the antennal club, and by the absence of any sexual difference in the apical tooth of the anterior tibia. Our American species have also a rather broad margin to the elytra, particularly at the basal third, similar to that seen in many species of the group *Pholotrupes*, and in the European *Anoplotrupes sylvaticus* and *Sternotrupes vernalis*. The thorax has a slight dorsal sulcus, and the scutellum is also sulcate.

Among the numerous specimens of this subgenus now before me, considerable variation exists in the degree of emargination of the second joint of the club. In one large specimen of *similis* Jekel the joint is deeply notched so as to appear reniform. From this we have every degree of degradation. Many specimens show simply an oblique trun-

cation of the joint, others again without any truncation or emargination, but a thinning of the edge so that the other joints, which are always thicker in this instance, readily conceal a portion of the edge. Specimens in my possession show in one antenna a slight truncation, in the other a normal condition of the second joint of the club, similar indeed to that seen in the other great sub-division of the genus.

Specimens agreeing in all particulars with the description of *Onychotrupes Starkii* Jekel are before me, which, it appears to me should enter into this subgenus, notwithstanding the absence of the characteristic emargination of the second joint of the antennal club. In no other of our species do we find anything approaching the margining of the elytra seen in this group. The fact of the resemblance of this species to his *Balyi* has been noticed by Jekel. A singular fact in connection with this species, is that it, also, was founded on females (?), as the measurements given refer to that sex alone, at the same time mentioning that the species was not rare in European cabinets. I was equally unfortunate in recognizing males referable to the subgenus *Onychotrupes*, in a comparatively large series gathered indiscriminately from all parts of our country. With this fact before me, and with the known variation of the degree of emargination of the club, the number of tibial ridges, and with the margining of the elytra, no other course could be pursued than that taken in the preceding part of this paragraph. In external appearance, *Starkii* cannot be distinguished from *Balyi*.

In regard to the characters separating *Balyi* and *similis* it can only be said that they are among the most evanescent of those used for defining species. The variation of the tibial ridges has been noticed in *Blackburnii*, and the same variation is seen in the species of this group. Specimens are before me with three well defined ridges, and as the specimens become smaller and the antennal emargination vanishes, the third ridge grows less, until a small tubercle remains on the line with the others which are normally above it.

I cannot therefore but consider all these as merely races of one species, and unite them under one specific name in the following order:—

Anoplotrupes Balyi Jekel.

Var. α, similis Jekel.—Posterior tibia tricarinate. Second joint of antennal club emarginate.

Var. β, Balyi Jekel.—Posterior tibia bicarinate. Second joint of antennal club emarginate or obliquely truncate.

Var. γ, Starkii Jekel.—Posterior tibia bicarinate. Second joint of antennal club normal or but slightly truncate.

I have the less hesitation in uniting these species as individuals in number are before me from the same localities from which the specimens of Jekel were obtained; while in determining the synonymy of all the species, specimens have been sought from all parts of our country, and have been studied individually.

The species of the genus *Geotrupes*, proper to Boreal America, may be arranged in the following manner, with only such synonyms given as rest on published descriptions, to which reference will be made.

GEOTRUPES Latr.

MYCOTRUPES Lec.

G. retusus Lec. Proc. Acad. 1866, p. 381.

ONYCHOTRUPES Jekel.

G. splendidus Fab. Syst. Ent. p. 18, No. 63.
Var. miarophagus Jekel, Monog. loc. cit. p. 611.
Var. mixtus Horn, supra.

G. semiopacus Jekel, Monog. l. c. p. 612.
Var. Melsheimeri Jekel, Monog. l. c. p. 613.

CNEMOTRUPES Jekel.

G. Egeriei Germ. Ins. Spec. I, p. 114.
Var. ♀ Lecontei Jekel, Monog. l. c. p. 592.

G. opacus Hald. Proc. Acad. 1853, p. 362.
Var. Haldemani Jekel, Monog. l. c. p. 593.
Var. Chevrolati Jekel, Monog. l. c. p. 595.

G. Blackburnii Fab. Spec. Insect. I, p. 20, No. 85.
excrementi Say, Journ. Acad. iii, p. 210.
Var. Jekelii Horn, supra.

G. conicollis Jekel, Monog. l. c. p. 591. (Not known to me.)

ANOPLOTRUPES Jekel.

G. Balyi Jekel, Monog. l. c. p. 617.
Var. similis Jekel, Monog. l. c. p. 617.
Var. Starkii Jekel, Monog. l. c. p. 609.

In order to render the preceding paper more easy of study, the author has had the following cuts prepared, rather as diagrams however than as exact illustrations. The species of *Geotrupes* are so common everywhere during the summer months, that with but little trouble a good series may be collected during a single season. As there does

not exist a good series in the collection of any one person or Society, it would be well for observers to turn their attention to a matter long since neglected by the older collectors among us, while novices for the most part care but little for investigation in material so unattractive as that forming the natural habitat of these insects.

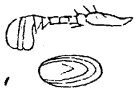


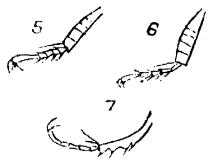
Fig. 1 represents the form of antennal club called normal. The joints are all visible when the club is closed, there is no thinning of the edge nor emargination at any part. A lateral or end view shows the margins of all the joints. Their outline is elongated oval, and as seen by the illustration arranged eccentrically. The outer joint has in many specimens two grooves oblique to each other, sometimes uniting in a form resembling V.

Fig. 2 affords an illustration of the abnormal antenna as seen in our species of *Anoplotrupes*. The second joint, in most of the specimens, shows a distinct emargination, in fact being reniform in outline. The outer joints are more or less thickened at a point corresponding to the emargination, so that when the club is closed its form is preserved, and the touching of the first and third causes the hiding of the intermediate joint at the point of emargination. As stated in the body of the paper, this character is subject to some variation. Fig. 3 will serve to give an idea of the forms assumed, the spot in each being the point of articulation.

Accompanying this character will be found another in a different organ of the body. Fig. 11 shows the lateral margin of the elytra. The dotted line is the last stria extending in a very nearly straight line from the humerus to the apex. Beneath this line is another somewhat sinuous, this is the true elytral margin. Near the humerus a wide space can be seen. This is smooth, not striate, and but sparsely punctured. The *margin* thus formed between the last stria and elytral edge appears more or less constant in those species in which there is no sexual distinction in the apical tooth of the anterior tibia, and is consequently found in no other North American species save those of the subgenus *Anoplotrupes*. Fig. 12 shows the nearest approach to it in *Egeriei*.

The thickening of the middle tarsus in the group *Onychotrupes*, is shown in Fig. 4, which illustrates the middle tarsus of the male, either of *splendidus* or *semiopacus*. The spur of the tibia is much longer than the first four joints. The claws are much thickened and rather suddenly recurved.

Fig. 5 is that of the same tarsus of the female. The joints are broader than long, being in fact so short that the tibial spur equals and even exceeds the length of the first four joints.



Among the *Cnemotrupes* the joints as shown in fig. 6 are normal, being cylindrical and of such a length that the first three generally equal and exceed the length of the longest spur of the same tibia. Fig. 7 shows both spurs; the shorter being slightly curved. In both groups, *Cnemotrupes* and *Onychotrupes*, the long spur of the middle tibia (in ♀) appears to be equal in length. The disparity between it and the tarsus being solely dependant on the shortening of the latter, and not upon any greater development of the spur in either case.

In the two groups above mentioned (as well as in *Mycotrupes*), the anterior tibia affords evidence of sex. Figs. 8 and 9 represent the form assumed in the males. The apical tooth will be seen to be produced inwards and emarginate at tip. The spur also varies in length and thickness, as will be seen in the two figures given, in one (8) short robust, scarcely equaling the half of the length of the apical tooth. In the other (9) it is much longer and more slender, being, in fact, as in the female. The anterior tibiæ of the females of all the groups resemble each other, and fig. 10 may represent that sex in each group. On the under surface of the tibia, running its whole length nearly, may be seen an elevated line, more or less denticulate or serrate, varying somewhat in each species, though not sufficiently in our own to be of much use in classification. In some East Indian species this line is elevated (in ♂) into several large hook-like teeth.

In figs. 13 and 14 will be found an illustration of the posterior marginal line of the thorax, more or less continuous across the whole border, broadly interrupted in *semiopacus* (13), continuous and well marked in *splendidus*, *Ejeriei* etc. (14).