INSECTS AND ARACHNIDS FROM CANADIAN AMBER

By F. M. Carpenter, J. W. Folsom, E. O. Essig, A. C. Kinsey, C. T. Brues, M. W. Boesel, and H. E. Ewing

INTRODUCTION

By F. M. Carpenter

Up to the present time our knowledge of the insect fauna of the Cretaceous period has been almost negligible. Apart from a few fragments of very dubious affinities, only about a dozen specimens have been described from strata of that horizon. Since there is every indication that most of the existing families of insects arose during the Cretaceous, the paucity of such fossils has been very disconcerting. It was lamented many years ago (1917) by Professor Cockerell, who asserted then that nothing would throw more light on the relationships of living insects than the discovery of a rich Cretaceous fauna. During the twenty years which have passed since then, no such fauna has been uncovered. But a little more than two years ago a deposit turned up which gives promise of filling in this extensive gap in the geological record of the insects, and the fact that this deposit is amber adds enormously to its significance. The existence of such a deposit came to my attention solely as a matter of chance. In the course of a routine perusal of geological literature in January, 1935, I happened to come upon a short abstract of a paper read by Dr. T. L. Walker at the fifteenth annual meeting of the Mineralogical Society of America, in which brief reference was made to the amber and insect inclusions.[1] In reply to my request for further information, Dr. Walker sent me a

[1]Proc. Geol. Soc. Amer., 1934: 418.

copy of his published paper[2] in which he refers to the discovery of the insects as follows: "In the course of the examination of the specimens [of amber] with the microscope, it was observed that some of the specimens showed remains of insects, often fragmental, but at times perfectly preserved even to the most delicate structures shown by the antennæ and wings. . . . There seems to be a great variety not only of insects but of spiders and other small forms. There is here an important fauna for the palæontologist and entomologist to which, so far as the writer is aware, attention has not previously been directed." As soon as the amber was prepared for shipment, twenty-seven pieces containing nineteen insects were sent to me, and in the fall of 1935 seventy-five more pieces including sixty-eight insects were also forwarded to me by Dr. Walker. A preliminary note on the first lot has already been published[3] and the present paper is an account of the eighty-seven insects represented in these two collections.[4]

Since several orders and families were represented in this assemblage and all of them belonged to groups in which I have done no systematic work, I felt that it was advisable and even necessary to enlist the aid of various other entomologists in order to obtain authentic accounts of the insects included. The parasitic Hymenoptera were accordingly referred to Professor C. T. Brues; the Chironomidæ to Professors O. A. Johannsen and M. W. Boesel; the Cynipidæ to Professor A. C. Kinsey; the Collembola to Dr. J. W. Folsom; the Aphididæ to Professor E. O. Essig; and the mites to Dr. H. E. Ewing. The manuscripts prepared by these specialists have been brought together and form the descriptive part of the present paper. I acknowledge with many thanks my indebtedness to these fellow entomologists for their indispensible co-

[2]Univ. Tor. Studies, Geol. Ser., no. 36, Contributions to Canadian Mineralogy 1934: 5-10.

[3]Carpenter, F. M. 1935. Univ. Tor. Studies, Geol. Ser., no. 38: 69.

[4]Since this paper was finished, the writer and C. T. Brues accompanied by Mrs. Brues, Alice M. Brues, and Mr. C. T. Parsons have collected about four hundred pounds of the amber at Cedar Lake for the Museum of Comparative Zoology.

operation. To Dr. Walker we all are more than grateful for the opportunity to study these remarkable fossils—an opportunity made possible not only by his courtesy in loaning the specimens but also by his discovery of the insects in the amber. We are also indebted to Dr. F. P. Ide, University of Toronto, for finding some of the insects in amber in his possession; to Mr. A. S. Fuller, Toronto, for collecting some of the amber at Cedar Lake; and to Mr. G. W. Allan of the Hudson's Bay Company for his assistance in obtaining most of the amber. My own part in the preparation of this paper has been confined to various routine tasks, such as grinding and polishing the pieces of amber so that the insects could be seen clearly, sending the specimens to the several specialists already mentioned, and editing the manuscripts.

Although insects have thus only recently been found in the amber, the existence of this deposit has been known for nearly half a century. In 1890 Mr. J. B. Tyrrell, while making a geological survey of the vicinity of Grand Rapids, Manitoba, reached the Chemahawin Indian Reservation at Cedar Lake. Here an Indian showed him a piece of amber, which he stated was found in that region. In company with the Hudson's Bay Company officer, Mr. W. C. King, Tyrrell examined the place where the amber had been found, on the west shore of Cedar Lake, near the mouth of the Saskatchewan River. Tyrrell's report on his observations follows:[5]

"[The amber] occurs mixed with sand and many fragments of partly decayed wood, on a low beach behind a gradually shelving shore and along the face of a deep wet spruce swamp. The pieces were for the most part smaller than a pea, but could be readily seen glittering among the sand and vegetable debris. Some pieces were found as large as a robin's egg, and Mr. King informed me that he had collected pieces very much larger. It has evidently been washed up on the shore by the waves, but its exact age has not yet been positively determined. . . .

"It is difficult to make an accurate estimate of the quantity of amber on this mile beach, but it may confidently be said

[5]Summary Rept., Geol. Surv. Can. 1890, 1891: 22. Also Ann. Rept., Geol. Surv. Can., N.S., vol. V, 1890-1: 30-1 A.

to be found throughout the distance in a band thirty feet wide, with a minimum depth of two feet. This band has thus a total bulk of 316,800 cubic feet. A number of specimens collected from various parts of it showed an average of a little over ten percent. of amber, which, in natural fragments, weighed 46 pounds to the cubic foot. The amount of amber on this strip of beach would, therefore, be about 31,680 cubic feet, or 1,457,280 pounds."

The following year, 1891, Tyrrell made a second and more extended trip to Cedar Lake, this time for the specific purpose of obtaining additional data on the occurrence of the amber. Although no other extensive deposits of the amber were found, grains of the amber were seen on the shores of several small lakes in the vicinity of Chemahawin, and to the north and east of Cedar Lake. From his observations on the geology of the region, Tyrrell was led to believe that the amber had been derived from the Cretaceous rocks in the prairie through which the Saskatchewan River flows and that it had been deposited in the delta formed by the river where it enters Cedar Lake.

It is surprising that no reference is made in these published notes to the presence of insects in the amber, especially since interest in fossil insects was very general among the geologists at about that time. I have been unable to find any mention of these inclusions, however, and since no other papers on the amber have been published prior to Dr. Walker's, he is the first to refer to the occurrence of the insects.

Inasmuch as the present place of deposition of the amber is obviously a secondary one, its geological age is difficult to determine. But a study of a geological map of Canada contributes materially to this problem. It may be assumed without question, I think, that the amber has been derived from some region west or north-west of Cedar Lake, following the present general drainage of the area. Cedar Lake itself, and the Saskatchewan River for fully 150 miles up from the lake, is situated in a Silurian formation, and above that for at least 700 miles the river and its branches (North and South Saskatchewan Rivers) flow through Cretaceous beds only.

A few hundred miles beyond this interval, approximately a thousand miles from Cedar Lake, the Saskatchewan River has its source in the Rocky Mountains of Alberta, in a series of formations considered to be either upper Cretaceous or lower Tertiary.[6] It is of interest in this connection that amber, or at least some form of fossil resin, has been found in lignitic beds in various parts of British Columbia (Nanaimo coalfields, Nechako River, Peace River, Frances River), but these regions are close to the Pacific Ocean and have probably always had a westerly drainage, away from the vicinity of Cedar Lake. Fossil resin has also been found in the very southern part of Saskatchewan, in a relatively small bed of Cretaceous lignite. In this connection it is interesting to note that the Cedar Lake amber differs in structure from the Baltic amber. The most complete chemical analysis was made by Harrington, who examined some of the pieces collected by Tyrrell.[7] He found that unlike Baltic amber it did not contain succinic acid, that it was more resistant to heat than Baltic amber, and that it had a somewhat different ultimate composition. He proposed the name Chemawinite to distinguish it from the other retinites, such as Krantzite, Jaulingite, *etc.*, and concluded that "though the origin of this substance is not certainly known, there is little doubt that it has been derived from one of the Tertiary[8] or Cretaceous lignites occurring on the Saskatchewan. Some of these are known to contain resins, one of which, examined by the writer, was not essentially very different from the Cedar Lake material." It is also pertinent to note that amber has been found in Cretaceous lignites in various parts of North America, such as New Jersey, Delaware, Staten Island (New York), Martha's Vineyard, and Colorado. One piece of this

[6]This is the "Laramaie" formation, as that term was used by Dawson in 1882 (Rept. of Progress, Geol. Surv. Can., 1880-1882: 48).

[7]On the So-Called Amber of Cedar Lake, N. Saskatchewan, Canada. Amer. Journ. Sci., (3) 42, 1891: 332-338.

[8]At the time when Harrington's paper was written, much of the area through which the Saskatchewan River flows had not been surveyed and its geological age was not certain. Since then surveys have shown all these regions to be Cretaceous, not Tertiary.

Cretaceous amber, from Hardin County, Tennessee, contained a caddis-fly, *Dolophilus præmissus* Cock., the first and only amber insect described from North America up to the present time.

The most striking indication of the age of the amber is provided by the insect inclusions. Our knowledge of the insect fauna of the Tertiary is much more complete than that of any other geological period, owing to a large extent to the thousands of specimens preserved in the Baltic amber. By comparing the insects present in the Canadian amber with those belonging to the same orders or families of the Tertiary fauna, especially in the Baltic amber, we can obtain some idea of the geological level of the Canadian amber. In the present paper twenty-two new species, seven new genera, and two new families are described from the Canadian amber. It will be apparent from the descriptions and discussions given below that the new genera and families are particularly striking because of their primitive or generalized characteristics, and because of their intermediate position between various existing families. As an example we might take the Collembolan described below as *Protentomobrya walkeri* by Folsom, which represents a new family, Protentomobryidæ. In contrast to this, all the twelve species of Collembola which have been described from the Baltic amber belong to *existing genera*! The whole picture presented by the Canadian amber species does not fit at all with our understanding of the Baltic amber (Oligocene) fauna. Of course a more extensive series of the insects will be needed to furnish conclusive proof of the age of the amber, but I believe that in view of the nature of the insects which we now have and the geology of the region, we are justified in assuming that it is Cretaceous.

Because of the small number of known Cretaceous insects, even the twenty-two species described in this paper contribute materially to our knowledge of the fauna of that period. Until now, aside from obscure fragments of uncertain family position, one dragon-fly, four cockroaches, one stone-fly, three possible midges, and a few beetles have comprised the known Cretaceous fauna. In this paper species of six existing

families are described from the Canadian amber and these constitute not only the first record of all six families in the Cretaceous but also their earliest geological occurrence.

In addition to the species described below, several others are included in the collection of amber, but the specimens are not well enough preserved to permit generic or, in some cases, even family position. There are two specimens of Coleoptera (Nos. 27A and 70), family uncertain; two specimens of Diptera Brachycera, possibly Empidids; and several Homopterous nymphs, apparently in the first stage. Since additional collecting of the amber will probably yield better specimens of these species, we have not attempted to describe them.

INSECTA

ORDER COLLEMBOLA

By J. W. Folsom[1]

The single peculiar specimen at hand represents a new family of Collembola.

The most remarkable characteristic of the Collembolan is the primitive condition of the furcula, or spring, on the fourth abdominal segment. The furcula (figure 1) consists simply of a pair of long slender diverging stylets, each swollen basally. No division into manubrium, dentes, and mucrones (as in recent forms) was detected.

In ventral aspect, under strong overhead illumination, the form of the furcula showed clearly in white, against the dark background of the abdomen.

On the whole, the affinities of this species are with Entomobryomorpha, particularly Entomobryidæ, as shown in the reduced, concealed pronotum, the reduced first abdominal segment, and the clothing. On the other hand, the third abdominal segment is not reduced, being almost as long as the fourth (as 14: 17), and in this respect suggests the genus *Orchesella*. Furthermore, the fifth abdominal segment is not reduced. The anterior limits of the sixth abdominal segment are obscure, though there is a dorsal subtriangular appendage, or suranal valve, and underneath this a subtriangular subanal valve. These two valves are separated from each other in the specimen by a bubble that projects from the rectum.

The antennæ, however, which are relatively short, with short stout segments, are not of the entomobryid type, but are such as are characteristic of Poduromorpha (Poduridæ and other families).

A new family is necessary for the reception of this species. That is something unusual, for the twelve species of Col-

[1]Bureau of Entomology and Plant Quarantine, U.S. Dept. Agr.

lembola hitherto known from amber have all been referable to recent genera (*Hypogastrura* 2, *Isotoma* 2, *Entomobrya* 1, *Tomocerus* 1, *Lepidocyrtus* 1, *Orchesella* 1, *Sminthurus* 1, *Allacma* 3), according to Handschin,[2] who has revised them.

Those twelve species, from Baltic amber, are from the Oligocene, however; while the species described here is apparently Cretaceous.

Our specimen is essentially as represented in figure 1. The parallel-sided condition of the abdomen is abnormal; on the ventral side are irregular folds which indicate that the abdomen has shrunk laterally. Probably the abdomen was normally fusiform.

The number of eyes on each side of the head could not be made out clearly. None could be seen on the right side, but there were apparently at least six on the left side. Since the area of the eye spot is not reduced (as compared with that of recent forms), and since the area is greater than is necessary for six eyes, it is possible that there were eight eyes on each side, as in most of the recent species.

The legs were contracted in confusion under the body, and the claws could not be studied. A ventral tube could be seen obscurely. A tenaculum was not seen.

PROTENTOMOBRYIDÆ Folsom, n. fam.

Body elongate. Pronotum probably membranous and naked, concealed under the mesonotum. Abd. 1 reduced. Abd. 3 almost as long as abd. 4, which is but slightly enlarged. Abd. 5 not reduced. Abd. 6 with suranal and subanal valves. Furcula present, consisting of a pair of long simple stylets. Antennal segments four, short and stout. Integument smooth. Clothing setaceous.

PROTENTOMOBRYA Folsom, n. gen.

The generic characters are contained in the preceding diagnosis of the family. They cannot, however, be listed

[2]Handschin, E. 1926. Revision der Collembolen des baltischen Bernsteins. Ent. Mitt., bd. 15: 161-185, 211-223, 330-342, figs.

separately, with only one species at hand. It may be said, though, that in the family Entomobryidæ the number of antennal segments, the relative lengths of abd. 3 and abd. 4, and the character of the clothing (whether setaceous or scaly) are characters of generic value.

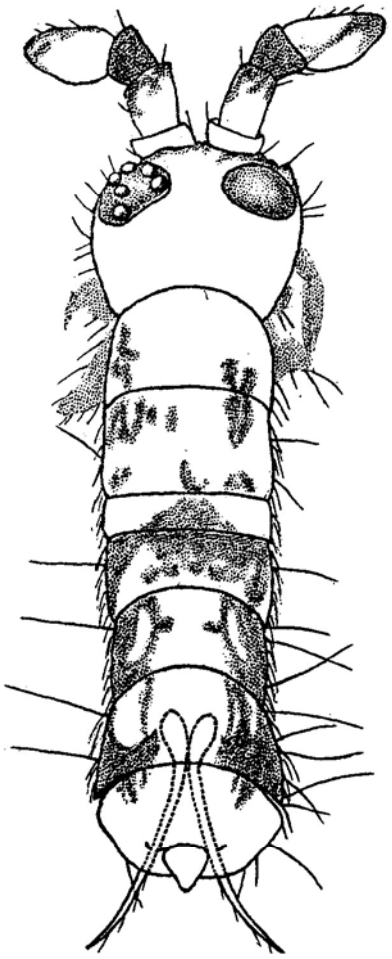

FIGURE 1.—*Protentombrya walkeri* Folsom, n. sp. Drawing of type.

Protentomobrya walkeri Folsom, n. sp.

Figure 1

Ground colour probably pale yellow or white, with blackish markings. Ant. 2 black apically; ant. 2 black throughout. The colour pattern of the body is partly indefinite, but abd. 1 shows a black median triangle; abd. 2 is mostly black except along the posterior border; abd. 3 is black laterally, with an elongate pale spot on each side; and abd. 4 has a black band across the posterior third (interrupted in the figure). Eye spots not reduced, and eyes at least 6 and possibly 8 on each side. Antennæ relatively short, with short stout segments, in relative lengths as 3:12:7:17 (right side) and 2.5:11:8:15 (left side). Clothing of dense, short, reclinate setæ and long, outstanding tactile hairs. Furcula with sparse, short, stiff setæ. Integument smooth. Length, 0.64 mm.

Holotype: No. 64, Royal Ontario Museum of Mineralogy, Toronto.

Locality: Cedar Lake, Manitoba, Canada.

Named for Dr. T. L. Walker, Director of the Royal Ontario Museum of Mineralogy, Toronto, to whom we are indebted for the opportunity to study these amber insects.

ORDER HOMOPTERA

FAMILY APHIDIDÆ

By E. O. ESSIG

The fossil aphid referred to me for determination is of special interest because of its geologic age. Since the Aphididæ have not previously been found earlier than the Baltic amber (Oligocene), this specimen is by far the oldest known member of the family.

An examination of the published descriptions and illustrations of the fossil aphids reveals an amazing and confusing situation. In the first place the described specimens appear

to be unusually well preserved considering the extremely delicate and fragile nature of these small insects. This is specially surprising of the large number of genera and species taken in the shales of Florissant, Colorado, and described by S. H. Scudder and G. B. Buckton. Those of the Baltic amber do not appear to be in such good condition if we are to judge by the illustrative material available. In the second place the taxonomic work, while done by eminent and thorough paleo-entomologists, reveals a lack of general knowledge of the Aphididæ as a group and the genera and species individually. Therefore, there is usually lacking in the descriptions certain characters that are now most used in the classification of the insects. The wings, which are best preserved, form the general basis for classifying fossil aphids, and there seems to be some confusion as to the exact use of the venation in erecting sub-families and genera. It is also difficult to conclude whether certain of the named species actually lacked cornicles, sensoria, and other organs now used in classification, or whether perhaps these were either destroyed during the process of preservation or do not show in the fossil specimens. My researches of the literature gave no helpful clue to the problem of naming the particular aphid at hand.

The individual herein described is preserved in a small piece of amber which is mounted in Canada balsam under a cover glass on a microscopic slide. With the use of our best microscopes it is impossible to locate secondary sensoria and cornicles. The thickness of the amber prevents the use of high magnifications, and it may be possible in the future, with better equipment, to see things which are wholly indiscernible by me.

Subfamily *Aphidinæ*

The question of the proper subfamily for this new species is a difficult one, since in modern classification certain habits and characters are used which cannot be ascertained for a fossil specimen. There is at present no way to relegate fossil aphids to suitable subfamilies without studying at first hand the various previously described species. If one is to follow

the broadest interpretation in the erection of subfamilies, this species would fall in the Aphidinæ from the fact that the media (third discoidal or cubitus) is twice-branched.[1] Most of the modern definitions of the subfamily are much more elaborate and comprehensive. However, such a designation as this accords with the present view that this subfamily Aphidinæ is the most primitive of the Aphididæ.

Canadaphis Essig, n. gen.

Wings with characteristic aphis-type venation; abdomen prolonged posteriorly into a tail-like cauda; antennæ six-segmented; cornicles absent.

Canadaphis carpenteri Essig, n. sp.

Figure 2

This small aphid lies embedded in a small bit of amber in the position shown in the accompanying illustrations in figure 2. The body is somewhat pigmented and too dense to permit careful study. The head is indeed quite unusual and the front appears like an extended two-lobed process. The antennæ, especially the apparently perfect left member, are clearly segmented, as are also the legs. The compound eyes are evident, but the facets are not well defined. There are indications of ocular tubercles. The wings are beautifully preserved in a most remarkable manner and are not unlike those of modern living specimens. Both pairs are visible; the venation is distinct; the stigma prominent, but short; the surfaces are covered with the characteristic cuticular scales; the fore wings are furnished with the anal folds which were engaged in flight by two humuli on the distal front margin of the hind wings. The legs are quite normal in size and the tarsi are two-segmented; the first segment very small and the

[1]Even this single character is too broad a statement since such a modern authority as A. C. Baker states: "In the typical forms of this subfamily the media of the fore wing is twice branched, but it is very commonly branched only once, and it is rarely simple" (Generic Classification of the Hemipterous Family Aphididæ. U.S. Dept. Agr. Bull. 826, 1920: 11).

second unusually long. There are indications of permanent sensoria on antennal segments V and VI, but no secondary sensoria are visible on III, a condition found in practically all modern alate individuals. It is possible that they are not discernible. The segmentation of the antennæ is quite modern in aspect.

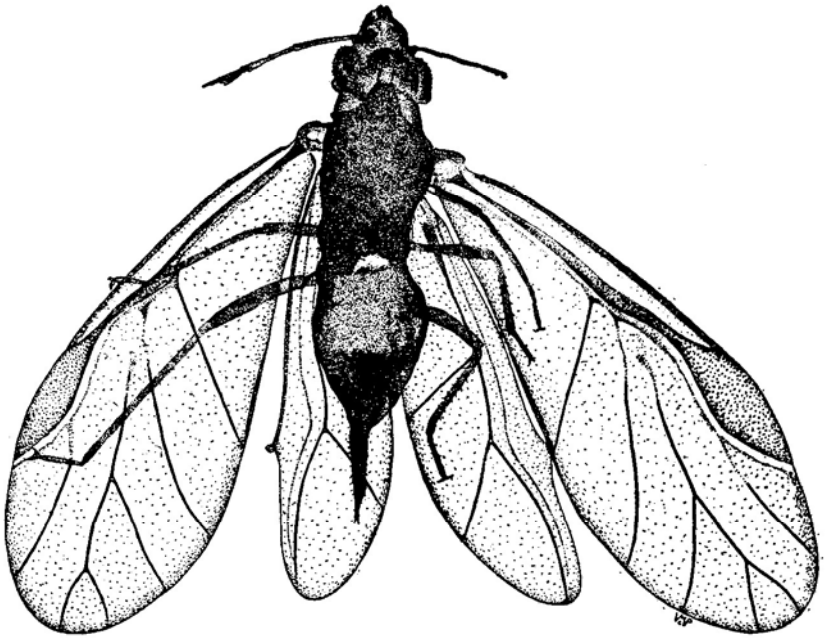

FIGURE 2.—*Canadaphis carpenteri* Essig, n. sp. Drawing of type by Virginia McPheter.

The most striking feature of the insect is the long pointed extension of the abdomen into what may be a cauda, but which bears little resemblance to that organ in present-day forms. Whether it is a natural condition or a forced prolongation of the body during the embedding process cannot be ascertained, but the presence of two small spines at the pointed apex suggests a natural condition. It includes about one-fifth of the entire length of the body. Camera lucida

measurements give lengths as follows: body, including cauda, 1.25 mm.; cauda 0.25 mm.; fore wing 1.43 mm.; stigma of fore wing 0.35 mm.; hind tarsi 0.15 mm.; antenna—I, 0.02 mm.; II, 0.03 mm.; III, 0.16 mm.; IV, 0.06 mm.; V, 0.07 mm.; VI, 0.11 mm. (base 0.04 mm.; unguis 0.07 mm.); total 0.46 mm.

The new species is named in honour of Dr. F. M. Carpenter.

Type: No. 30, Royal Ontario Museum of Mineralogy, Toronto.

ORDER HYMENOPTERA

FAMILY CYNIPIDÆ

By ALFRED C. KINSEY[1]

There are only seven fossil Cynipoids described to date. Several other references to Cynipoids in the paleontological literature are too vague to be ascribed with any assurance to this group (*see* Kinsey, 1919).[2] The acceptable species are the following:[3]

Figites solus, Brues 1910, Miocene, Florissant, Colo.
Protoibalia connexiva, Brues 1910, Miocene, Florissant, Colo.
Aulacidea progenitrix, Kinsey 1919, Miocene, Florissant, Colo.
Aulacidea ampliforma, Kinsey 1919, Miocene, Florissant, Colo.
Aulacidea succinea, Kinsey 1919, Oligocene, Baltic amber.
Rhodites vetus, Cockerell 1921, Oligocene, Isle of Wight.
Andricus vectensis, Cockerell 1921, Oligocene, Isle of Wight.

It is to be observed that all the species previously described are Miocene and Oligocene in origin. Consequently the discovery of the Cretaceous specimen described below pushes

[1]Contribution from Dept. Zool., Indiana Univ., no. 251 (Entomological Ser. no. 12).

[2]Kinsey, A. C. 1919. Fossil Cynipidæ. Psyche, 26: 44-49.

[3]Brues, C. T. 1910. The Parasitic Hymenoptera of the Tertiary of Florissant, Colorado. Bull. Mus. Comp. Zool., 54: 1-125.

Cockerell, T. D. A. 1921. Fossil Arthropods in the British Museum. V. Oligocene Hymenoptera from the Isle of Wight. Ann. & Mag. Nat. Hist., (9) 7: 1-25.

the known history of the group back a very long way. It is remarkable that the new species is clearly cynipoid, even at that remote horizon; and that it is only a little more primitive than the Oligocene and Miocene species and, indeed, than some of the simpler present-day genera of the families Figitidæ and Cynipidæ.

One of the species described from the Oligocene of the Isle of Wight by Cockerell is assigned to *Andricus* and another to *Rhodites*; but there seems nothing in the published records of the two that would rule them out of the present-day tribe Aulacini. It is in that tribe that all of the other described fossils clearly belong; and it is also with the Aulacini that the new, Cretaceous species has most of its affinities. This continued relation of the fossils with the most primitive of the present-day tribes may have some significance. It is possible that the more specialized genera which constitute the bulk of our recent gall wasp fauna have all come into existence since the early Miocene; but the fossil record is much too scant to warrant drawing such a conclusion from it alone.

Protimaspis Kinsey, n. gen.

With the characters found in the Cretaceous fossil described below. Closest to the present-day genera *Timaspis* and *Phanacis*, and not far removed from *Aulacidea*. Differs from these in having the abdomen more lenticulate in profile, the second segment of the abdomen larger, the terminal segment lacking on the subcosta, the second abscissa of the radius nearly straight, the radial cell more narrow at base, the areolet larger, the nervulus peculiarly modified, and the whole wing a bit shorter (with a wing-body ratio of 0.94, instead of 1.05 or more as found in the present-day genera).

Genotype: *Protimaspis costalis* n. sp., from the Cretaceous amber of Cedar Lake, Manitoba, Canada.

Protimaspis costalis Kinsey, n. sp.

Figures 3A and 3B

Female (?). Entire body dark to black (as seen in the fossil!). Head about as wide as thorax, slightly widened

behind cheeks; antennæ 14- (or 15-) segmented, somewhat moniliform, with segments 4-13 subequal, with segment 3 only slightly longer (and slightly incised?), with segment 14 nearly twice as long as 13 and with a more or less obscure division. Thorax rather slender and elongate (the other details not evident in the fossil). Abdomen essentially sessile, slender,

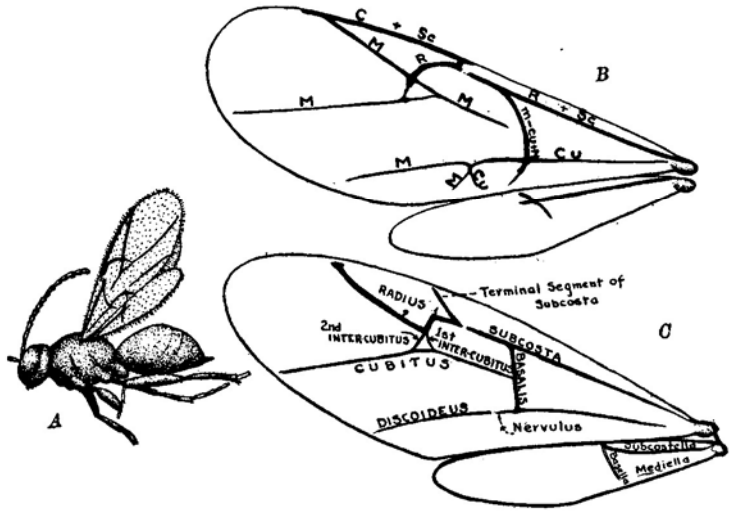

FIGURE 3.—A. *Protimaspis costalis* Kinsey, n. sp. Drawing of type specimen in the position in which it was found, and without any reconstruction.

B. *Protimaspis costalis* Kinsey, n. sp. Detail of front wing, indicating possible homologies in venation. C = costa, Sc = subcosta, R = radius, M = medius, Cu = cubitus.

C. *Cynips sp.* Detail of front wing, with current nomenclature for veins.

elongate, lenticular in profile, with segment 2 covering more than one-third, but the other segments sub-equal; the hypopygium without a spine. Legs usual; tarsal claws simple. Wings normal, but only 0.94 of the body in length; ciliate over the entire surface and on every margin (unless lacking on part of the anal margin of the fore wing); veins only moderate in weight, those about the radial cell heaviest;

subcosta straight, not extending beyond usual break in vein, not turned up toward margin; a vein along entire margin of radial cell, closing it and extending a bit beyond it in both directions; radial cell long triangulate, twice as long as its width at base; first abscissa of radius well curved but not angulate; second abscissa of radius fairly straight, a direct continuation of (though heavier than) the first part of the cubitus; cubitus originating near mid-point of basalis; areolet moderate in size; nervulus replaced by two recurved veins. Length: rather small, about 1.8 mm.

Type: One insect (No. 39), apparently female, from the Cretaceous amber of Cedar Lake, Manitoba, Canada; in a rectangular piece of clear though not light amber measuring approximately 6x6x3 mm., contained in the collection of the Royal Ontario Museum of Mineralogy, Toronto.

The single insect on which this species is based is a remarkably preserved specimen hardly less perfect than a present-day insect freshly embedded in balsam. Such defects as there are in our description are due to the fact that the fossil lies in a fixed position which makes it difficult to see dorsal surfaces and to examine the sculpture and clothing. For the same reason, the sex of the insect is not quite clear. Even the living species of the Aulacini show few secondary sexual characters, and without an opportunity to move the fossil from its embedded position we cannot be certain what we see. The antennal count, 14-15, is that of normal males, and one more than that usually found in the females of the Aulacini; but the Cretaceous insect might very well have had more segments than the present-day species. There is a suggestion of an incision in the third segment of the antenna, and this is a male character; but the embedded specimen cannot be turned into a position which makes this character certain. The abdomen is narrowed more or less as in males of the Aulacini, but it is large for a male. Moreover, the terminal organs look like ovipositor sheaths with a protruding ovipositor, and this character is so clear that we are inclined to consider the specimen a female.

The wing venation of the insect is somewhat more primitive than that found in any of the living Cynipidæ. It is

suggestive of the venation found in the Ibaliidæ and in some of the simpler Figitidæ. It may prove significant when we come to consider the origins of these three families from the ancestral stocks. Since the Chalcidoidea also appear to have had their origin in this same cynipoid stock, it will be interesting to secure more fossils of the group. The present species is closest to the primitive, weed-stem gall makers of the genera *Timpaspis* and *Phanacis*, which belong to the tribe Aulacini in the family Cynipidæ. But *costalis* is not so far removed from some of the simpler parasitic cynipoids; and we cannot be certain whether the fossil represents a parasite in the family Figitidæ or a gall maker in the family Cynipidæ. No certain interpretation of the wing venation of the fossil can be made until we have more elaborate studies of homologies in the Hymenoptera in general, and of a wide range of species in the present-day Cynipidæ. Pending such a study we can, however, note the observable differences between *Protimaspis* and the more specialized cynipid wings.

Referring to the accompanying figures, it will be seen that what we commonly call the "subcosta" terminates at the break near the base of the radial cell. There is no "terminal segment to the subcosta". The connection between the marginal vein and the first abscissa of the radius looks more like a fusion between veins than like the terminal segment of the subcosta. If the subcosta really continues beyond the break in the vein, the "first abscissa of the radius" would appear to be the true continuation.

The remarkable vein on the margin of the radial cell extends beyond that cell at both ends, suggesting that it is the long-lost costa, and not the continuation of the subcosta which we usually consider any vein that closes that cell.

The vein which is ordinarily called the "second abscissa of the radius" appears to be directly continuous with the first (the basal) portion of the "cubitus"; and since other studies of the hymenopterous wing[4] seem to show this basal portion

[4]Bradley, J. C. 1931. A Laboratory Guide to the Study of the Wings of Insects. Daw, Illston and Co., Ithaca, N.Y.: 28-32, plates 38-58, 67.

Comstock, J. H. 1918. The Wings of Insects. Comstock Publ. Co., Ithaca, N.Y.: 362-381.

to be the medius rather than the cubitus, it is possible that the "second abscissa of the radius" is also part of the medius. The terminal half of the so-called "cubitus" also appears to be the medius, just as Comstock and Bradley have interpreted it.

WING VEIN NOMENCLATURE

Current in systematic literature	In Comstock 1918	In Bradley 1931	In Protimaspis
Subcosta			
Basal portion	Sc+R+M	R+M	Sc (+R?)
Terminal segment	Sc+R	Sc+R	fusion between C and R
Extension on margin	R (?)	Sc+R	C (+Sc?)
Radius			
First abscissa	R	R	R
Second abscissa	R	R	M
Cubitus			
Basal portion	M	M	M
Terminal portion	M	M	M
Discoideus			
Basal half	Cu	Cu	Cu
Terminal half	M	Cu	M
Basalis	m−cu+M	m−cu+M	m−cu+M

What passes for the basal portion of the "discoideus" in descriptive literature is probably, at the base of the wing, really the cubitus, as Comstock and Bradley are again agreed. But the peculiar arrangement near what should have been

the nervulus in *Protimaspis* makes it look as if the true cubitus ended at that point, while the terminal half of the discoideus seems to represent another vein which may be another branch of the medius.

Our figure 3B shows a wing of *Protimaspis* with the interpretations which we have just suggested. For comparison the wing of the present-day species of *Cynips*, bearing the nomenclature current in taxonomic descriptions, is shown in figure 3C. A further comparison of several interpretations of cynipid wings is given in the table above. The fragmentary nature of Bradley's publication leaves it uncertain whether we have fairly interpreted his views on the subject.

None of the available studies of hymenopterous wings, nor our suggested interpretation of this wing of *Protimaspis*, makes us feel confident that we have yet found the correct homologies for the cynipid wing veins. Until we can make an extensive study of gall wasp wings, we are not warranted in using anything but the current nomenclature in descriptive word with the group. Meanwhile every fossil will contribute materially to our further interpretations of the group.

SUPERFAMILIES ICHNEUMONOIDEA, SERPHOIDEA, AND CHALCIDOIDEA

By CHARLES T. BRUES

The present small collection contains only nine species, but is extremely interesting as it includes several remarkable forms. There are representatives of three well-known families, Braconidæ, Scelionidæ, and Mymaridæ, and still another, the Serphitidæ, which is proposed as new. The latter is based on a highly anomalous form which presents characters that must exclude it from any family heretofore recognized although it shows resemblances to several widely distinct modern groups. Several of the species are referable to modern genera, but others, such as *Proteroscelio* and *Bæomorpha*, are strikingly different from the modern representatives of the family to which they belong. There is some

similarity to the fauna of the Baltic amber, but obviously this resemblance is not close. It is, of course, not possible to make any generalized statements on the basis of such meagre material. However, this Cretaceous amber fauna gives promise of furnishing very important evidence on the relationships of the families of the parasitic Hymenoptera, and it will quite probably be found to include types that throw light on the origin and relationships of some of the larger groups of this order.

FAMILY BRACONIDÆ

SUBFAMILY DIOSPILINÆ

Diospilus Haliday

Diospilus (*sens. lat.*) **allani** Brues, n. sp.

Figure 4A

This is represented by an incomplete specimen in which most of the head and thorax, the base of the abdomen, part of the legs, and the complete antennæ and wings are preserved. The antennæ are long, filiform, 20-jointed; scape short, pedicel very short; base of flagellum thinner than the middle, with the first joint longer than the scape, the joints beyond gradually shorter, those near the middle more than twice as long as wide; the entire antenna two-thirds longer than the head and thorax together. The head is not preserved in the oral region so that the clypeus and mouthparts cannot be seen. The head in dorsal view shows a very sharp black edge to a reflecting band which indicates that the occiput is margined; head strongly transverse, just about twice as wide as thick; the eyes large, but not bulging out beyond the rounded lateral contour of the head; seen from above twice as broad as the temples behind them. Thorax distinctly less than twice as long as high, including the prothoracic neck; mesonotum strongly convex in front, with deep parapsidal furrows; propodeum showing some elevated tooth-like projections and evidently at least partly areolated. Anterior and middle coxæ small, hind ones obovoid, as long as the posterior slope of the propodeum. Legs rather slender,

the posterior tibiæ with two very short spurs. Abdomen preserved only at the extreme base, sessile, with the first segment rounded above in profile. Basal side of stigma apparently slightly longer than the apical side. First discoidal cell with a very short petiole above, *i.e.*, the cubitus arises from the basal vein; nervulus postfurcal, entering the first discoidal cell at its basal third; anal cell with an in-

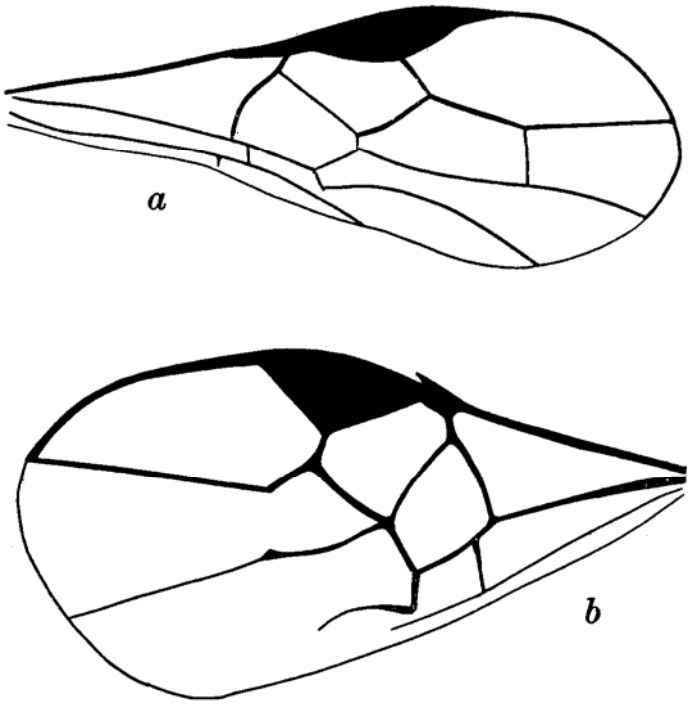

FIGURE 4.—A. *Diospilus (sens. lat.) allani* Brues, n. sp. Wing of type.
B. *Pygostolus patriarchicus* Brues, n. sp. Wing of type.

complete cross-vein, just before the nervulus, extending halfway to the wing margin; radial cell extending almost to the wing-tip, the first section of the radius about half as long as the second; third considerably longer than the second. Second cubital cell scarcely narrowed apically, the recurrent nervure entering it near the base; second discoidal cell rather im-

perfectly closed at apex, the nervellus arising below the middle of the cell. Hind wing with the basal cell complete, the median and discoidal of about equal length, incomplete below; radiellan cell not indicated apically.

Type: from Cretaceous amber, Cedar Lake, Manitoba, Canada; No. 3, Royal Ontario Museum of Mineralogy, Toronto.

This species is named in honour of Mr. George W. Allan, Head of the Canadian Committee of the Hudson's Bay Company, who gave assistance in obtaining this collection of amber.

This form is undoubtedly a member of the subfamily Diospilinæ. It could not be placed in the genus *Diospilus* as now restricted on account of the very long radial cell, and in view of the imperfect condition of the fossil I do not wish to propose a new genus at this time, or to attempt to place it in any other described genus as it will not fit well in any so far known.

It is evident that *Diospilus* and its allies represent a primitive group of Braconidæ as several localities have already produced fossil forms. I have described several from the Baltic amber, belonging to *Diospilites* and *Microtypus* (Brues, 1933); Cockerell (1921) described from the Oligocene of Gurnet Bay a *Diospilus* which seems to approach some of the amber *Microtypus* rather closely; and I found (Brues, 1910) the related genus *Dyscoletes* in addition to an apparently typical *Diospilus* in the Miocene of Florissant. With this array of fossil forms known, the comparative scarcity of the group at the present time indicates very clearly that it was much more abundantly represented in Cretaceous and Tertiary times.

SUBFAMILY BLACINÆ

Pygostolus Haliday

Pygostolus patriarchicus Brues, n. sp.

Figure 4B

♀. Length 2.1 mm.; ovipositor 0.5 mm. Light coloured in the specimen, except for the eyes, apices of antennæ, most

of thorax, and apical half of abdomen. This is probably due to fading at least in part, as the stigma and wing veins are paler than usual. Antennæ 21-jointed; scape oval, about the length of the first flagellar joint which is somewhat less than four times as long as thick; second flagellar joint about as long as the first; third to last progressively shorter, becoming more or less moniliform after the ninth which is decidedly longer than thick. Head of normal form although the temples and vertex are slightly elongated antero-posteriorly as in *Electroblacus* Brues.[1] Eyes small, ovate, the cheeks, temples, and malar space consequently larger than usual. Mandibles small, curved, acutely pointed at tips. Mesonotum with such very deeply impressed parapsidal furrows that it appears trilobed anteriorly. Propodeum very strongly areolated above. Abdomen (in lateral view) apparently rather narrowly sessile, arcuately arched above, and apparently strongly bicarinate; second tergite about as long as the first, slightly longer than the propodeum; following segments together somewhat less than half the length of the abdomen. Ovipositor stout, curved slightly downwards just beyond the middle, a little more than half the length of the abdomen. Stigma broad, triangular, its basal and apical sides equal; second section of radius one-third longer than the first and about one-fifth the length of the third; cubital vein arising at the upper fifth of the basal vein, the first discoidal cell therefore petiolate above; recurrent nervure interstitial with the first transverse cubitus; nervulus postfurcal, entering the second discoidal cell at its basal third; the latter cell open below at apex; radial cell attaining the tip of the wing. Legs slender, the hind pair stouter.

Type: from Cretaceous amber, Cedar Lake, Manitoba, Canada; No. 16, Royal Ontario Museum of Mineralogy, Toronto.

This species is a quite typical *Pygostolus*. The genus is already known from Baltic amber by a similar species, *P. clavatus* Brues, from which the present form differs in the form of the antennal joints and the insertion of the recurrent nervure.

[1]A genus known from Baltic amber.

Neoblacus Ashmead

Neoblacus facialis Brues, n. sp.

♂. Length 1.4 mm. Black, with the abdomen reddish brown, except at tip; legs brownish, especially the front pair; wings hyaline or very slightly infuscated. Head strongly transverse, the temples narrowed behind the eyes. Antennæ slender, except for the rather stout scape; about 16-jointed, inserted somewhat below the middle of the face on a distinct elevation, below which the face recedes obliquely to the mouth; first and second flagellar joints of about equal length, the first more slender, fully four times as long as thick; following joints growing gradually thicker, but very little shorter, those near the apex more than twice as long as thick. Mandibles small, narrow, strongly bidentate at tips. Upper side of thorax not very clearly visible, apparently smooth, with the parapsidal furrows deep and the scutellum deeply foveate at base. Abdomen long and narrow, the sides nearly parallel, except at the base; nearly as long as the head and thorax together; first segment apparently furrowed at the base. Legs stout, the femora and tarsi noticeably thick, the first joint of the hind tarsi longer than the two following joints together. Stigma long and narrow, fully four times as long as wide; the radius arising well before the middle of the stigma, its first section nearly perpendicular to the costa, slightly longer than the width of the stigma; second and third sections of approximately equal length, the radius slightly angulate at the middle although the second transverse cubitus is absent; first cubital and first discoidal cells fused as the base of the cubitus is present only as the faintest trace which, however, is sufficiently indicated to show that it arises from the basal vein rather than the costa; recurrent nervure entering the extreme base of the second cubital cell although almost obsolete at its upper end; second and third sections of cubitus complete; nervulus strongly postfurcal; nervellus arising rather high up, the second discoidal cell open at apex. Radiellan vein in hind wing absent.

Type: from Cretaceous amber, Cedar Lake, Manitoba,

Canada; No. 46, Royal Ontario Museum of Mineralogy, Toronto.

From the general form of the body, legs, and wings, this species is evidently a member of this group and fits quite well in the genus *Neoblacus* which has already been found fossil in Baltic amber.

SUPERFAMILY SERPHOIDEA

SERPHITIDÆ Brues, n. fam.

Figure 5A

Abdomen petiolate, inserted at the apex of the propodeum slightly above the hind coxæ, the petiole composed of two slender joints and the gaster large, oval, composed of six segments; convex above; more or less flat below, with the tergites extending slightly inwards in ventral view to form a lateral carina on each side of the sternites. Fore wings with large stigma, the costa and subcosta separated, enclosing a well-developed costal cell. Antennæ 10-jointed, with long scape, pedicel and clavate flagellum; mandibles large, trifid. Prothorax short, scarcely visible from above; tegulæ present; mesonotum and scutellum separated by a deep groove; the axillæ small, widely separated. Trochanters probably one, possibly two-jointed; coxæ of moderate size, legs rather slender, the tarsi of the usual form. Wing venation considerably reduced; median and submedian cells closed, second discoidal open below; radius and cubitus indicated, but weak apically.

Type: *Serphites* n. gen.

Serphites Brues, n. gen.

Figure 5A

Head rather large, considerably broader than thick; eyes large, extending close to the base of the large mandibles; mandible on right side with three long curved teeth directed inwards, toward the median line; ocelli present. Antennæ inserted below the middle of the face, the scape not reaching

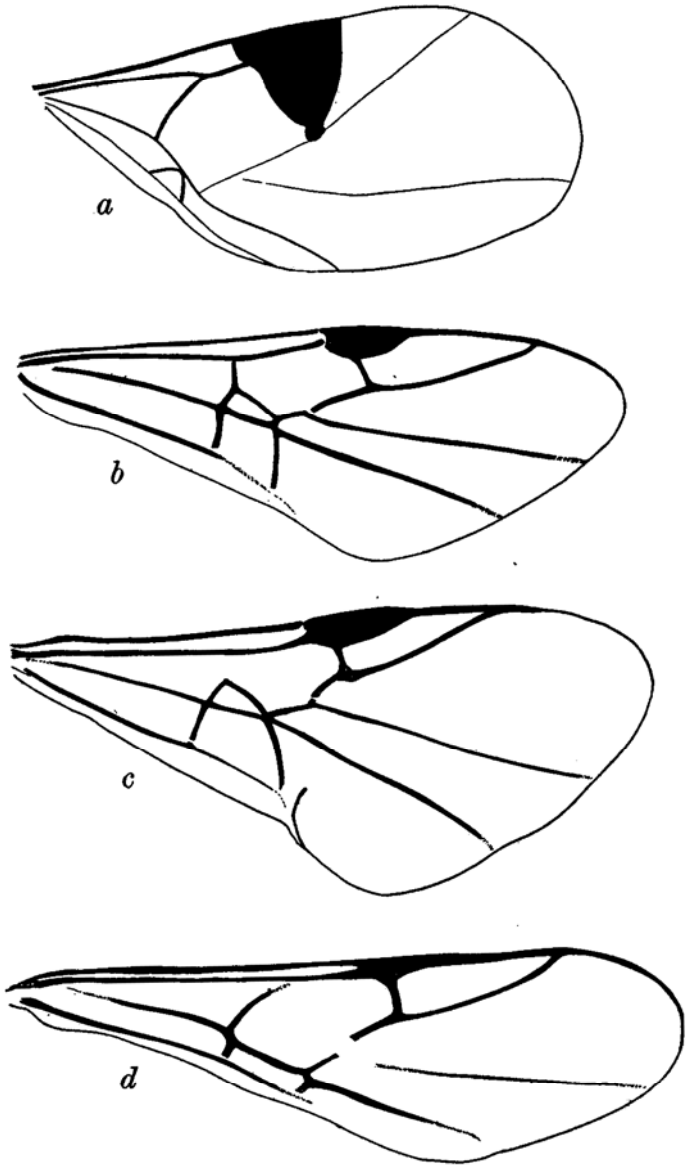

FIGURE 5.—A. *Serphites paradoxus* Brues, n. sp. Wing of type.
B. *Vanhornia aucnemidarum* Crawford, wing.
C. *Helorus anomalipes* Panzer, wing.
D. *Acanthoserphus albicoxa* Dodd, wing.

to the vertex; pedicel rather long, oval; flagellum gradually clavate. Mesonotum with complete, widely separated weakly impressed parapsidal furrows; scutellum large, elongate, strongly convex, with a deep crenate furrow at base. Propodeum evenly sloped behind, short and narrowed to apex. Abdominal petiole about as long as the width of the thorax; its first joint twice as long as the second, cylindrical, about one-fourth as wide as long, the second segment slightly curved downward toward the tip. Body of gaster about as long as, and slightly wider than, the thorax, its first segment rounded at base when seen from above, about as long as the second, third and following successively shorter, the last very small. Femora slightly thickened near the middle; middle and hind tibiæ with short, delicate spurs. Fore wing with large triangular stigma, the costal margin slightly shorter than either of the other two sides; costal vein slightly thicker than the subcostal; basal vein sharply bent at middle; submedian cell much longer than the median; first cubital and first discoidal cells fused; second discoidal open apically, the third discoidal open below; the costal, subcostal basal and median veins (except base and apex of latter) stout; other veins thin basally and very weakly indicated in the apical part of the wing; radial cell narrow and short, about as long as the stigma along the wing margin; radial vein straight weak, at its base with a small dark, rounded swelling which extends as a thick stub into the cubital area and presumably represents the upper end of the first intercubital vein. Hind wing apparently with a submarginal and basal vein, enclosing a cell, but without radiellan vein.

Type: *S. paradoxus* n. sp.

Serphites paradoxus Brues, n. sp.

Figure 5A

♂. Length 1.2 mm. Apparently uniformly black or dark coloured, with hyaline wings, the antennæ possibly lighter brown or yellowish; middle and hind legs yellowish on the trochanters, the knees, the tibiæ and tarsi. Sculpture

of face and front obscured in the type; mesonotum and scutellum shagreened; abdomen smooth, the genitalia extruded as a small quadrangular projection in vertical view, no conspicuous valves.

Type: from Cretaceous amber, Cedar Lake, Manitoba, Canada; No. 7. A second specimen, No. 71, shows only the thorax, legs, and abdomen. Both specimens are in the Royal Ontario Museum of Mineralogy, Toronto.

The type specimen is fairly well preserved and shows very clearly the form of the antennæ, mandibles, thorax, wings, legs, and abdomen. These parts exhibit several discordant characters and peculiarities that are utterly impossible to reconcile with any modern family of Hymenoptera. The wing venation is much reduced, even near the base of the wing. Aside from the stigma, it resembles more or less closely that of *Brachygaster* of the family Evaniidæ except that the apical veins are less completely atrophied. This similarity is probably not of much significance on account of the tendency noticeable in many insects with simplified venation whereby particular veins tend to disappear earlier than others and produce similar patterns which have no common phyletic origin. The large, triangular stigma at once recalls the genus *Serphus* and its allies but this alone undoubtedly indicates no relationship as it is not a general character of the group. Other serphoid characters of definite nature are lacking, however, in the wing, although there seems to be nothing there to exclude it from that group. The longer pointed radial cell occurs in even more elongate form in the Australian genus *Acanthoserphus* of the family Serphidæ. As no figure of the wing of this genus has been published, one is here included (figure 5D). In wing venation *Acanthoserphus* shows also a great similarity to *Ropronia*, *Helorus* (figure 5C), and *Vanhornia* (figure 5B), representatives of the three other related families Roproniidæ, Heloridæ, and Vanhorniidæ, although its body structure is fundamentally that of *Serphus*. So far as the venation is concerned *Serphites* has the stigma and marginal cell and second discoidal cell nearest to that of *Acanthoserphus* or of *Austroserphus* another recently de-

scribed Australian genus. The petiolate abdomen, with its distinctly two-jointed pedicel, occurs among Hymenoptera only in ants, and there in its completely binodal form is characteristic of the highly specialized subfamily Myrmicinæ. Obviously there can be no significance to this similarity in the abdominal petiole as the general form is entirely different from that of any ant and, moreover, no other part of the body is in any way similar to the Formicidæ. The form of the head and its appendages is certainly not ant-like and among recent Hymenoptera finds its closest counterpart in the superfamily Chalcidoidea. In fact the shape of the head in front view, strong, tridentate mandible and antennæ would pass perfectly well for a pteromalid or other chalcid-fly. The same is in general true of the thorax and abdomen. Except for the fact that the petiole consists of two joints, the form of the abdomen is not dissimilar from that of the subfamily Sphegigastrinæ of the Pteromalidæ. The legs do not appear to offer any peculiarities which would suggest relation with any particular family or superfamily.

Thus, I have been unable to place this peculiar form satisfactorily in any family. I believe it should be regarded as a primitive, although degenerate form which shows in general, particularly in wing venation, the closest affinity with certain Serphoidea, especially *Helorus* (figure 5C), Acanthoserphus (figure 5D), and the otherwise rather different Families Vanhorniidæ (figure 5B) and Roproniidæ.[2] That these groups are old is evidenced by the presence of a perfectly typical genus of Heloridæ, *Mesohelorus*, described by Martynov from the Jurassic in Turkestan.[3]

There are, therefore, close similarities in venation between Serphites and several members of the superfamily Serphidæ and no good reasons for excluding the fossil from this group. The thorax is of a generalized type that would not be anomalous for almost any group of Clistogastra.

For the reasons set forth above, this insect has been made

[2]I have previously called attention to the close similarity between *Ropronia*, *Vanhornia*, and *Helorus* in Psyche, 34, 1927: 81.

[3]Bull. Acad. Sci., U.R.S.S., 1925: 758.

the type of a new family in the superfamily Serphoidea. Its relationship to the several more similar families of this group is not easily indicated.

I do not believe that it can possibly be associated with the peculiar Oligocene genus *Pelecinopteron* recently described by me from Baltic amber.[4] *Pelecinopteron* shows characters that lead one to think that it forms more or less of a transition between the Stephanidæ and the Pelecinidæ and Monomachidæ, but I can discern absolutely no stephanid-like characters in *Serphites* and if the latter furnishes any evidence on the origin of modern forms, it certainly does not in any way relate to the Pelecinidæ which would seem from the present state of our knowledge to bear little relationship to the Heloridæ and other serphoids. However, the many peculiarities of *Serphites* indicate that it is not very near to the line of descent of any living Hymenoptera.

FAMILY SCELIONIDÆ

Baryconus Förster

Baryconus fulleri Brues, n. sp.

♀. Length 1.4 mm. Apparently entirely black, with the wings hyaline, the wing venation moderately dark brown. Antennæ 12-jointed; scape long, slightly curved, extending well above the level of the vertex; pedicel obovate, with very narrow base, about one-half longer than its greatest thickness; first four joints of flagellum small, of about equal size and more or less moniliform, scarcely half as thick as the terminal club which includes six closely attached joints; the latter are of nearly equal length, the first slightly longer and rounded at the base and the last conically narrowed to tip, the middle four club-joints each fully one-half wider than long. Mesonotum rather flat, slightly shagreened, or at least dull; scutellum with a broad, deep, and apparently crenulate furrow at the base; its apex, and also the postscutellum rounded, simple, and without spines or projections. Abdomen not so very

[4]The Parasitic Hymenoptera of the Baltic Amber. Part I. Bernstein-Forschungen, Heft 3, 1933: 19.

clearly visible in dorsal view, apparently rather narrow at the base and seemingly with rather close-set longitudinal carinæ, at least toward the base of the first segment; body of abdomen elongate oval, shining and without distinct sculpture, at least near the sides, nearly twice as long as broad. From below, the abdomen is seen to be very strongly margined laterally, the third tergite very much longer than the others, longer than either the first and second combined, or the more apical ones taken together. Legs slender, of the usual form. Marginal vein short, about twice as long as thick, about half as long as the stigmal vein which is slender with a distinct knob at the tip.

Type: from Cretaceous amber, Cedar Lake, Manitoba, Canada; No. 51, Royal Ontario Museum of Mineralogy, Toronto.

This species is named in honour of Mr. Archie S. Fuller of Toronto, who collected a large part of the amber considered in this paper.

This species is certainly a true *Baryconus* or closely allied although certain details are not clearly to be made out in the specimen. There is no indication of a tubercle at the base of the abdomen and the lateral angles of the propodeum may be produced. However, such differences occur among the three subgenera of *Baryconus* that are recognized by Kieffer.

Proteroscelio Brues, n. gen.

Figure 6A

A member of the subfamily Scelioninæ, but differing from all described members of the Scelionidæ in having the antennæ 14-jointed. Head considerably flattened; seen from above it is nearly four times as broad as thick; much lengthened below, with the malar space about as long as the eyes. Eyes small, set at the sides of the head, the lower border angulate (at an angle of about 70°), upper border rounded; seen from above occupying the full thickness of the head; back of head flat, the occiput long as the head rises far above the occipital foramen; lateral ocelli rather close to the eyes. Antennæ

14-jointed, the scape reaching about to the vertex, distinctly flattened but not really widened; remainder of antennæ flattened, especially the pedicel and first two flagellar joints which form together with the rest of the flagellum a long, flattened club. Pronotum long, more or less neck-like; mesonotum and scutellum nearly flat, separated by a narrow groove; no parapsidal furrows. Abdomen elongate, fusiform; second tergite longest, but not greatly exceeding the others; lateral carina strong. Legs slender. Wings with the marginal, postmarginal, and stigmal veins well developed, also a weakly defined radial vein enclosing a narrow radial cell.

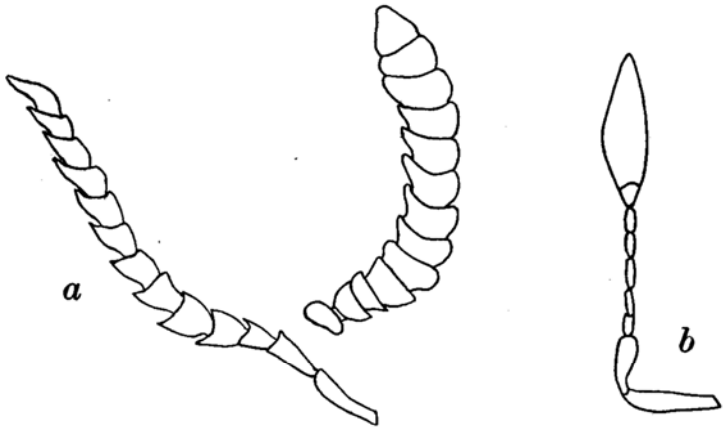

FIGURE 6.—A. *Proteroscelio antennalis* Brues, n. sp., antennæ.
B. *Bæomorpha dubitata* Brues, n. sp., antenna.

Type: *P. antennalis* n. sp.

Among living genera *Proteroscelio* resembles the remarkable Austromalayan genus *Platyscelio* somewhat in the form of the antennæ and in the less strongly flattened head and thorax, but it is much less highly modified.

Proteroscelio antennalis Brues, n. sp.

Figure 6A

♀. Length 1.5 mm. Apparently entirely dark coloured or black; wings hyaline with deep brown veins. Front and

vertex finely rugulose or shagreened, face and cheeks more smooth and shining; ocelli in a nearly equilateral triangle, the lateral ones closer to the eye than to one another. Pedicel of antennæ elongate, very slender at base, much flattened and widened apically where it is nearly as wide as long, but its thickness at apex is only about one-third its length; first flagellar joint shorter, of the same thickness and nearly as long as the pedicel; first flagellar joint wider and shorter; following broad, about one-half wider than long, last more or less conical; in side view the antennal club appears serrate as the third and following joints of the flagellum project tooth-like at the apical angle below. Thorax smooth or minutely punctulate above. Abdomen smooth both above and below.

Type: from Cretaceous amber, Cedar Lake, Manitoba, Canada; No. 56, Royal Ontario Museum of Mineralogy, Toronto. A photograph of this specimen was published by Walker, without name, as figure 2 on Plate 1 of his paper.[5]

This peculiar form differs from all living Scelionidæ in having fourteen joints in the antennæ instead of twelve or the lesser number which occurs in a few genera. There is, however, an undescribed species in Baltic amber with fourteen joints, but the latter is otherwise very different from the present form.

FAMILY SCELIONIDÆ (?)

Bæomorpha Brues, n. gen.

Figure 6B

Antennæ inserted high up on the face, far above the clypeus, set in slight broad depressions; arising at about the level of the middle of the eyes; consisting of eight joints and a solid, fusiform club which is more or less connate with the preceding (sixth) flagellar joint; no frontal ridge or prominence below the insertion of the antennæ, but there is apparently a short median carina between them. Head more or less rounded, the eyes oval, rather small; malar space long;

[5]Univ. Tor. Studies, Geol. Ser., no. 36, Contributions to Canadian Mineralogy 1934: Plate I, fig. 2.

mandibles apparently projecting forward, but their minute structure is not preserved. Abdomen short. Legs of typical scelionid type, rather slender. Wings ample, extending well beyond the abdomen; with the submarginal vein about one-third the length of the wing; marginal vein long, nearly as long as the submarginal, twice as long as the curved stigmal which is very slightly thickened at apex and gives off a spur representing the base of the radial vein extending toward the wing margin; this spur is distinctly curved, concave apically and behind; postmarginal vein thin, but distinctly defined, nearly twice as long as the marginal; basal vein strong, extending directly downwards from the base of the marginal vein.

Type: *B. dubitata* n. sp.

This insect has the habitus of a typical member of the subfamily Bæinæ of the Scelionidæ, but the insertion of the antennæ which shows very clearly in the type is entirely different from any known scelionid, as all the members of this family have the antennæ arising very low down on the head at the edge of the clypeus. In this respect it resembles the Diapriidæ and Belytidæ, except that in the latter groups there is always a transverse, elevated ridge or shelf just below the antennæ. On account of the consolidation of the apical antennal joints into an unsegmented club, the number of joints in the complete antenna cannot be stated; however, by reflected light two indistinct sutures appear on the club in addition to six clearly defined flagellar joints which would make a total of eleven joints in the antennæ. In all described Bæinæ there are only four free flagellar joints in addition to the completely fused club in the female, although the male has the 12-joints characteristic of most Scelionidæ. So far as wing venation is concerned, *Bæomorpha* might fall in the subfamily Teleasinæ on account of the long marginal vein, or in the Scelioninæ by reason of the long postmarginal. It is therefore an extremely anomalous form.

Bæomorpha dubitata Brues, n. sp.

Figure 6B

♀. Length 0.6 mm. Apparent colour: head and antennæ black; thorax in great part pale brownish or yellowish;

abdomen with some yellowish at sides, base and apex; legs black; wings hyaline. Antennal scape short, not reaching quite to the vertex; pedicel obovate, much thicker and more than half as long as the scape; first five flagellar joints very small, distinctly longer than wide, and of subequal length; sixth flagellar joint of the same length, but broader and quite closely fitted to the club which is as long as the five preceding joints together.

Type: from Cretaceous amber, Cedar Lake, Manitoba, Canada; No. 37, Royal Ontario Museum of Mineralogy, Toronto.

FAMILY CALLICERATIDÆ

Lygocerus Förster

Lygocerus (?) **dubitatus** Brues, n. sp.

♀. Length 0.9 mm. Black or very dark coloured, the legs apparently more or less pale basally; wings considerably infuscated, the large stigma dark brown. Head nearly twice as wide as thick in dorsal view. Antennæ 10-jointed, distinctly enlarged near the middle and then tapered to a point apically; scape extending only about halfway to the vertex from its insertion near the lower margin of the face; pedicel one-half longer than wide, much expanded apically, with the apical corner triangularly produced on one side; first flagellar joint short; very strongly transverse, with one apical corner acutely produced; second and third joints increasingly larger and with the produced corner less acute; joints four to seven cylindrical, each about as long as thick, eighth (terminal) joint more slender, pointed, more than twice as long as thick. Surface of head and thorax above apparently smooth and polished. Wings with the stigma very large, twice as long as wide, its lower margin evenly curved; marginal vein weakly curved, reaching the margin of the wing; the marginal cell one-half longer than the stigma.

Type: from Cretaceous amber, Cedar Lake, Manitoba, Canada; No. 69, Royal Ontario Museum of Mineralogy, Toronto.

This species is undoubtedly very similar to the large modern genus *Lygocerus*, but as the female antennæ are 10-jointed as in certain other genera with linear stigma, its position here is questionable, as the antennæ are uniformly 11-jointed in *Lygocerus* and related genera. As the type is not so perfectly preserved as might be wished, I have hesitated to propose a new generic name.

SUPERFAMILY CHALCIDOIDEA

FAMILY MYMARIDÆ

Ooctonus Haliday

Ooctonus (?) **minutissimus** Brues, n. sp.

♀. Length 0.4 mm. Apparently entirely dark, the wings hyaline. Antennæ 10-jointed, the club one-jointed; pedicel nearly half the length of the scape, pedunculate at base, greatly widened apically and several times as thick as the basal flagellar joints; these are all slender except the last two before the club which are gradually broader, the last submoniliform; club elongate oval, three times as long as thick, obtusely pointed at tip. Wings strongly widened apically, the submarginal hairs at least as long as the width of the wing in front and those that extend from the posterior border considerably longer.

Type: from Cretaceous amber, Cedar Lake, Manitoba, Canada; No. 54, Royal Ontario Museum of Mineralogy, Toronto.

This is an extremely minute species, which although very well preserved is very difficult to study. The antennæ appear to be 10-jointed, but as they are slightly shrivelled near the base of the flagellum, nine may perhaps be the correct number. Otherwise the species fits very well in *Ooctonus*.

ORDER DIPTERA

FAMILY CHIRONOMIDÆ

By M. W. BOESEL

With a single possible exception, all the fossil Chironomids which have been described and given specific names have come

to light within the last one hundred years. It was not until 1904 that Meunier published his extensive work on the Baltic amber midges and other Diptera, and this was followed in 1916 with a supplementary work.[1] Of the 119 fossil midges named specifically to date, 85 are from the rich Baltic amber of the early Oligocene and of these Meunier has named 77. Naturally enough, 105 species have been described from the Palearctic whereas only four have been recorded from the Nearctic. There are seven Ethiopian species and one each for the Neotropical, Oriental, and Australian regions. Of the four North American forms, three were described by Scudder (1890) from the Eocene (Green River) and one by Cockerell (1916) from the Miocene (Florissant).[2] The foregoing discussion does not take into account the fact that some of the above species are probably not Chironomids.

Compared with the Baltic amber fauna, the Cretaceous species described below present little variety, being mostly Ceratopogoninæ. The three non-biting species all belong to the Orthocladiinæ. In the Baltic amber the latter subfamily constitutes over one-third of the described species, the Chironominæ and Ceratopogoninæ each about one-fourth, and the Tanypodinæ nearly one-tenth. In all probability when a larger series of Chironomids from the Cretaceous amber has been studied a more diversified fauna will be found. The chief significance of the present collection of fossil midges is that it comprises some of the oldest known members of the family.

The writer wishes to express his indebtedness to Dr. O. A. Johannsen of Cornell University for a list of generic determinations covering this series of amber Chironomidæ.

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[1]Meunier, Fernand. 1904. Monographie des Cecidomyidæ, des Sciaridæ, des Mycetophilidæ et des Chironomidæ de l'ambre de la Baltique. Ann. Soc. Scient. de Bruxelles 28: 12-275.

————————————1916. Sur quelques dipteres (Bombylidæ, Leptidæ, Dolichopodidæ, Conopidæ et Chironomidæ) de l'ambre de la Baltique. Tijdschr. Ent. 59: 274-286.

[2]Cockerell, T. D. A. 1916. Some American Fossil Insects. Proc. U.S. Nat. Mus., 51: 89-106.

Scudder, S. H. 1890. The Tertiary Insects of North America. Rept. U.S. Geol. Surv., 13: 1-734.

SUBFAMILY CERATOPOGONINÆ

Lasiohelea Kieffer

Lasiohelea cretea Boesel, n. sp.

Figures 7A, 7F, and 8

Female. Head with numerous hairs about one-third to one-half as long as width of head. Antennæ with second segment subapically attached to first (figure 7A); segments 2 to 9 wider than long, 10 to 14 longer than wide; terminal

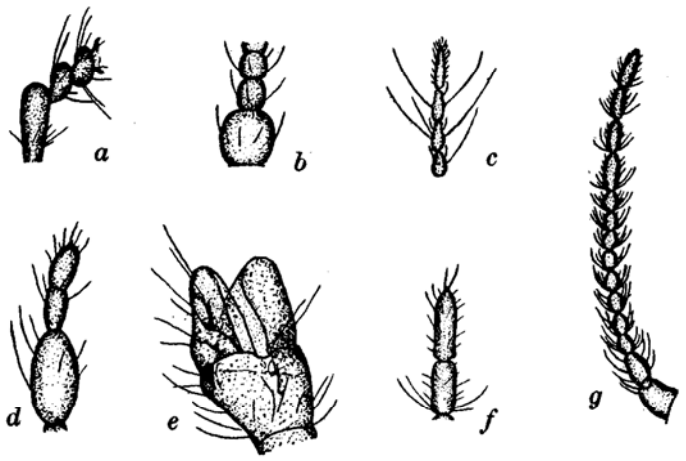

FIGURE 7.—A. *Lasiohelea cretea* Boesel, n. sp., female, basal segments of antenna.
B. *Lasiohelea globosa* Boesel, n. sp., female, basal segments of antenna.
C. *Metriocnemus cretatus* Boesel, n. sp., female terminal segments of antenna.
D. *Lasiohelea globosa* Boesel, n. sp., female, terminal segments of palp.
E. *Spaniotoma conservata* Boesel, n. sp., male, hypopygium in dorso-lateral view.
F. *Lasiohelea cretea* Boesel, n. sp., female, terminal segments of antenna.
G. *Protoculicoides depressus* Boesel, n. sp., female, antenna.

segment not distinctly enlarged or thickened (figure 7F). Relative lengths of antennal segments from base to tip, 77: 33: 25: 21: 22: 23: 28: 29: 60: 65: 62: 55: 75. Antennal style short, indistinct. (Some of the antennal segments in a

paratype are swollen but it is significant that the enlargements on the right antenna do not agree with those on the left.) Palps apparently 4-segmented with second segment longest and somewhat thickened; third segment very short, about half as long as fourth. Thorax moderately hairy. Tibio-tarsal proportions of foreleg, 30: 19: 9: 6: 6: 5: of midleg, 40: 17: 10: 5: 5: 4: of hindleg, 35: 22: 10: 6: 5: 5. Wing as in figure 8A; microtrichia covering entire surface. Total length, 1.4 mm.

Specimens: holotype, female; No. 36, paratype, female; No. 4, Royal Ontario Museum of Mineralogy, Toronto.

Lasiohelea globosa Boesel, n. sp

Figures 7B and 7D

Female. Head with short hairs. Antennæ 14-segmented; second segment attached apically to first, which is globose (figure 7B); terminal joint in the only available specimen enlarged but probably not naturally so. Relative length of antennal segments from base to tip approximately as follows: 60: 35: 30: 30: 32: 30: 33: 30: 65: 50: 60: ?: ?. Terminal joints apparently about as long as the three preceding but difficult to measure accurately. Second segment of palp distinctly enlarged and twice as long as each of the succeeding segments (figure 7D). Thorax hairy. Tibio-tarsal proportions of foreleg, 45: 23: 12: 9: 6: 7; of midleg, 52: 25: 11: 7: 6: 6; of hindleg, 48: 32: 13: 8: 7: 6. Wing (which is slightly imperfect) very similar to that of *L. cretea* except for the following details: the basal portion of the anterior margin is hairy; there is no apparent "break" in the anterior margin just distad of the end of costa. Total length, 1.7 mm.

Specimen: holotype, female; No. 47, Royal Ontario Museum of Mineralogy, Toronto.

Atrichopogon Kieffer

Atrichopogon canadensis Boesel, n. sp.

Figure 8B

Female. Antennæ slender with approximate proportions of segments 2 to 14 as follows: 4: 3.5: 4: 3.5: 3.5: 3.5: 3.5:

4: 4.5: 6.5: 6: 5.5: 8.5; maximum diameter of these segments, 2. No antennal style evident. Palps with segments in approximately the following proportions: 3: 6: 2: 2; second segment distinctly swollen. Tarsal claws apparently uncleft. Tibio-tarsal proportions of midleg, 40: 22: 8: 5: 4: 4. Wing as shown in figure 8B: microtrichia covering entire

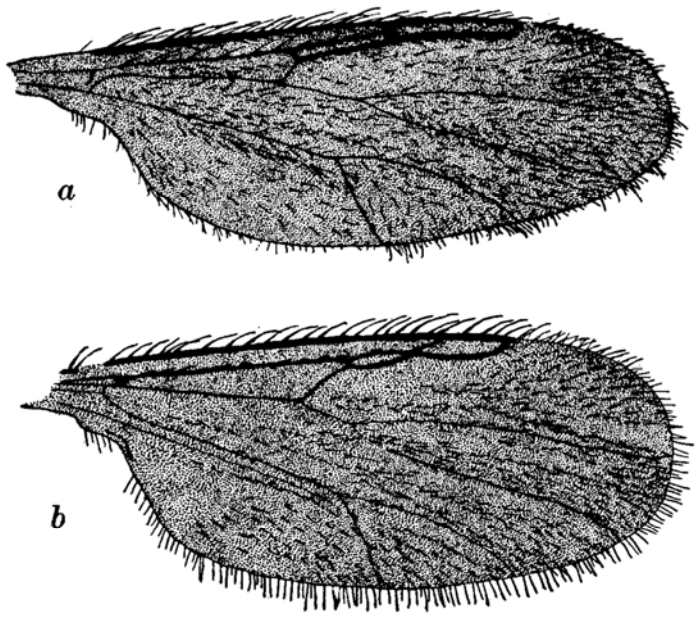

FIGURE 8.—A. *Lasiohelea cretea* Boesel, n. sp., female, wing.
B. *Atrichopogon canadensis* Boesel, n. sp., female, wing.

surface; macrotrichia numerous, except proximally. Total length, 1.7 mm.

Specimen: holotype, female; No. 35, Royal Ontario Museum of Mineralogy, Toronto.

Dasyhelea Kieffer

Dasyhelea tyrrelli Boesel, n. sp.

Figure 11A

Male. Eyes apparently base. Second joint of antenna over twice as long as wide; segments 3 to 8 about as long as

wide; segments 10 and 11 slightly longer; segments 12 and 13 flask-shaped with a circlet of about 10 hairs around the bulge at the base; segment 14 wider than the several preceding segments, pointed apically and covered with short hairs but lacking circlet of large hairs; relative lengths of last four segments, 4.5: 10.5: 8: 8. The antennæ of the specimen at hand are not in perfect condition and the exact nature of segment 9 is doubtful. Antepenultimate segment of palp nearly as long as penultimate and last segments combined. Wing as in figure 11A, microtrichia covering entire surface. The veins in all except the base of the wing are exceedingly vague. The anterior veins in the figure are shown as much more distinct than is warranted by the type specimen. The base of the wing, which is best preserved, indicates, however, that the anterior veins were originally very distinct. Furthermore, loose hairs in the amber indicate that many hairs of the wing were lost. In the unfigured wing of the other side of the type, the fringe hairs on the anal angle are hardly longer than are those at other points along the posterior margin of the wing. Proportions of segments of midleg, 40: 21: 9: 4: 4.5. Abdomen turned ventrally in type so as to make any details exceedingly obscure. Total length, about 1.5 mm. Length of wing, 1.1 mm.

Specimen: holotype, male; No. 28, Royal Ontario Museum of Mineralogy, Toronto.

Ceratopogon Meigen

Ceratopogon aquilonius Boesel, n. sp.

Figure 9A

Female. Antennæ slender, composed of 14 segments, as long as combined length of head and thorax. Basal segment about three times as wide as second segment. All segments longer than wide. Proportions of antennal segments, 8: 4: 3.5: 3: 3.2: 3.5: 4: 3.5: 3.5: 3: 3: 3.5: 4.5: 5.2. Terminal segment of palp at least twice as long as preceding, but slightly shorter than antepenultimate segment. Wing as in figure 9A.

Legs and abdomen in exceedingly poor position for observation. Total length, about 0.8 mm.

Specimen: holotype, female; No. 61, Royal Ontario Museum of Mineralogy, Toronto.

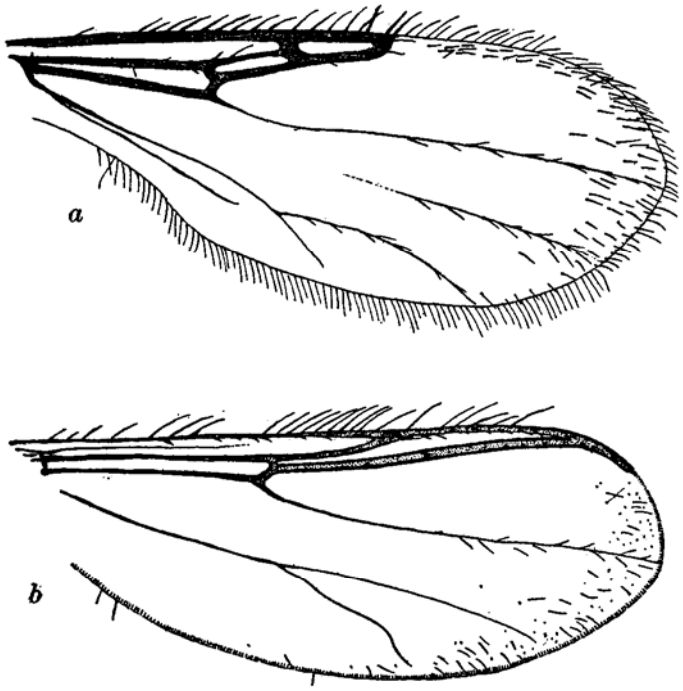

FIGURE 9.—A. *Ceratopogon aquilonius* Boesel, n. sp., female, wing.
B. *Metriocnemus cretatus* Boesel, n. sp., female, wing.

Protoculicoides Boesel, n. gen.

Eyes bare. Antennæ of female with segments 3 to 10 short, 11 to 14 cylindrical. Humeral pits present. Wings with microtrichia present over entire surface; macrotrichia absent on wing membrane; radius extending distinctly beyond middle of wing. Empodia apparently lacking; tarsal claws of female equal; hind femora not very noticeably larger than fore and mid femora.

Genotype: *P. depressus* n. sp.

This genus seems to be closely related to the modern *Culicoides* as indicated especially by the very evident humeral pits. As regards the radius it is distinctly more primitive than *Culicoides*: R_{4+5} ends about midway between R_1 and M_{1+2}, causing the second radial cell to be sharp apically rather than blunt; in *Culicoides* R_{4+5} ends nearer R_1, usually not far from the middle of the anterior wing-margin and the second radial cell appears blunt apically. It is not to be inferred, however, that this genus is directly ancestral to *Culicoides*. The extremely depressed nature of the thorax and abdomen (if this is natural), the absence of subcosta, and perhaps other features seem to be marks of specialization.

Protoculicoides depressus Boesel, n. sp.

Figures 7G and 11B

Female. Head about twice as wide as long. Antennæ 14-segmented; segments 3 to 10 short, 11 to 14 elongate, as in figure 7G; second segment joined subapically to first. Thorax depressed; mesonotum only slightly convex, lateral margins flaring, slightly raised; area anterior to scutellum depressed. Humeral pits distinct, parallel with anterior mesonotal margin. Approximate tibio-tarsal proportions as follows: foreleg, 60: 25: 10: 8: 7: 9; midleg, 55: 30: 13: 10: 7: 7. Tarsal proportions of hindleg, 33: 14: 8: 7: 7. (Difficulties in making these measurements have made them somewhat doubtful.) Tarsal claws on all legs equal. Wing as in figure 11B: microtrichia present over entire surface; macrotrichia confined to costa, radius, and the wing margin. Anal area of wing and part of cubitus not clear in the single available specimen. Abdomen extremely depressed. (The flattened nature of the thorax and abdomen may not be natural.) Total length, 2.2 mm.

Specimen: holotype, female; No. 6, Royal Ontario Museum of Mineralogy, Toronto.

SUBFAMILY ORTHOCLADIINÆ

Metriocnemus van der Wulp

Metriocnemus cretatus Boesel, n. sp.

Figures 7C and 9B

Female. Antennæ apparently 6-segmented, with last four segments as shown in figure 7C. Tibio-tarsal proportions approximately as follows: foreleg, 33: 19: 12: 9: 4; midleg, 35: 12: 7: 5: 4: 4; hindleg, 34: 19: 11: 9: 4: 4. Wing as in figure 9B: hairs evidently once present on R_1, R_{3+4}, and along nearly the entire length of costa; fringe of hairs on wing margin also almost entirely absent although undoubtedly present originally. Length of wing, 1 mm. Almost entire abdomen of holotype absent.

In the paratype, the palps are apparently 4-segmented. The fringe of the wing is fairly complete, the hairs on the posterior margin being at least 1½ times as long as those along the costa but more slender; one particularly long hair originates in the margin below the posterior arculus and extends parallel with the wing margin among the fringe hairs to a point in the margin about opposite crossvein *r-m*; squama with a few short hairs. This specimen has macrotrichia along the branches of *M* near the wing-apex but none on the wing-membrane. Total length of paratype, 0.8 mm.

Specimens: holotype, female; No. 59 (two specimens on slide; the specimen with three complete legs is the holotype; the second very incomplete specimen on the slide seems to belong to the same species but is not included in the type series), paratype, female; No. 13, Royal Ontario Museum of Mineralogy, Toronto.

Spaniotoma Philippi

Spaniotoma conservata Boesel, n. sp.

Figures 7E and 10B

Male. Eyes minutely hairy. Palps very long and slender (poorly preserved); proportions of last three segments about 9: 9: 11. Dorso-central thoracic hairs suberect. Tibio-tarsal ratios as follows: foreleg, 60: 33: 23: 15: 7: 6; midleg,

58: 26: 10: 9: 5: 5; hindleg, 60: 35: 19: 14: 9: 8. Wing as in figure 10B. Hypopygium shown in figure 7E. Total length, 1.8 mm.

Female. Proportions of antennal segments as follows: 6: 6: 6: 5: 7. First four segments with whorl of about 5 hairs nearly twice as long as the antennal segments; the basal segment with an additional partial whorl near its base; terminal (fifth) segment with scattered short hairs. Wing

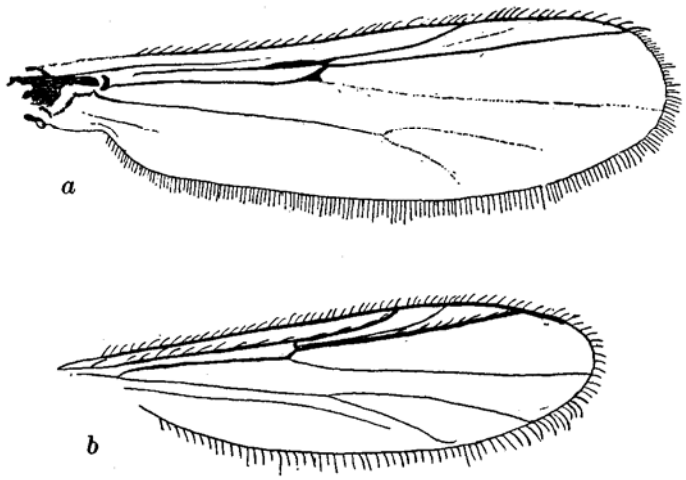

FIGURE 10.—A. *Spaniotoma* (*Smittia*) *veta* Boesel, n. sp., male, wing.
B. *Spaniotoma conservata* Boesel, n. sp., male, wing.

similar to that of male but broader; R_{2+3} almost straight; R_{4+5} toward the tip curving gracefully posteriorly and meeting *C* nearer the wing-apex; *C* produced nearly to the apex. Total length, 1.3 mm.

Specimens: holotype, male; No. 31, allotype, female; No. 31, Royal Ontario Museum of Mineralogy, Toronto.

Spaniotoma (Smittia) veta Boesel, n. sp.

Figure 10A

Male. Length of longest antennal plumes about equal to width of head. Terminal segment of antenna of same dia-

meter as others. Eyes apparently bare. Palps elongate, slender, not clearly visible in holotype. Wing as in figure 10A, with a distinct thickening of *R* near *fR* and of *r* especially at its point of union with *M*. Ends of media and cubitus very indistinct. No microtrichia present. Tibio-tarsal proportions approximately as follows: foreleg, 35: 25: 19: 16: 11: 6; midleg, 32: 16: 7: 5: 4: 4. Fourth tarsal segment of hindleg

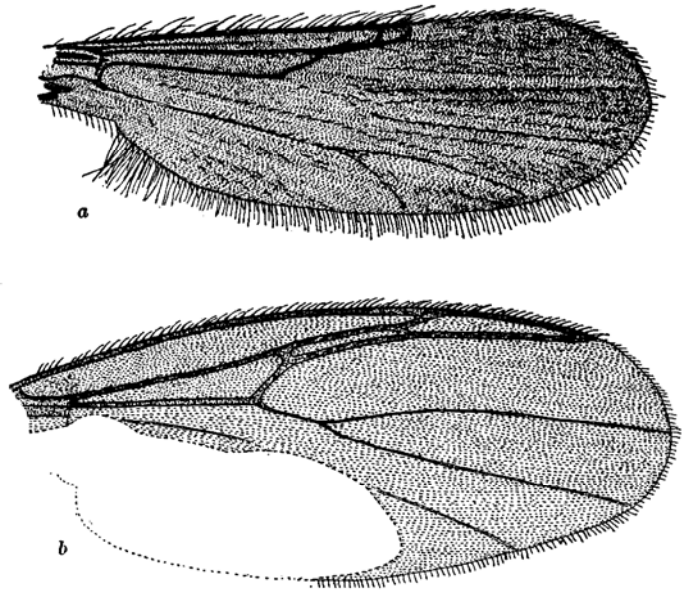

FIGURE 11.—A. *Dasyhelea tyrrelli* Boesel, n. sp., male, wing.
B. *Protoculicoides depressus* Boesel, n. sp., female, wing. (Details of anal area not shown.)

cylindrical, slightly longer than fifth. Eighth abdominal segment slightly more than twice as wide at apex as at base; spur apparently slender and well-developed. Total length, 1.3 mm.

A rather incomplete male specimen has so many features in common with the holotype that I am regarding it as a paratype. The venation at the base of the wing especially coincides with that of the type. The last three segments of

the palp have proportions about as follows: 2.5: 5: 9. The wing differs from that of the holotype as follows: the thickenings of *R* and *r* are not evident; subcosta extends to near wing margin about as far from R_1 as R_1 is from R_{2+3}; the tips of media and of cubitus are more distinct.

Specimens: holotype, male; No. 45, paratype, male; No. 68, Royal Ontario Museum of Mineralogy, Toronto.

ARACHNIDA

ORDER ACARINA

By H. E. Ewing[1]

Two species of mites have been found in the Cretaceous amber from Canada, one being a new species of *Bdella* (family Bdellidæ) and the other a larva of an undetermined genus of Erythræidæ.

Among the fossil arachnids described in the past the mites have been well represented, but not before the Tertiary Period. Apparently the only species to be described for an earlier period is *Protacarus crani* Hirst. This species was described in 1923 from Rhynie Chert (Devonian).[2] It belongs to the family Eupodidæ, a family regarded by some as the most generalized of all those of the order Acarina.

It is of interest to note that the two species of mites described in this paper belong to families abundantly represented by living species and that the three families represented by the oldest known fossil mites all belong to the suborder Prostigmata.

Most of the described fossil mites have come from amber[3]

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[1]Bur. Entomology and Plant Quarantine, U.S. Dept. Agr.

[2]Hirst, S. 1923. On Some Arachnid Remains from the Old Red Sandstone (Rhynie Chert Bed, Aberdeenshire). Ann. & Mag. Nat. Hist., ser. 9, 12: 455-474, text figs. 1-13, Pls. XI-XV.

[3]Karsch, F. 1884. Neue Milben in Bernstein. Berl. Ent. Zeitsch., Bd. 28, Heft 1, s. 175-176, figs. 1-3.

Koch, C. L. and Berendt, G. C. 1854. Die im Bernstein befindlichen Crustaceen, Myriapoden, Arachniden und Apteren der Vorwelt. From Die im Bernstein befindlichen Organischen Reste der Vorwelt, Bd. 1, Abt. 2, 124 s., 17 tab.

Sellnick, M. 1918. Die Oribatiden der Bernstein-sammlung der Universität Königsberg i. Pr. Schr. Physiköhonom Gesells. Königsberg i Pr., Jahrg. 59, s. 21-42, 23 text figs., 1 T.

————————1931. Milben im Bernstein. Bernstein-Forschungen (Berlin und Leipzig), Heft 2, s. 148-180, figs. 1-39.

(Koch and Berendt, 1854; Karsch, 1884; Sellnick, 1918, 1931; and others) but of a later date than those described in this paper. They belong for the most part to the suborder Cryptostigmata, or beetle mites. Scudder[4] (1890) described from the Green River beds of Wyoming (Tertiary) a fossil arachnid as *Ixodes tertiarius*. Commenting on this fossil he says, "Its size makes it tolerably evident that it belongs to the Ixodidæ." The length given by Scudder is 3.5 mm. It is very doubtful if this fossil represents a tick. We have several living mite species in the United States that are longer than it is. However, to the present writer, the description and figure given by Scudder suggest a primitive phalangid (Cyphophthalmi) rather than either a tick or a mite.

A few species of the genus *Bdella* have been described from European amber deposits. One of these, *Bdella lata* Koch and Berendt, 1854, belongs to the genus *Scirus* according to our present classification. Two of the others are said to have conspicuous markings on the back, thus differing from the species described in this paper. Another species is so inadequately described that it is impossible to recognize it.

In 1909 the present writer described[5] as *Bdella lata* a living mite species from Illinois. As this name is preoccupied by *Bdella lata* Koch and Berendt just mentioned, the name *Bdella recens* is here suggested to take its place.

The specimen of the genus *Bdella* in the Cretaceous amber rests with its dorsal side nearest the ground surface. The appendages are spread out much as they would be in a resting position. The tarsal claws and pulvillus of each leg, except for the second left leg, can be easily seen and are in good condition. The sutures between the segments of the palpi and the legs are easily detected. The eyes are well preserved on the left side but cannot be seen on the right. All of the larger setæ are represented on one or both sides. Some

[4]Scudder, S. H. 1890. The Tertiary Insects of North America. Rept. U.S. Geol. Surv., 13: 1-734, 28 pls.

[5]Ewing, H. E. 1909b. A Systematic and Biological Study of the Acarina of Illinois. Univ. Ill. Bull., vol. 7, no. 14 (Univ. Studies, vol. 3, no. 6): 1-120, 6 text figs., 8 pls.

structures cannot be made out. Thus most of the smaller setæ of the appendages cannot be detected. Also the groove between the beak and the rest of the cephalothorax and that between the latter and the abdomen cannot be observed because of the opacity of the body itself. The plumose setæ on the tarsi are not visible. The new species of *Bdella* is here described.

Bdella vetusta Ewing, n. sp.

Figure 12

Beak long, slender, reaching to tip of segment III of palpus, slightly swollen near base; median groove not visible; only a single pair of setæ detected, each seta of which is situated laterally at about one-third the distance from tip to base of beak.

Palpi reaching beyond beak by about one-third their length; segment I slightly broader than long; segment II about equal in length to all other segments taken together and bearing a small dorsolateral seta near its base; segment III very short, but longer than broad; segment IV slightly shorter and slightly narrower than III; last segment about equal in length to III and IV taken together, and bearing distally two tactile setæ, the outer being twice as long as the inner and equal in length to segments II, III, and IV taken together.

Cephalothorax as broad as broadest part of abdomen; eyes two on each side, submarginal, equal, situated about diameter of either from each other; rostral setæ slightly curved, about as long as femur I; posterior dorsal setæ very large, equal in length to last three segments of leg I taken together.

Abdomen long, fully twice as long as greatest width, broadly rounded behind, and bearing at least four pairs of posterior marginal setæ, the inner of which is longest. Other abdominal setæ not observed, although they must originally have been present.

Legs slender, posterior pair longest. Tarsus I slightly longer than tibia; tibia I about one and one-half times as long as patella I. Tarsus IV long, slender, longest of all tarsi;

tibia IV very much shorter than tarsus IV; patella IV about two-thirds as long as tibia IV. Most of setæ of legs not detected. Claws and pulvillus of each leg as shown in figure. Total length, 0.665 mm.; greatest width, 0.215 mm.

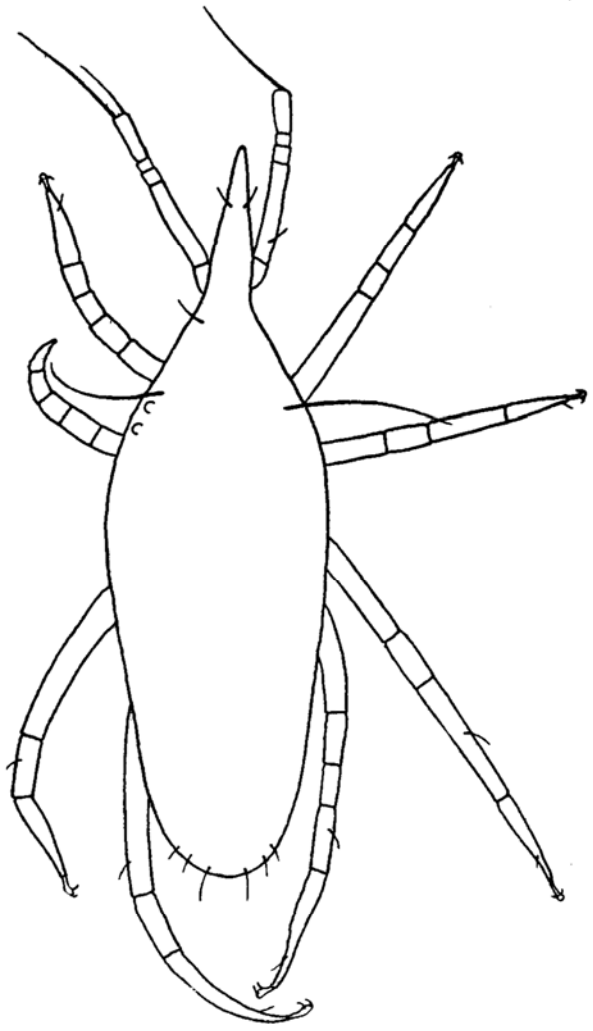

FIGURE 12.—*Bdella vetusta* Ewing, n. sp. Drawing of type.

Holotype: Royal Ontario Museum of Mineralogy, Toronto.
Type locality: Cedar Lake, Manitoba, Canada.

Remarks: *Bdella vetusta* is very closely related to two living species of *Bdella* described some years ago by the writer. One of these, *Bdella muscorum* Ewing, 1909, has two varieties.[6] The type variety was collected by the writer in moss at Muncie, Illinois. The other variety, *B. m. minnesotensis* Ewing, was described in 1913.[7] It was taken in Minnesota (situation unknown) by the late Professor J. E. Guthrie. The second species to which *Bdella vetusta* is very closely related is *Bdella subnigra* Ewing, 1909. It was collected by the writer in moss at Mahomet, Illinois.

Bdella vetusta differs from *B. m. muscorum* in being much smaller, in having the last segment of the palpus but slightly widened distally, instead of being markedly widened, and in having segment II of the palpus much shorter in relation to the other segments than it is in *B. m. muscorum*. From *Bdella muscorum* v. *minnesotensis*, *B. vetusta* differs in being smaller and in having longer tactile setæ on the tip of the palpus. From *Bdella subnigra*, *B. vetusta* differs in being much smaller and more slender, and in having the last segment of the palpus shorter in proportion to the other segments.

In the following table measurements are given of these four closely related forms.

	B. muscorum	*B. m. minnesotensis*	*B. subnigra*	*B. vetusta*
Length of beak	0.245 mm.	0.235 mm.	0.235 mm.	0.175 mm.
Length of body without beak	0.645 mm.	0.625 mm.	0.670 mm.	0.490 mm.
Total length of body and beak	0.890 mm.	0.860 mm.	0.905 mm.	0.665 mm.
Greatest width of body	0.315 mm.	0.380 mm.	0.385 mm.	0.215 mm.

The specimen of *B. vetusta* may be immature. If so, the increased size of the adult would bring it very near to *Bdella subnigra*.

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[6]Ewing, H. E. 1909a. Three New Species of the Genus Bdella. Can. Ent., 41: 122-126, Pl. VI.

[7]Ewing, H. E. 1913. New Acarina, Pt. I. Bull. Amer. Mus. Nat. Hist., 32, art. 5: 93-121, text figs. 1-9, Pls. VII-VIII.

LARVAL MITE

(Family Erythraeidæ; genus unknown)

The larval mite mentioned earlier in the paper rests in a doubled-up position and must be studied in a side view. Thus the characters of the dorsal plate and the mouth-parts cannot be studied properly. In fact, the former cannot be seen.

Beak swollen at base. Palpus slightly longer than beak; segment I not longer than broad; segment II about one and one-half times as long as broad, curved upward; segment III slightly arched, equal in length to all other segments taken together; segment IV almost half as long as III and ending in a slender, downwardly curved, bifurcate claw; segment V (thumb) short, swollen. Abdomen rather small, slightly swollen (probably due to partial engorgement at time of death); studded dorsally with prominent, simple, almost straight, spinelike setæ. Dorsal plate and eyes not visible. Legs very slender and similar. Each tarsus swollen near base, attenuated distally and bearing two lateral, strongly-curved, sharp, simple, subequal claws and a single middle claw much more slender and somewhat longer than lateral ones. Tarsus I slightly shorter than tibia I; tibia I about one and one-half times as long as patella I; patella I subequal to femur I.

Length of beak, 0.140 mm.; length of abdomen, 0.335 mm.; total length of body + beak, 0.475 mm.; greatest thickness of body, 0.145 mm.

Specimen number: No. 8, Royal Ontario Museum of Mineralogy, Toronto.

Remarks: Some workers might place this larval mite in the genus Erythraeus Latreille. It has the palpal characters of *Erythraeus*,—slender segments, very short thumb, slender bifurcate palpal claw, *etc.*, but differs from species of *Erythraeus* in having both lateral tarsal claws simple, instead of one of them being pectinate. Eventually it may be possible to place this specimen to genus, but at present our knowledge of the larval forms of the Erythraeidæ is not sufficient.

The somewhat swollen condition of the abdomen of this specimen indicates that it had attached and fed upon some arthropod host. It probably became detached from its host when the latter was caught in the liquid amber. The head and legs of a midge-like fly of the suborder Nematocera are imbedded in the amber deeper down below the mite. This dipteron seems too small to have been the host of the larval mite.