Danmarks geologiske Undersøgelse.
II. Række. Nr. 37.

Eocene Insects from Denmark.

By.

Kai L. Henriksen.

København.
I Kommission hos C. A. Reitzel.
Trykt hos Andelsbogtrykkeriet i Odense.
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CONTENTS.

Introduction.

The insect material from the Eocene deposits of Denmark which I have had for examination, and which will be treated on the following pages, comprises — to the best of my knowledge — all insect finds procured from the Eocene deposits of Denmark. All the finds originate from the lower Eocene Diatom-earth bed occupying a limited territory round the western part of Limfjorden in northern Jutland. With a single exception (Rhamphidia sp. which has been found in »Moler« (Diatom-earth proper) the rock from which all the finds have been produced is the hard, chalky »Cementsten« (cement-stone)[1]) in which the impressions keep better than in the soft, loose Diatom-earth.

Only few insects have been previously mentioned in the literature as originating from the Eocene deposits of Denmark, and then only in a few phrases or remarks.

The first author who speaks about them is WILSE who records »en Kalkskiver, hvori en Libellula fandtes indtrykt« from Fuur, in his Reise-Iagttagelser i nogle af de nordiske Lande V. 1798 p. 240.

Further FORCHHAMMER in his Danmarks geognostiske Forhold 1835 p. 88 mentions »nogle Insecter af Familien Sirex (Hymenoptera terebrantia)« from »det hvide skifrige Ler« viz Diatom-earth.

In the same year (1835) BECK's Notes on the Geology of Denmark (Proc. Geol. Soc. London II. p. 217) was published in which »the elytra of beetles, the cases of the larvæ of Phryganæa, and an hymenopterous insect which the author has called Cleptis Steenstrupii« are mentioned from a stratum which, according to the description, most likely is to be recognized as cement-stone.

Finally MØRCH in his Forsteninger i Tertiærlagene i Danmark (11. Skand. Naturforskermøde i Kbhvn. 1873 p. 273) records

[1]) The cement-stone appears as concretions which are to be found as a secondary part of the Diatom-earth formation, partly presenting rows of clumps, partly continuous, 1/8 to 1/2 m thick layers.

that in the Diatom-earth bed of Silstrup, Mors, and the north side of Fuur he has found »Insekter, navnlig en stor Cimex (Scarabæus Forch.), Coreus, Termes etc. (bestemte af Prof. SCHIØDTE).«

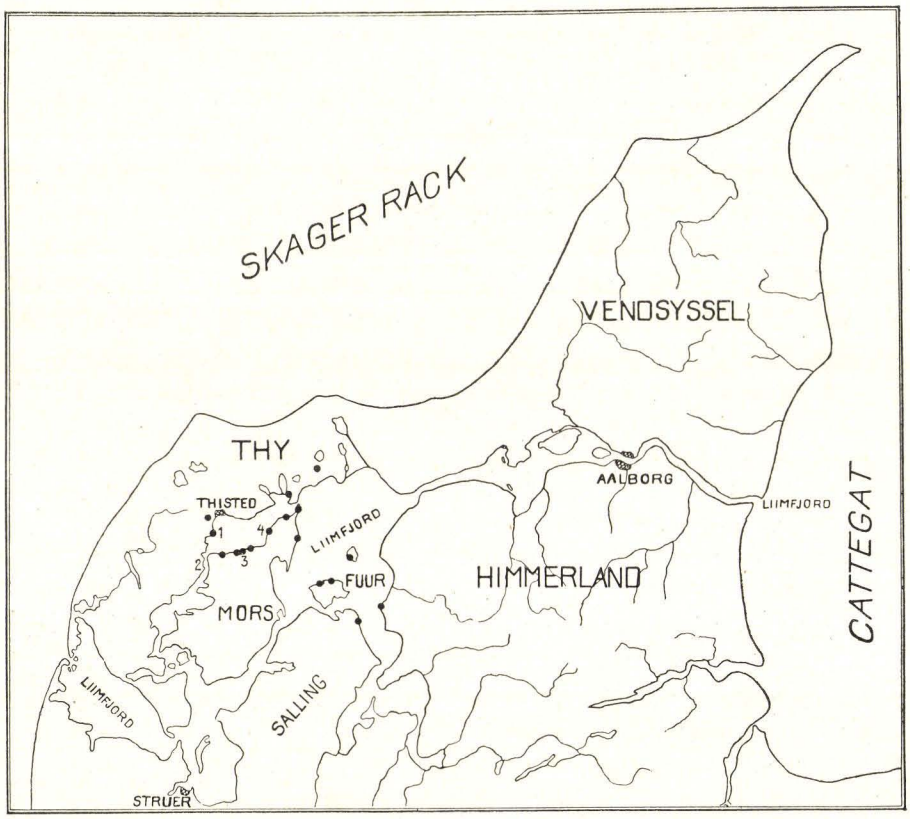

Fig. 1. Map of Northern Jutland, showing the localities (marked as black spots) of the diatom-earth bed.
1) Silstrup, 2) Vilsund (erratic block), 3) Hanklit, 4) Skærbæk.

Records in the world literature of Eocene insects from other countries than Denmark are likewise only scanty [1]) particularly so when compared with the rich fauna known from later periods of the Tertiary age, especially the Miocene.

As to the Arctic Regions HEER in his great work Flora fossilis arctica [2]) has recorded the following forms from strata which are now generally considered to be Eocene:

[1]) We do not consider the amber fauna here which, at any rate as far as certain groups are concerned, has called forth a relatively rich literature, but the Eocene age of which is certainly most problematic (see later on).

[2]) Complete list with cross references in the 7th Vol. of this work (Flora fossilis groenlandica II) 1883 p. 143—146.

Carabites Feildenianus Heer — Grinnell Land.
Trogosita insignis Heer — Atanikerdluk.
Hydrophilites naujatensis Heer — Naujat.
Buprestites agriloides Heer (Heeri Scudder) — Hareø.
Cistelites punctulatus Heer — Atanikerdluk and Puilasok.
Cistelites minor Heer — Hareø and Puilasok.
Helops Wetteravicus Heyden — Hareø.
Chrysomelites Lindhageni Heer — Upper Atanikerdluk.
Chrysomelites Fabricii Heer — Atanikerdluk.
Blattidium fragile Heer — Atanikerdluk.
Locusta groenlandica Heer — Upper Atanikerdluk.
Phryganea hyperborea Heer — Upper Atanikerdluk.
Cercopidium rugulosum Heer — Upper Atanikerdluk.
Pentatoma boreale Heer — Upper Atanikerdluk.

and to this list HENRIKSEN (Medd. om Grønl. LVI. 1917 p. 205) has added Eugnamptus decemsatus Scudd. from the middle Eocene of Cape Dalton.

From Holstein HARTZ (D. G. U. (2) No. 20, 1909 p. 18) records remains of 2 different species of weevils of which the greater is »maaske en Erirhinus« from an (Eocene?) septaria-like knoll from Brothen.

From England MANTELL (Geol. Exc. Isle Wight 1847 p. 140) records a find of undetermined Coleoptera in the lower Eocene London clay at Parkhurst Barracks.

WESTWOOD (Proc. Geol. Soc. London 1854 p. 381, and Qu. J. Geol. Soc. 1854 p. 395) from London clay at Corfe (Corfe clay) mentions the occurrence of click-beetles, buprests, tenebrionids, curculionids, and chrysomelids, all undetermined. Of these forms GIEBEL later on (Fauna d. Vorwelt II 1856 p. 93 and 148) has named 2 forms respectively Elaterium Murchisoni (by COCKERELL renamed Elaterites M.), and Curculionites marginatus.

SMITH & EVANS (Geologist IV. 1861 p. 40) mention an Elater, a Cneorhinus (or Strophosomus?) and undetermined Coleoptera from the lower Eocene Paludina beds at Peckham (London), the material has been revised by COCKERELL who has renamed the first Elaterites palæophilus, the second Ceuthorhynchus? eocenicus.

HEER (Philos. Trans. CLII. 1862 p. 1082) describes a Buprestites Falconeri from upper Eocene in Devonshire.

BRODIE (Geol. Mag. VII. 1870 p. 141) mentions the find of undetermined Buprestidæ, Tenebrionidæ and Curculionidæ from the middle (upper?) Eocene Bagshot series in Dorset, and (Distrib. and Correl. of Fossil Insects 1873 p. 13) Tenebrionidæ and Curculionidæ from Corfe clay. The material has been revised by COCKERELL (see below).

Goss (Proc. Ent. Soc. London 1878 p. 8) further mentions the find of likewise undetermined buprests, curculionids, and neuropters

from upper Eocene in Bournemouth and (Entomologist XI. 1878 p. 193), an Æschna, later on by SCUDDER referred to the genus Basiæschna, from the same place.

J. S. GARDNER (Quart. Journ. Geol. Soc. XLIII. 1887 p. 270) records the elytron of a beetle, and the hind wing of a Homopteron from I. of Mull, Scotland.

Finally COCKERELL (Ann. Mag. Nat. Hist. (9) V. 1920, p. 273—279, 455—463, (9) VI. 1920 p. 65—72) has recorded the following forms from the English Eocene:

Pycnoscelus (?) Gardneri n. sp. (Bagshot series, Bournemouth).
Allopterites multilineatus n. sp. (» » »).
Hammapteryx anglica n. sp. (» » »).
Oecophylla bartoniana n. sp. (» » »).
Formica heteroptera n. sp. (» » »).
Megapterites mirabilis n. sp. (» » »).
Carabites gardneri n. sp. (» » »).
Elaterites murchisoni Giebel (Lower Bagshot beds, Corfe clay).
Elaterites perditulus n. sp. (Corfe, Dorset).
Elaterites laconoides n. sp. (Bagshot series, Bournemouth).
Elaterites sculptilis n. sp. (Corfe, Dorset).
Elaterites palæophilus n. sp. (L. Eocene, Woolwich and Reading beds, Peckham).
Curculionites marginatus Giebel (Bagshot series, Corfe).
Ceutorhynchus (?) eocenicus n. sp. (L. Eocene, Woolwich beds, Peckham).
Ophryastites gardneri n. sp. (Bagshot series, Bournemouth).
Baris (?) palæophilus n. sp. (Bagshot series, Bournemouth).
Chrysomelites allochlamys n. sp. (» » »).
Leptura (?) bartoniana n. sp. (Corfe clay, Dorset).
Pelidnotites atavus n. sp. (Bagshot series, Bournemouth).
Carabites cuneatus n. sp. (» » »).
Carabites parallelus n. sp. (» » »).
Tenebrionites anglicus n. sp. (» » »).
Chrysomelites quadrilineatus n. sp. (» » »).
Carabites peracutus n. sp. (» » »).
Buprestites purbecensis n. sp. (» » Dorset).
Curculionites brenthiformis n. sp. (» » Bournemouth).
Chrysomelites bartonicus n. sp. (» » »).
Curculionites optimus n. sp. (» » »).
Erotylites wallacei n. sp. (Corfe clay, Dorset).

And in Canad. Entomologist 1921 p. 22 he has added

Carabites scoticus n. sp. from I. of Mull, Scotland.

From the Eocene of France GOSS (Proc. Geol. Assoc. V. p. 214) records the find of "a number of insects" in lower Eocene deposits at Sterzanne sur Marne.

From the Eocene of Italy MASSALONGO (Nereid. foss. 1855 p. 32 and Stud. paleont. 1856 p. 14—21) has described the following insects from middle Eocene, Monte Bolca:

Forficula bolcensis Mass.
Termes peccanæ Mass.
Perotis lævigata Mass.
Cordulia Scheuchzeri Mass.
Bibio Sereri Mass.
Dipterites angelinii Mass.

and OMBONI (Atti. R. Istr. Venet. (6) IV 1886 p. 1430) records Perotis lævigata Mass. and a Hydrophilus from the same locality, and further a Carabus novalensis Omb. from middle Eocene i Novale.

Whilst the above mentioned finds of Eocene insects in Europe are scanty and partly undetermined and indeterminable, the fauna from the Eocene of Rocky Mountains in U. S. A. is much more richly represented, all its species originating from Green River series in Colorado, Wyoming, and Utah, especially from the localities of Green River, White River, and Roan Mountain. The recent American and European insect faunæ as well known mutually differ so much that American animals and their descriptions cannot serve for determinating purposes to European species. The same difference did evidently also exist during the Tertiary period. That the faunæ from both sides of the Atlantic Ocean also then were extremely different is proved by the present literature, and the author's investigations likewise confirm that the American fauna at most once in a while may give a hint as to some genus, but never as to species. It, therefore, is of no special consequence, when a European fauna is concerned, to give a list of all species known from the Eocene of Rocky Mountains, and in the following I shall only give a list of the papers in which insects from American Eocene have been described:

SAMUEL H. SCUDDER: The Tertiary Insects of North America. Washington 1890 pp. 663, 28 plates.

SCUDDER: Tertiary Rhynchophorous Coleoptera of the United States. Washington 1893.

SCUDDER: Adephagous and Clavicorn Coleoptera from the Tertiary deposits at Florissant Colorado with descriptions of a few other forms. Wash. 1900.

T. D. A. COCKERELL: A new fly (Fam. Mycetophilidæ) from the Green River beds. Amer. Journ. of Sci. (4) XXIII 1907 p. 285.

COCKERELL: Descriptions of Tertiary Insects I—VII. Amer. Journ. of Sci. (4) XXV—XXVIII 1908—09.

COCKERELL: Eocene Fossils from Green River, Wyoming. Amer. Journ. of Sci. (4) XXVIII. 1909 p. 447.

COCKERELL: Some American fossil Insects. Proc. U. S. Nat. Mus. LI. 1917 p. 89—106.

COCKERELL: New Tertiary Insects. Proc. U. S. Nat. Mus. LII. 1917 p. 373—84.

COCKERELL: New Species of North American fossil beetles, cochroaches and Tsetseflies. Ibid. LIV. 1919.

COCKERELL in Nature 20 March 1919 p. 44.

COCKERELL in The Entomologist 1919 LII p. 122 [1]).

COCKERELL: Eocene Insects from the Rocky Mountains. Proc. U. S. Nat. Mus. LVII. 1920 p. 233—60.

COCKERELL: Some Eocene Insects from Colorado and Wyoming. Proc. U. S. Nat. Mus. LIX 1921 p. 29—39.

COCKERELL AND GRACE SANDHOUSE: Some eocene Insects of the family Fulgoridae. Ibid. LIX. 1921 p. 455—57.

As will be seen from my determinations in the following, a comparison between my material and the Eocene insect forms previously known has not been of much importance. The determination of European finds is for the greater part insufficient, and the species described are so few that it is not likely that new finds belonging to a group so rich in species as that of the insects might be referred to the few European ones described, and the Rocky Mountain fauna of which a considerable number of species has been described is — as above mentioned -- geographically too distant from us to be of any special use.

It has turned out that a critical use of the much more thoroughly based systematics of the recent insects yielded good hints as to the systematic reference of examined forms, and for this purpose I, therefore, have made use of the literature dealing with these recent systematics, as well as of the recent forms proper, in so far as they were represented in the collections of the Copenhagen Zoological Museum.

As species of hitherto known Eocene insects are so few, as said above, it is no wonder that all the forms, referred to species by me, have turned out to be novæ species to science. Some specimens, especially a number of Hemiptera I have only referred to families. Though I was well aware that at any rate the greater part of these Hemiptera cannot be referred to previously described fossil forms, I have not been able to find any "characteres essentiales" (to use a Fabrician term) by which with certainty to refer eventual further finds

[1]) I have not seen this paper.

to one of these forms in particular — and to that alone. I, therefore, have resigned as to the further denomination of these forms, hoping thus to have secured a more solid base for my species than is generally the case in the present literature.

Description of the Fauna.

Odonata.

A fine impression of parts of wings and abdomen of an Agrionid has been found in cement-stone at Struer. Of the abdomen the 6 outermost segments with anal appendages are present; on the 2 most completely preserved wings the basal half (from Nodus inwards) is wanting, but also their hind margin is somewhat molested; as for the rest they are fine and well preserved, this also applies to a small rest of a third wing.

From a comparison with the literature, especially with the paper of CALVERT [1]) it becomes evident that the wing impression must be due to a representative of the genus *Phenacolestes* Cock., formerly only known from the Miocene of Colorado. As the basal parts of the wings are missing, the number of the antenodal veins, the position of Arculus and Nodus in proportion to the length of the wing, and the shape of the quadrangle cannot be stated, but the following characters prove the specimen in question to belong to the genus *Phenacolestes*: Between M_1 and M_1a there is only one row of cells reaching to the margin of the wing, between M_2 and Rs there is proximally one row, further on 2 rows, and at the margin 3, this is also the case with the area between Rs and M_3; also between M_4 and Cu_1 there are more (at least 4) rows of cells at the margin.

Dysagrion, the only Odonat genus previously known from the Eocene period, differs from the above named form among other things by having up to 5 cell rows between M_1a and M_2, and up to 8 between Rs and M_3.

Phenacolestes jutlandica n. sp.

It is characteristic to this species (in contradistinction to the previously known Miocene species *mirandus* Cock. and *parallelus* Cock.) that between M_1a and M_2 there are only 2 cell rows distally, and posterior to Cu_2 likewise only 2 cell rows. Length of stigma

[1]) Philip P. Calvert: The Fossil Odonate Phenacolestes, with a Discussion of the Venation of the Legion Podagrion Selys. Proc. Acad. Nat. Sci. Philadelphia 1913 p. 223—272, pl. XIV.

like 2 to 2½ of the underlying cells. At the wing margin 5 cells are counted between Rs and M3, and 4 between M2 and Rs. 19 postnodal cross-veins. Length of upmost wing fragment 21 mm.

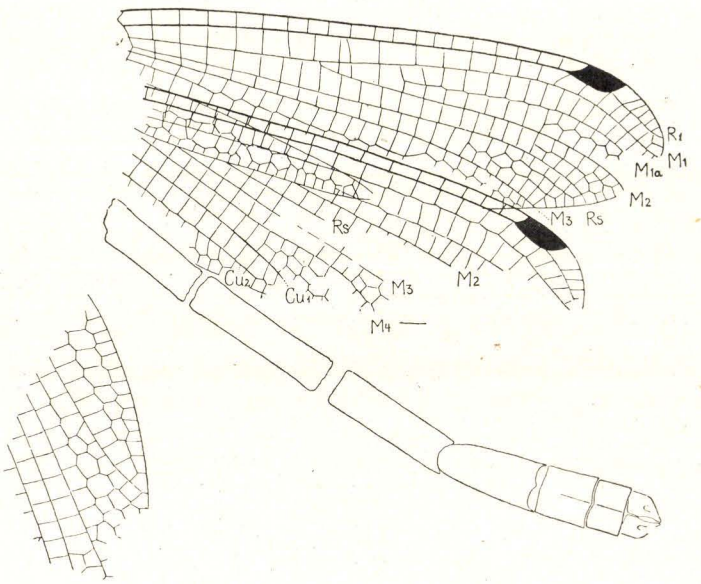

Fig. 2. Phenacolestes jutlandica n. sp.

Segments of abdomen transversally rugose. Anal appendages broad, square, with a slight curve on the inside margin, and midway on the surface a groove which is steeply bounded anteriorly but flattened posteriorly. Length of the preserved piece of abdomen (in a straight line) 25 mm.

1 specimen. Struer (poss. Min. Museum).

Orthoptera Saltatoria

The fragment of a hind wing of a saltatorial Orthopteron is at hand; judging by the radial sector branches (S_1 and S_2) which join below, it must be referred to a locust, *Phasgonoridæ* (Locustidæ olim). It is, however, impossible to decide to which of the subfamilies it belongs. The venation of the hind wing does not in the recent forms present any subfamily character allowing with certainty an application to unknown forms. As the vein at the margin of the wing, which I have lettered M_3, issues from the vein behind, and not from that before it, we most likely may exclude the greatest of the subfamilies, *Phaneropterinæ* and also *Pseudophyllinæ*, the two groups to which we should otherwise a priori have turned for a comparison. It is much more likely that it may belong to one of the subfamilies

Phasgonurinæ and *Decticinæ*, although a reference to any of these latter cannot be proved.

Though we are obliged to leave the question about subfamily undecided, our wing, however, displays features so characteristic both in comparison with the recent and with the few Tertiary forms that I think it justifiable to establish it as a new genus and species to which I give the name of

Nymphomorpha n. g. **medialis** n. sp.

As it is impossible by means of this one specimen to decide which of its characters belong to the genus and which to the species, I shall state them all together; it is most probable that by far the greater part (and perhaps all of them) are generic characters.

R is forked at the very apex.

It is distinctly seen that the distal half of the vein next to R is an Rs, as its inner part (at the offspring from R) is stronger and more oblique than the cross-veins, between which it is situated. Basad the line formed by Rs is continued by M_{1+2}, but whilst this latter vein in the recent forms distally bends caudad even basally to the middle of the wing, backwards and outwards converging with the Rs branches (S_1 S_2 S_3), in order to join the longitudinal vein formed by M_2 together with the lower parts of S_1 and S_2, this backwards curve of M_1 in our form takes place more distally on the wing membrane (we may estimate it to be at about $^2/_3$ of the wing length, counted from base). This distal part of M_1 is very short, not much longer than the other cross-veins proper between M_{1+2} and M_{3+4}, whereas in the recent forms it is much longer than the corresponding parts of S_1.

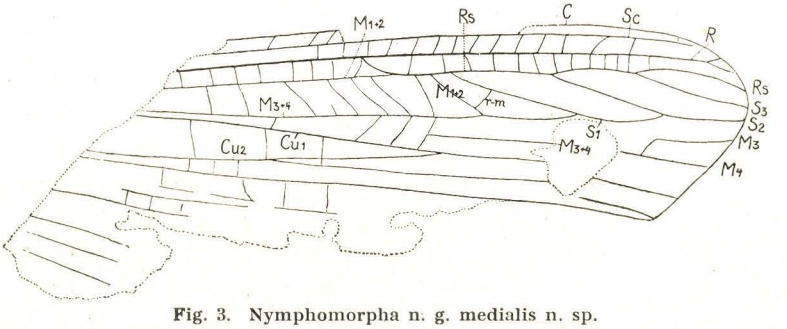

Fig. 3. Nymphomorpha n. g. medialis n. sp.

That the backwards bending part of M_{1+2} really is represented by the cross-vein-like part, which I have indicated with these letters, and not by any of the similar cross-veins basad to it, is proved by the presence of the very distinct radiomedial cross-vein (r-m).

About midway on the wing M_{3+4} in a characteristic way bends backwards and continues outwards in another line than that of the proximal part. M_3 under a very steep angle issues from M_4 but then turns sharply outwards parallel with the veins on both sides of it.

The anal veins are only seen in fragments, and the anal area most probably folded over and found partly below the preserved part, the direction of some few veins indicates that these veins must belong to a hind series hidden in the stone below the other visible veins.

The drawn veins are distinctly seen in the stone, but no such network of fine veins between them (nor f. inst. in the cells surrounded by the Rs-branches) as is found in the recent forms. We cannot completely deny the possibility that such an irregular accessory vein-reticulation may have been present, but when we observe the distinctness of the cross-veins between Sc and R, of those between R and Rs, and of those between M_1 and M_2, whilst nothing whatever indicates the presence of more cross- or net-veins distally to them, it is by far the most probable that such accessory veins have not been present.

The interpretation of the veins has been much facilitated through the use of Comstock's figures, f. inst. that of a recent *Scudderia* nymph (Comstock: The Wings of Insects fig. 123). We here meet with the curious fact that the veins of this fossil wing are much more easily homologized with the tracheation of a recent nymph, than are the wing veins of a recent imago belonging to the same type as the nymph.

The length of the preserved piece of wing (measured from apex of wing to the basal lower corner) is 27 mm.

1 specimen. Struer (poss. Min. Museum).

Neuroptera Planipennia.

Megalomus densistriatus n. sp.

The Neuropterous wing, fig. 4, which has been found in cement-stone, distinctly appears to belong to a representative of the family *Hemerobiidæ* (by the presence of more than 1 radial branches and by the rather few cross-veins arranged in series). Especially by the rich ramification of its veins it agrees with the Tertiary (Oligocene) genus *Bothriomicromus* Scudder, but as the 1st cross-vein of the costal area is bent backwards towards the base of the wing as a nervus recurrens it cannot belong to this genus. By the broadness of its costal area it, however, agrees with the recent Hemerobiid genera *Megalomus* Ramb., *Drepanopteryx* Burm., and *Drepanacra* Tillyard which as to venation show the most primitive features within the family.

Of these 3 genera the palæarctic (and American) *Megalomus* has wings with evenly curved margins, while the 2 other, respectively palæarctic and Australian, genera have the back margin near apex falcat or concave. Strange to say, the present specimen has some irregularly bounded incisions just where the concavity is to be seen in the mentioned recent genera; and what is more, in several *Depanacra-* and *Drepanopteryx*-species (compare R. J. Tillyard in Proc. Linn. Soc. N. S. Wales XLI 1916 p. 269—332) some so-called fenestellæ (transparent spots) are to be found at the margin of the wing, viz. a deep narrow one on the hind margin a little basally to the middle, and 1—4 short but broad ones along the falcation. Exactly in these places the wing at hand also presents its incisions: a deep narrow one a little basally to the middle of the hind margin, and 3 broader ones distally towards apex (the very number presented by *Drepanacra humilis* Mac L.!); but the borders of these incisions are

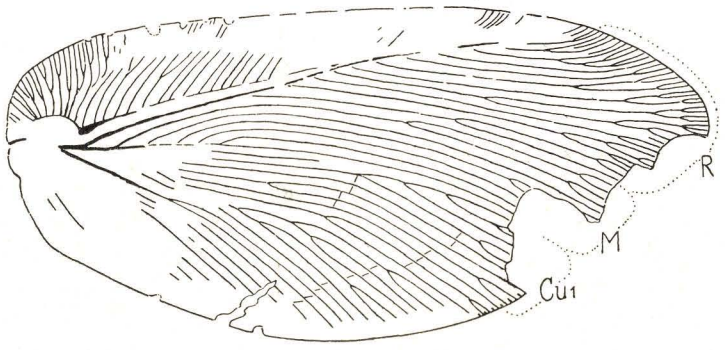

Fig. 4. Megalomus densistriatus n. sp.

evidently fractured, not outlines of fenestellæ. The direction of the longitudinal veins ending at the 3 broad incisions, as well as the place where they bifurcate etc. seem to indicate that the hind margin of the wing has been evenly curved. I have, therefore, taken this to be the fact; the species at hand consequently must be a *Megalomus* to which genus it also is assigned by the missing cross-veins in the costal area, and the few cross-veins in the row almost midway on the surface of the wing.

Whether the presence of fenestellæ in the named recent forms might find its explanation in the above mentioned fractures of our Tertiary form — or whether it is the reverse — I dare not decide.

As characters peculiar to the present species the dense venation is first to be stated. From Ramus recurrens ca. 10 mostly ramificated veins issue, R, M and Cu_1 together issue from the base of the wing. From its distal half Radius sends out 16 branches whilst Media,

strange to say, sends out 5 branches from its upper side, close to its base. Most of the branches ramificate dichotomically, till they are about half so distant from each other at the margin of the wing as on the middle of it. The outermost row of crossveins is not exactly parallel with the margin. The innermost row only consists of very few cross-veins. It must, however, be observed that I have only drawn the veins which I know for certain to exist, it is possible that there are more veins than drawn in both cross-vein series, but the state of preservation of the wing does not justify the statement of a greater number of veins.

Length 18 mm. 1 specimen. Fuur (poss. Min. Museum).

The distal part of another wing likewise belonging to a *Megalomus* further is at hand. Judging by the broad costal area we might suppose it to be a fore wing, but 1st radial branch appears as a radial sector from which the other radial branches (except the hind one, 8th), issue, and this is a specific hind wing peculiarity.

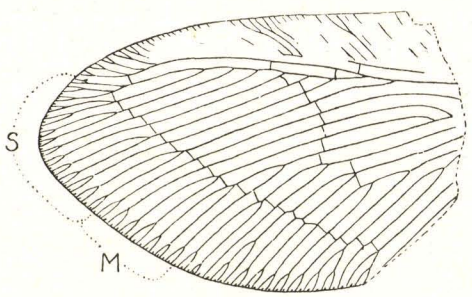

Fig. 5. Megalomus ? densistriatus n. sp.

On account of the form and size of the wing (the preserved piece is 9 mm long) as well as the course and density of the longitudinal veins, it is not excluded that this wing might be the hind wing corresponding to the *Megalomus densistriatus* fore wing described above. This conception is confirmed by the observation that the most peculiar character of this latter: the median branches issuing from the upper side of the median stem, is also represented in this wing (by 3 such branches).

If I am right in the supposition that the wing at hand belongs to *M. densistriatus*, we must add to the characters of this species the fact that both fore and hind wings have a broad costal area which then would justify the establishment of a new genus to this species.

1 specimen. Skærbæk (poss. Min. Museum).

Megalomus sp.

Besides the two above named finds an impression of one more *Megalomus* has been procured, an impression of a whole insect with its wings and in lateral position.

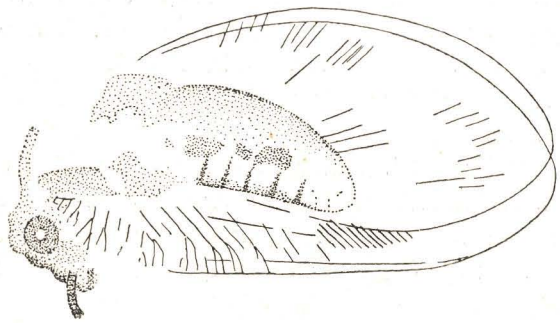

Fig. 6. Megalomus sp.

For want of sufficient characters, especially the venation of the wings, the material does not allow any determination beyond the statement that it has to do with a *Megalomus*. Length of the insect measured from tip of front to apex of wing 11 mm.

1 specimen. Silstrup Bakke (poss. Min. Museum).

Coleoptera.

Cassida sp.

Not only in the recent time but also in earlier geological periods the beetles have held their own as the insect group showing the greatest number of species. Of the known Tertiary insects more than one third are beetles. It is, therefore, astonishing that only a single of the Diatom-earth finds is represented by a beetle. According to its habitual appearance, especially the broad limbus on the elytra, this individual (consisting of Prothorax and elytra connected) must be a *Cassida*.

From Oligocene and Miocene deposits a small number of *Cassida* species has been described, further several finds not referred to species are known from these deposits. On the other hand, no *Cassida* is known from Eocene deposits, the individual at hand thus certainly must represent a new species. The elytra are, however, seen from the inside, and neither elytra nor prothorax displays characters sufficient for the characterization of a species. The length of the insect is 5 mm, its breadth 3.4 mm.

1 specimen, found as erratic block at Struer (poss. Min. Museum).

Hymenoptera.

Pimpla stigmatica n. sp.

Of the 2 forms of Hymenoptera, of which impressions have been found in cement-stone, one belongs to the family *Ichneumonidæ*. Only one specimen of this latter has been procured; head and thorax are very badly preserved, abdomen a little better. The wing venation and the long ovipositor, however, make it quite clear that we have to do with a representative of the subfamily *Pimplinae*, and with the very genus *Pimpla*.

A small number of Tertiary *Pimpla* species (all from Oligocene deposits) has been described, it is, however, to be observed that these species do not all belong to the genus *Pimpla* in the present sense of the word, and no *Pimpla* has till now been recorded from the Eocene deposits.

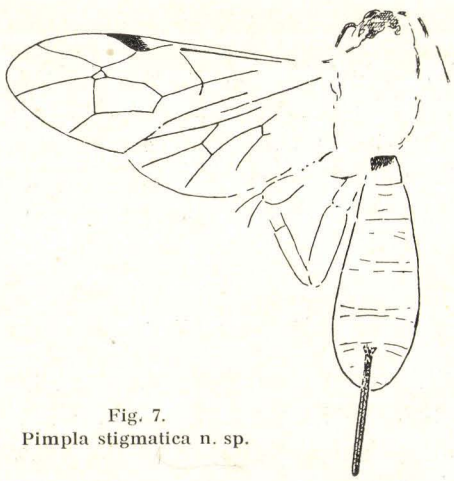

Fig. 7.
Pimpla stigmatica n. sp.

The present species is characterized by its bicoloured stigma which is basally pale, distally dark. It is true that many recent *Pimpla* species have the very base of stigma pale, but in the present case the pale colour covers about half the stigma. The 2nd cubital cell is triangular with a short peduncle, the basal vein (m-cu + the innermost part of M) almost straight. The radial cell of the hind wing is rather small, it issues proximally at about one third from the apex of the wing. The legs have been strong. Abdomen appears the broadest between the fourth and fifth segment. Ovipositor ca. half as long as abdomen. Length (ovipositor included) 11 mm. Length of anterior wing 7 mm.

1 specimen. Thy (poss. Min. Museum).

Proctotrupidæ sp. (Idiotypa aff.).

The second impression of an Hymenopteron from cement-stone (likewise only 1 spec.) is due to an insect which, according to the obconical form of its abdomen, must be referred to *Idiotypa* or to a closely allied Proctotrupid-genus. Other characters are, however, not to be distinguished (of the wing f. inst. only the basal part of the anterior margin onto stigma are to be recognized), hence further reference is excluded. Length 5.5 mm.

1 specimen. Silstrup (?) (poss. Min. Museum).

Lepidoptera.

From Hanklit a stone with impressions of remains of 3 insects and another with remains of one insect are at hand, further a stone from Silstrup with impressions of one insect. They all look somewhat alike, and most likely may be referred to one species, they evidently originate either from a caddis fly or a moth. In one specimen a typical Lepidopterous-palp is seen before the front of the head, a sufficient proof that we have to do with a moth. This is so far interesting as no Lepidopteron was formerly known from the Eocene deposits, but there is no possibility of any further reference of my specimens.

Diptera.

Tipula binoculata n. sp.

Remains of a cranefly are at hand; its most essential characters are the fine, spotted wings, with one spot near apex and another almost at the end of costa, both rounded and darker at their margins than in the middle. Further there is an infuscation along some of the veins, especially M_1 and M_2, and the outer part of their basal stem, and also along the inner cross-vein-like part of Cu_1, and the adjoining Cu_2.

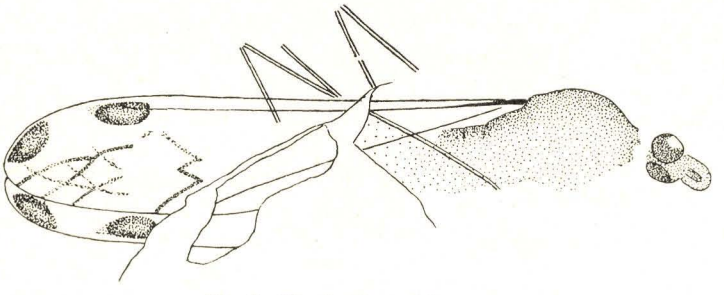

Fig. 8. Tipula binoculata n. sp.

What has been preserved of the venation is not sufficient to allow us to refer it with certainty to any genus. But the position of the mentioned veins, and the infuscation along the named wing parts indicate the genus *Tipula* proper of which we know a large group of species presenting the same peculiarities (f. inst. the recent *eluta* Lw., and several Miocene (*maclurei*, *limi* etc.) figured and described in Scudder: Tertiary Tipulidæ (Proc. Amer. Philos. Soc. XXXII. p. 224 1893—94).

The present species is highly characteristic by the 2 distinct, rounded, eye-like spots (when similar spots are found in other forms they are never well outlined but diffuse and longish, extending more or less backwards on the wing), and the relatively long fork formed by M_1 and M_2. The insect measures 3.05 cm. from tip of head to tip of wing.

1 specimen. Skærbæk (poss. Min. Museum).

Eriocera dimidiata n. sp.

This cranefly-wing does not present the two foremost longitudinal veins (C and Sc); the foremost part has obviously been folded over and is hidden behind the radial part of the wing. The venation otherwise totally agrees with that of the recent tropical genus *Eriocera*, and within this genus with the oriental species-group having Cu_2 in direct elongation of the Cu-stem. To the genus *Eriocera* 2

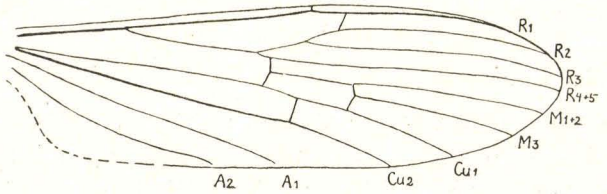

Fig. 9. Eriocera dimidiata n. sp.

Tertiary species, *succini* Lw. and *palpata* Lw. also belong, both from amber, but none of them presenting any nearer relation to the Eocene species which is characterized by all its cross-veins being placed more basally than in all other species of this genus, so that the issue of R_{4-5} and the inner border of the discoidal cell are almost in the centre of the wing and basad to the ending of the anal vein in the hind margin of the wing. Cu_2 is half as long as the Cu stem, and the discoidal cell some times longer than high. All the other distal vein parts are likewise of very great length so that it may be justifiable to characterize all the apical part of the wing as unusually elongated. Length of wing 9.5 mm.

1 specimen. Struer (poss. Min. Museum).

Rhamphidia thybotica n. sp.

At a first glance it may seem rather strange that I have referred the Tipulid-wing, fig. 10, procured from cement-stone, to the genus *Rhamphidia*. In this genus Subcosta ends in the anterior margin of the wing, and in the present form it is seen to end in Radius, a character which is stated as typical to the family *Tipulidæ*, whilst the family *Limnobiidæ*, to which *Rhamphidia* belongs, has Subcosta ending in Costa and at the same time near apex sends a small cross-vein down to Radius. This character is, however, not more stable than that Subcosta in the recent North-European *R. longirostris* bifurcates quite apically sending one branch in a right angle on to Costa and the other, the stronger one, down to Radius. In some species, such as the American *R. flavipes* Macq. and *mainensis* Alex. (figured by Alexander in Proc. Acad. Nat. Sci. Philadelphia 1916 pl. XXV. fig. 13—14 — I regret that I do not know them from autopsy)

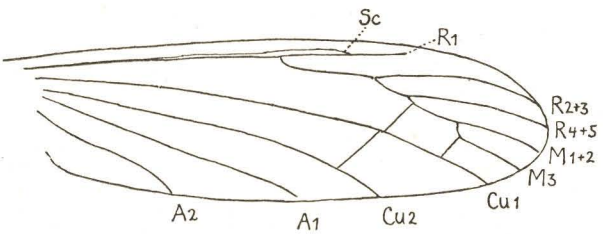

Fig. 10. Rhamphidia thybotica n. sp.

the fork branch on to Costa is missing, so that these species present the Tipulid character: Subcosta only ending in Radius. The venation of the Eocene wing otherwise agrees the best with the *Rhamphidia*-genus (of which also some few species are known from Tertiary deposits, from amber and from Florissant). The above described peculiarity of Subcosta thus not preventing its reference to this genus it must be reckoned justifiable to refer it to *Rhamphidia*, as its venation otherwise quite agrees with that of this genus.

As characteristics of the present wing it further is to be stated that Subcosta is slightly proconvex in its distal part, just before its ending in Radius. The distal part of R_1 is not recognizable in this on the whole rather indistinct impression, wherefore its distal course cannot be stated. The stem of the other R-branches issues from the Radius-stem some way basad to the place where Subcosta issues from the latter. M_3 issues from M_{1-2} and not from the cross-vein bounding the discoidal cell distally. Cu_2 is slightly and evenly curved, on account of which the cross-vein connecting it with Cu_1 is well developed. Length 14 mm. As for the rest, the wing much resembles

the wing of *Rh. falcaria* Scudd. from Florissant (Proc. Acad. Amer. Philos. Soc. XXXII. p. 206).

1 specimen. Silstrup (poss. Min. Museum).

Rhamphidia sp.

An impression of remains of wings and legs of a cranefly from diatom-earth is at hand. The wings are somewhat shorter than those of the above named *Rhamphidia* species, only 10 mm. long. The venation of the wing is difficult to observe, the Diatom-earth proper not yielding as good impressions as cement-stone. I have f. inst. not been able to find any cross-veins preserved, but the preserved veins

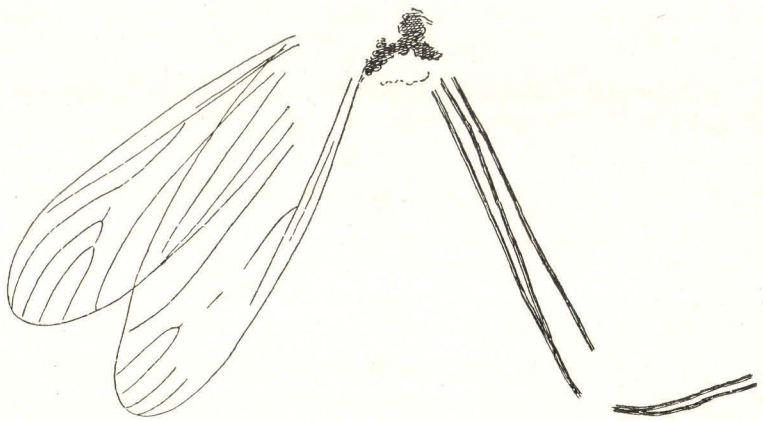

Fig. 11. Rhamphidia sp.

agree so completely with those of *R. thybotica* that I do not hesitate to refer this find to the same genus, though for want of typical characters I desist from naming the species.

1 specimen. Silstrup (poss. Min. Museum). The specimen is the one indicated by Mörch as »Termes«.

Nematocera Polyneura spp. indet.

In cement-stone procured from Silstrup 2 single cranefly's wings further are at hand, one 19, the other 25 mm. long. The state of preservation, however, is so bad that a reference to a genus is impracticable.

Brachycera Schizophorinæ sp. indet.

A fly's wing, found in cement-stone at Struer and 10.5 mm. long, in all its characters agrees with the large group of the *Schizophorinæ* to which group it accordingly is referred. Further reference, is, however, impracticable, as only the wing is preserved.

Homoptera.

A number of Homoptera from the Eocene of Rocky Mountains has been described first by SCUDDER and later on by COCKERELL, whilst Homopterous finds from the old world are scanty. They only consist of a *Hammapteryx anglica* from England (Cockerell), a *Cercopidium rugulosum* from Greenland (Heer), and an undetermined hind wing from Scotland (Gardner).

In cement-stone remains of 5 species of Homoptera now have been procured, one specimen of each. It has been proved that they all may be referred to the superfamily *Fulgorina* and within this to relatively the *Ricaniidæ*, the *Flatidæ* and the *Cixiidæ*.

Ricaniidæ.

Hammapteryx paucistriata n. sp.

The find represented in fig. 12 according to the many cross-vein sin the costal membrane must belong either to *Ricaniidæ* or *Flatidæ*, the two Fulgorin families with many cross-veins in the costal area. Unfortunately the anal area of the wing with the most distinctly separating family characters is missing, but the curious upwards curve of the distal part of Subcosta, the anterior branch of which even completely coalesces with Costa, is only met with in a certain number of genera within the *Ricaniidæ*, and not in any Flatid, although Medius being much more richly ramificated than Cubitus perhaps might be suggestive of the reverse.

The form described here so completely agrees with the Tertiary (exclusively Eocene) Ricaniid genus *Hammapteryx* that I do not hesitate in referring it to this latter. Within the *Hammapteryx* genus 4 American species are at present known: *H. reticulata* Scudder, *H. tripunctata* Cockerell, *H. (?) lepidoides* Cockerell, and *H. (?) ceryniformis* Cockerell together with a species from the Eocene deposits of England: *H. anglica* Cockerell. From the first 4 forms it is distinguished by the relatively few longitudinal veins in the apical part of the wing, and from the last one, at any rate, by the low costal membrane.

Wing relatively narrow in proportion to length; costal membrane rather narrow with ca. 30 cross-veins. Costal vein joins the costal margin a little distally to the outermost third part of the wing. The anterior branch of Subcosta joins with Costa at about three fifths of the wing, measured from base, whilst its posterior branch soon bifurcates, and the anterior branch of this latter bifurcation is strongly opistocurved and once more bifurcated. Radius issues from the basal

cell in common with Subcosta and parts from this common stem at about 1 mm from base. Medius has a longer basal stem, and whilst its anterior branch only once bifurcates, its posterior branch ends in 6 (7) branches. Cubitus is also bifurcate, and its ramification takes place a little more distally than that of Medius, its anterior branch alone once more bifurcates and ends in 3 (4?) branches. Thus Cubitus is more scantily ramificated than Medius. 29 veins in all are counted along the margin from the end of Costa to the beginning of Clavus.

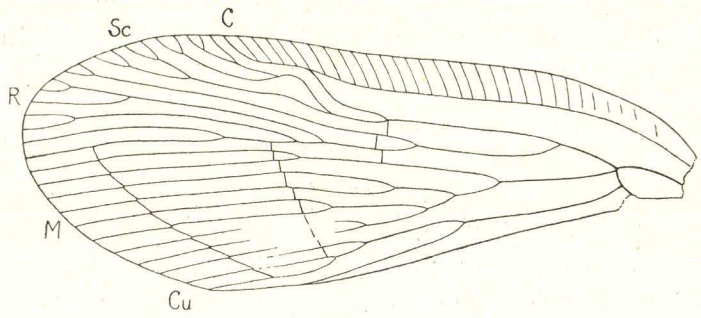

Fig. 12. Hammapteryx paucistriata n. sp.

Along the apical margin there is a row of cross-veins extending over 11 vein intervals. Further inwards there is an a little shorter series of cross-veins, and at about the middle of the wing a few cross-veins forming a third series are seen. In this last series there are perhaps more cross-veins than the three drawn by me, I have namely only drawn those which I was sure to know to exist. Length of wing 13.5 mm.

1 specimen. Struer. (poss. Min. Museum).

Eoricania n. g. **danica** n. sp.

In the fragment of a wing, seen fig. 13, fortunately so much of Clavus has been preserved that we are able to identify it as originating from a Ricaniid and not from a Flatid.

As shown in the little sketch to the left showing the claval part of a recent Ricaniid wing, the members of the family of *Ricaniidæ* have a characteristic course of the 2 anal veins which form a Y, with the peduncle pointing outwards. It may be supposed in advance that A_2 in these recent forms has been secondarily obliterated proximally as it does not issue from the base of the wing as all longitudinal veins primarily do. The Eocene specimen at hand in this respect displays a more primitive feature, in as much as the 2 anal veins also join proximally, thus enclosing an elliptic cell, a character of generic value, on which I have established the genus *Eoricania*. The genus *Ham-*

mapteryx, the only hitherto known Tertiary Ricaniid genus has many fanshaped radiating anal veins on Clavus, as seen in SCUDDER's figure (Tert. Ins. North Amer. pl. VI. f. 34). This feature of course must be the starting point for the Clavus nervation of the living *Ricaniidæ*, and the new form, in this respect, obviously forms the intermediary

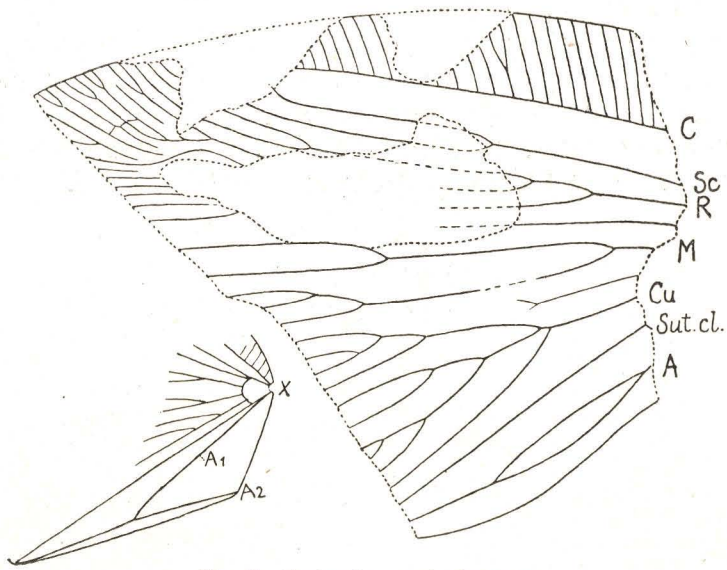

Fig. 13. Eoricania n. g. danica n. sp.
To the left Clavus of a recent Ricaniid.

between *Hammapteryx* and the recent Ricaniids. *Hammapteryx* and *Eoricania* agree in the respect that the bifurcation of Radius takes place a rather short way off base (as far as may be estimated at about one third of the length of the wing, measured from base) whilst the bifurcation in the recent genera takes place more distally.

Subcosta distally curves a little towards the margin which seems to indicate that it is proconvex in the outermost (missing) part of the wing (as in the recent genera *Pochazia, Ricania* etc.). Also in the distal part of one of the median Radius branches we meet with a similar proconvexity. Cubitus presents a much richer ramification than Medius, sending its branches almost equally in costal and anal directions.

Between Medius and Cubitus is seen an outwards interrupted (and apically bifurcated) line which looks like a vein, but which is most probably to be recognized as a fold or an edge of the wing.

As to cross-veins I dare not state more than 3 small ones in a series close by the apex of the wing.

The length of the preserved fragment, measured from the inmost point of R to the outmost corner of the fore margin, is 16 mm.

1 specimen. Northern slope of Fuur (poss. Min. Museum).

Flatidæ.

Ormenis furcata n. sp.

Unfortunately the Clavus part of the wing is missing in the find, drawn fig. 13, but I refer it to the Flatidæ, on account of the rich ramification of Media, and the scanty ramification (only a single bifurcation) of Cubitus. In venation it agrees so well with the recent genus *Ormenis* that I have no doubt about this reference.

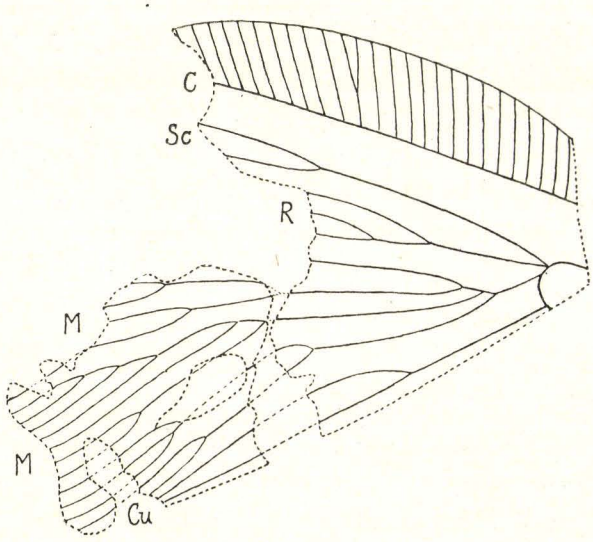

Fig. 14. Ormenis furcata n. sp.

The fact that Subcosta is bifurcate is of great value as a peculiar species character, as it is simple in recent species. This bifurcation is estimated to take place about midway on the wing. Radius and Subcosta issue from the same point of the basal cell. The posterior branch of Radius once more bifurcates near its base. The furcation of Media near its base is most characteristic, because it soon appears quadrifurcate, as only the anterior branch of each of its 3 bifurcations has bifurcated.

Its secondary branches bend strongly downwards in their outmost parts, still curving slightly forwards at the very tip. Cubitus only once bifurcates, and the branches approach outwards.

Between the secondary branches of Media can be seen some crossveinlike impressions in the stone, but I have not drawn any of

them as I dare not decide which are really due to cross-veins and which are not.

Judging by the course of the veins the wing seems to have been of a very high triangular form.

Length of the preserved piece 14 mm.

1 specimen, without locality (poss. Min. Museum).

Lechæa primigenia n. sp.

The find, dealt with in the following, consists of one fore wing and the marginal part of the other fore wing (of which the rest is hidden in the stone). Also here Clavus is missing. As far as the course of its veins may be stated with certainty, the venation turns out to be in so great agreement with the recent Flatid genus *Lechœa*

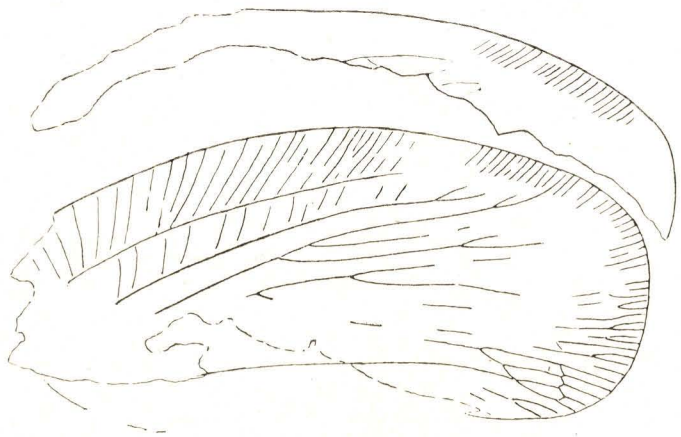

Fig. 15. Lechæa primigenia n. sp.

that I have no doubt in referring it to this genus. The Eocene Flatid genus *Lithopsis* SCUDD. to which SCUDDER as well as COCKERELL have referred several Flatid wings described by them, is out of the question here — both as regards this find and the above mentioned *Ormenis furcata.* SCUDDER'S species have a totally different venation, and COCKERELL'S figures do not allow any comparison, as the venation cannot be stated in them.

It is characteristic of the present species that the costal cell is relatively narrow, more so than the costal membrane, and that the cross-veins of the costal cell are not bifurcate as in the recent species, but simple. Subcosta, on the other hand, is bifurcate quite distally. Radius bifurcates almost midway on the wing, and its anterior branch soon after once more bifurcates, the posterior branch, however, about

midway between its offspring and the margin. The first bifurcation of Media takes place a little basad to that of Radius. Length 23 mm.

1 specimen. Skærbæk (poss. Min. Museum).

Cixiidæ.

Cixiidæ sp.

In cement-stone a large Homopteron, measuring 24 mm from tip of head to tip of wing, has been procured; on the wings, which are far exceeding apex of abdomen, some veins are discerned, but none of them in full length. As some of these veins belong to the fore wing and others to the hind wing, though it is not possible to refer them all with certainty to one or other of the two wings, and as they are, moreover, only few in number, further systematic reference

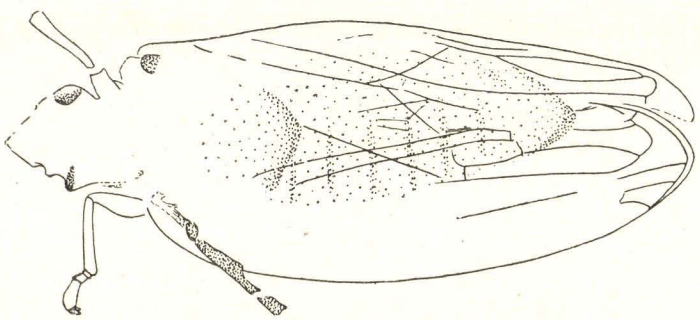

Fig. 16. Cixiidæ sp.

is excluded. We do, however, recognize that the fore wing has a marginal vein parallel to the apical part of the wing. Further a series of outwards closed cells are discerned with their apices near the tip of the fore wing; yet they must belong to the hind wing, indicating that this latter, is of almost the same length as the fore wing. This fact together with the convex anterior margin of the fore wing and its issuing far anteriorly, apparently directly behind the head, are suggestive of the family *Cixiidæ,* but as before said, further reference is excluded.

1 specimen Hanklit. (poss. Min. Museum).

Hemiptera Heteroptera.

As mentioned in the introduction the greater part of the insect finds from Eocene deposits of Denmark consists of bugs, but as a rule only the dorsal aspect of the bodies is recognizable in the stone; the habitual appearance of the members within a Hemipterous family is so uniform that when a peculiar plastic feature is not to be ob-

served in a find it is not possible to refer this otherwise than to Lygæidæ, Saldidæ etc.

Scutelleridæ.

Tectocoris? angustilobatus n. sp.

A Pentatomid form, more than 20 mm. long, thus a very large bug, is present. Prothorax distinctly broadest behind the middle.

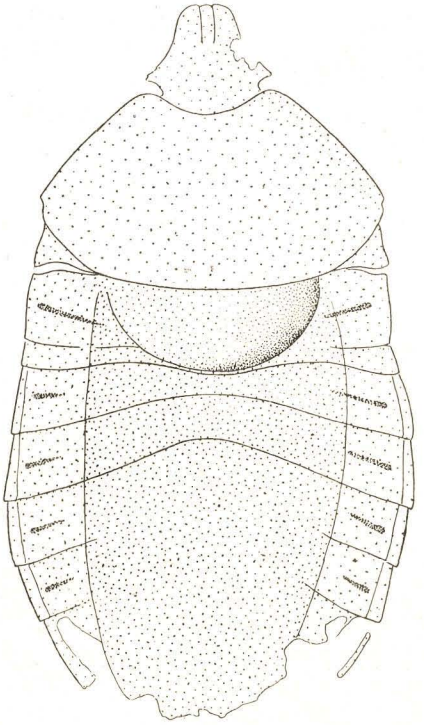

Fig. 17. Tectocoris? angustilobatus n. sp.

The middle lobe of Rostrum hardly as long as the side lobes. The most surprising features of this specimen is the apparently very short Scutellum with semicircular hind margin. Such a Scutellum is unknown in the recent Pentatomids and also in the Tertiary forms. A comparison with the recent forms belonging to this group, however, calls the attention to the Scutelleridæ, the Scutellum of which is projecting tonguelike backwards covering almost all the abdomen, whilst only a short basal area is connected with the underlying part of the body. In *Tectocoris* and allied forms the solid basal part of Scutellum has exactly the same semicircular outline found in our Tertiary species. The question now is whether the Tertiary form really is a Scutellerid and has the long tongue-like projection backwards from the solid

part of Scutellum or not. This projection is very thin in the recent Scutellerids so that it will not be easily recognized in fossil specimens, and yet it is clearly seen here that the middle part of the body (about three fifths of the breadth of the body) is distinctly darker in colour, which certainly indicates that we here have the trace of the Scutellar projection, and the Scutellarid nature of our form thus is clearly proved.

Among the Scutellerid genera *Tectocoris* in general appearance agrees with the Tertiary form, especially in the shape of Prothorax, but as the genera in the Pentatomids cannot be recognized with certainty on the habitual appearance alone I have put a ? at the generic name.

The Tertiary species at hand is characterized by its relatively narrow projection of Scutellum and by the middle lobe of Epistoma (tylus) being a trifle shorter than the side lobes (juga).

Material: 1 specimen (the type) 22 mm. long. Cement-stone Silstrup. (poss. Min. Museum). — 1 specimen (the individual mentioned by MØRCH under the name of »Cimex (Scarabæus Forchh.)« ca. 26 mm long. Cement-stone Fuur. (poss. Min. Museum). — Finally in cement stone Silstrup a Pentatom, about 22 mm long, has been found in lateral position and, therefore, rather unidentificable. Judging by the semicircularly outlined scutellar impression it also applies to a large Scutellerid, probably a *Tectocoris*; for this reason I have — although not with certainty — referred it to *Tectocoris angustilobatus*. (poss. Herlufsholm).

Further the right hemelytron of a Pentatomid with 13 parallel simple veins on the membrane is present. It obviously originates from a Scutellerid, and the size (17 mm) proves that it must have been a large form. In fact it so completely corresponds with *Tectocoris angustilobatus* in size that it most probably belongs to this species. Corium is however equally densely and opaquely chitinized all over, while in the recent *Tectocoris* the greater basal part of Corium which is hidden under the Scutellar projection is rather hyaline and thin.

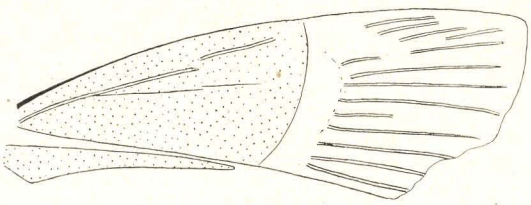

Fig. 18. Hemelytron, most probably of Tectocoris angustilobatus n. sp.

1 specimen, found as erratic block at Klitgaard near Vilsund (poss. Min. Museum).

Pentatomidæ.

Teleoschistus multinervosus n. sp.

The dispersed remains of a Pentatomid have been found, head, Prothorax and Scutellum in connection, the rest of Thorax and abdomen likewise in connection, and a wing membrane separately. They were, however, all found close by each other, so that there can be no doubt of their belonging to one and the same individual. The most characteristic feature of the present form is that the broad Scutellum has no apical projection at all, a circumstance unknown within the recent Pentatomids, but found in several Tertiary genera,

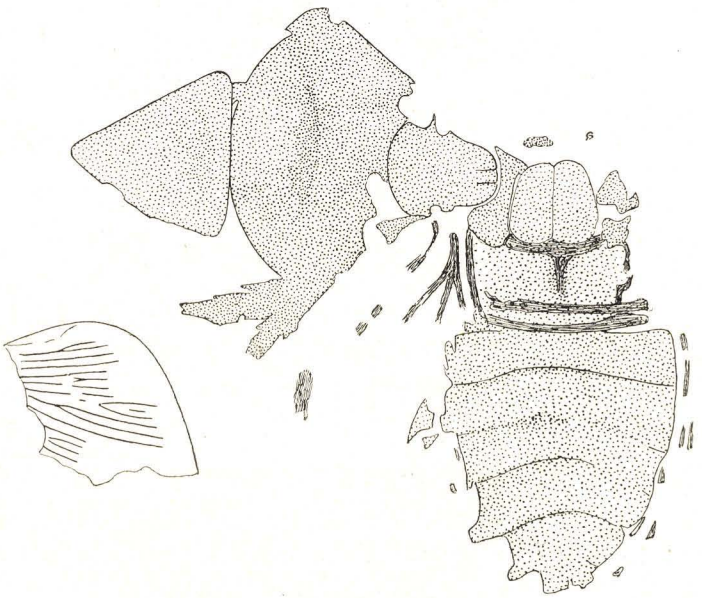

Fig. 19. Teleoschistus multinervosus n. sp.

described by SCUDDER in his Tert. Ins. N. Amer. Among these genera our form agrees the best with *Teleoschistus* which has been established according to 2 Miocene and 1 Oligocene species. It namely has a broad head, and Scutellum does not cover more than half the length of abdomen.

Our species agrees with *T. antiquus* SCUDDER (from Oligocene, Quesnel) in so far that Scutellum must have reached to about the middle of abdomen. The head is, however, distinctly narrower than in the named species, Pronotum has another form (perhaps partly due to pressure however), and especially from the preserved piece of membrane it is evident that the veins have been numerous, more than 16, a very great number in a Pentatomid — and a primitive feature.

Length from front margin of head to apex of Scutellum and from front margin of Mesonotum to apex of abdomen 10.75 mm.

1 specimen. Silstrup (poss. Min. Museum).

Pentatomidæ spp.

Four different finds of remains of bugs are present, the character and state of preservation of which only allow a reference to a family, viz. the Pentatomidæ, but no further identification or particular characterization. One of the remains is a head + prothorax, 6.5 mm. long with adjacent large remains of antennæ and fore legs, from Cement-stone Silstrup. The next is a torso, 7 mm. long, consisting of thorax + the foremost half of abdomen, from cement-stone Mors (poss. Herlufsholm). The third is a 9.5 mm. long thorax + abdomen, of which only the apical segments have been lost, from Cement-stone Silstrup. (poss. Min. Museum). The fourth is an underside of abdomen, 5.8 mm. long, from Cement-stone Silstrup (poss. H. Ødum).

Cydnidæ.

Teleocydnus n. g. **tra sitorius** n. sp.

The most characteristic feature found in the bug mentioned in the following is a hollow impression along the middle line of abdomen, being about one fourth the breadth of abdomen but reaching to about its apex. It quite evidently delineates a scutellar projection, curiously narrow in relation to its length, and with equal right we may regard this projection as a primitive Scutellerid Scutellum or an excessively developed Cydnid Scutellum. My having referred the genus to the *Cydnidæ* is due to the habitual appearance which the preserved remains of hemilytra lends to the insects. The strongly punctuated surface of the hemilytra and the convex fore margin of these wings which when closed quite cover the Connexivum, are certain Cydnid characters. It is, however, most interesting that the long scutellar projection issuing from a little oviform, solid basal part classifies it as a transitorial form to the *Scutellaridæ* which are already for other reasons derived from the *Cydnidæ*.

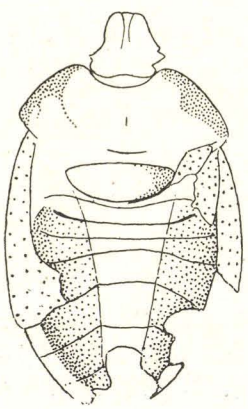

Fig. 20. Teleocydnus n. g. transitorius n. sp.

The specimen mentioned here is besides so badly preserved that further characters cannot be stated, but the characteristic Scutellum will no doubt be sufficient for an identification of future material. Length 13 mm.

1 specimen. The north coast of Fuur (poss. Min. Museum).

Cydnidæ sp.

In cement-stone a bug has furthermore been found with missing legs and antennæ, and with a strongly molested membrane. According to its habitus also this insect, measuring about 15 mm. in length, must be referred to the Cydnids, but further reference is excluded.

1 specimen. Mors (Poss. Herlufsholm).

Coreidæ.

Coreidæ sp.

In cement-stone the body of a bug, 6.25 mm. long, has been found; like the former without legs or other appendages; according to its general appearance, it must be referred to the family *Coreidæ*. It agrees best with the genus *Corizus* or its allies, but no systematic characters are to be discerned which might justify its final reference to this genus.

1 specimen. Silstrup (poss. Min. Museum).

Lygæidæ.

? **Lygæidæ** sp.

The body of a bug, 7 mm. long, procured from cement-stone, either belongs to the Lygæids or to the Coreids. The broad head and the, especially in comparison with the former specimen, narrow abdomen most probably refer the animal to the Lygæids. Also here further reference is excluded.

1 specimen. Silstrup (poss. Min. Museum).

Saldidæ.

Saldidæ sp.

The body of a bug, 6 mm. long, without antennæ, legs or wings has been found in cement-stone. According to the breadth of the head, the large eyes, and the shape of its Scutellum, it must be referred to the family *Saldidæ*. Further systematic reference excluded.

1 specimen. Silstrup (poss. Min. Museum).

General Remarks.

The finds of Eocene insects from Europe, recorded on p. 7—9, however fragmentary and uncertain they are, serve to prove that beetles are the most frequently occurring finds, but it is of course impossible to draw any general conclusions from these finds on account of the small number of determinable and describable forms found.

Through the investigations of SCUDDER and COCKERELL the Rocky Mountain fauna, on the other hand, has become so well known that our conception of this fauna, obtained through an investigation of the systematic position of the forms, cannot be very wrong. From the Eocene of the Rocky Mountains we know as referred to species:

1 Psocid.
8 Odonates (+ 1 only referred to genus).
3 Trichoptera.
6 Orthoptera (+ some not further referred).
1 Aphid.
43 Homoptera of which 28 Fulgorids.
10 Bugs.
3 Physopods.
120 Beetles (+ some more or less undetermined) of which 76 weevils
37 Nematocera (+ some undetermined) of which 12 craneflies.
36 Flies (+ some undetermined).
18 Hymenoptera (+ some undetermined).

286 species.

The Rocky Mountain fauna thus appears to be characterized by its large amount of beetles; these insects make out half the number of species, and the number of individuals in the single groups corresponds rather well with the number of species within the same groups. It is, therefore, of interest to make a comparison with the Diatom-earth bed fauna of Denmark. It is true that the finds from the Diatom-earth bed are but few, only 35 specimens in all, so that they are in a much higher degree to be regarded as casual finds, but in spite of this a general view of the fauna is of interest. The Diatom-earth bed fauna consists of:

Odonat 1 species (1 specimen).
Locust 1 species (1 specimen).
Planipennia 2 (3?) species (3 specimens).
Beetle 1 species (1 specimen).
Hymenoptera 2 species (1 specimen of each).
Undetermined Moths (5 specimens).
Craneflies 4 species (1 specimen of each) + 2 not referred to species.
Fly 1 species (1 specimen).
Homoptera 5 species (1 specimen of each), all Fulgorids.
Bugs, at least 8 species (3 referred to species, and at least 5 not referred to species) 15 specimens in all.

By systematic palæontological investigations like those of this paper two questions naturally arise, viz. how was the nature in which these forms lived? and what do they tell us about the climate of the period in which they lived?

As to the first question, we must begin by stating that both terrestric and aquatic forms are represented in the 2 faunæ compared, (Rocky Mountains: Trichoptera, Odonata, several Nematocera; Diatom-earth: the Odonat and perhaps the craneflies). Whether the Danish aquatic forms have completed their development in the very lagoon in which the Diatom-earth was deposited or in pools on the firm land behind it, we cannot determine, and it, therefore, is of rather small interest to us. A comparison between the terrestric forms of the two faunæ is, on the other hand, most interesting. It namely distinctly displays a characteristic difference which may very well be designated by difference of facies, a word otherwise only applied to marine deposits. As far as America is concerned, we must especially call the attention to the many weevils and other beetles developing in wood which indicates that the surroundings of the American localities then were close to rich forests. The Diatom-earth insects, on the other hand, the Planipennids, Fulgorids, Moths etc. and above all the very great contribution of bugs, in a much higher degree belong to the open country than to forests; the range of the Diatom-earth insects thus obviously must be characterized as meadow near water.

As regards the climate of the Eocene period several forms are suggestive of a tropical one. The *Phenacolestes* genus belongs to the *Podagrion*-group, the living representatives of which all are tropical forms (tropical America, tropical Africa, the East Indies, Australia). The cranefly genus *Eriocera* likewise belongs to the Tropics (South Amerika, Sumatra, Formosa) and the species group to which the Diatom-earth species belongs is specifically east Asiatic. All the Homoptera belong to the Fulgorids of which the main part, especially the large lepidopterous forms, belong to the Tropics; the family *Ricaniidæ* to which two of the Diatom-earth forms have been referred consists of nothing but tropical insects (the Brasils, the Guinea coast, India, the East Indies, Japan, Australia etc.). This also applies to almost all the Flatids, the two Diatom-earth representatives of which must be referred respectively to the genera *Lechœa*, the two species of which occur in Borneo, Celebes a. s. f. and to *Ormenis* the many species of which belong partly to tropical America, partly to the islands of South Asia (Ceylon, Sumatra, Java etc.). Finally the obviously common bug (3 finds of this species existing) *Tectocoris angustilobatus* must be named which appears to be tropical

partly on account of its large size, partly by its reference to the *Tectocoris* genus, the only recent species of which occurs in the East Indies and down to Australia.

All these forms unmistakeably point to a tropical climate in the Eocene period and thus confirm the estimate obtained by other ways, namely that the middle temperature of the Eocene period has been 10^0 higher than that of our days. For the sake of completeness I shall add that none of all the other Diatom-earth forms are incompatible with the Tropics.

As will be seen from what has been said about the tropical occurrence of the recent allies of the Diatom-earth insects, these recent forms seem most likely to occur in East Asia, and especially in the East Indies where they are all to be found. Whether this fact is of any importance, and whether any consequence may be drawn from it, or not, I shall leave undecided.

For conclusion I shall only point to the difference between the fauna of the Diatom-earth and the amber fauna. Surely the original countries of the amber and the Diatom-earth have not been far distant from each other, and at about the same latitude. The layers in which amber is found in Samland are, as well known, referred to the beginning of the Oligocene, but the origin of amber and the age of the fauna enclosed in amber are sometimes — though hypothetically — referred to the Eocene. The amber fauna, however, is of a specifically temperate appearance, it consists of the same types as we meet with in the North-and Central-european fauna of our days [1]). The Diatom-earth bed fauna, on the other hand, is as above mentioned just as specifically tropical, and the (lower) Eocene age of the Diatom-earth being certain, it is not likely that the amber fauna indicating a much cooler temperature also should belong to the Eocene.

[1]) even if more tropical forms may be found among them — as already indicated by Berendt (Org. Reste d. Bernst. I. p. 59).