Michael Hubbard with best wishes.

LARVAL AND ADULT INSECTS FROM THE PALEOCENE OF ALBERTA, CANADA

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Abstract

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Two localities in central Alberta yielding insects of Paleocene age are described. About half of the 176 specimens obtained are coleopteran larvae; many of the adults and larvae are members of aquatic groups.

Introduction

Fossil insects of Paleocene age are rare compared with those from later divisions of the Tertiary (F.M. Carpenter, pers. comm.). Any new collections from that time (58–64 Myr. B.P.) should fill the evolutionary gap between Cretaceous faunas and the relatively abundant Eocene and Oligocene faunas of North America. Our collections from the Paskapoo Formation on the Red Deer River are unusual because of the diversity of recognizable taxa and because of the abundance of well-preserved larvae.

Study Area and Methods

Paleocene insect localities are also rare in North America; the known sites are mostly in Alberta and Montana. We discovered fossil insects from two localities. One site (Blackfalds, locality 22 of Wilson, 1978) at the junction of the Blindman and Red Deer rivers, has long been known for its abundant leaf impressions (Hickey and Peterson 1978); the other is 3 km upstream of the Blackfalds site. Fossils, matrix, and position of the fossiliferous layer with respect to surrounding layers appear identical at the two sites.

The matrix was exposed with a hand shovel, carefully cleaved with hammer and chisel, and examined for insects with a 6× magnifying lens. The insects were prepared in the laboratory using a stereomicroscope and a modified vibrating engraving tool.

Results and Discussion

The Paskapoo Formation overlies Cretaceous (Maestrichtian) age beds, but appears to be younger than earliest Paleocene, based on mammalian assemblages. According to Krause (1978) mammals identified from other Paskapoo sites in the area are late Torrejonian to late Tiffanian. The exact age of our sites is unknown.

The fossiliferous layer, ranging in thickness from 5 to 10 cm, is a fine-grained argillaceous limestone of 1 part hydromica to 2 parts calcite. It overlies a coal seam of varied thickness. Unlike many lacustrine sediments, the matrix shows no laminations. Hickey and Peterson (1978) suggest the Blackfalds site was once a forested backswamp; the absence of fish remains and the presence of mollusc shells (predominantly *Physa* spp.) and a few water lilies support this suggestion. Dominant plant species at both sites include the gymnosperm *Glyptostrobus europeus* (Brongniart) Heer, the dicotyledon "*Viburnum*" *cupaniodes* (Newberry) R.W. Brown, and the monocotyledon *Zingiberopsis attenuata* Hickey and Peterson.

The insects are preserved as flattened 3-dimensional carbonized remains on both halves of the split matrix. Preservation includes specimens exhibiting eye facets, setae, and spiracles.

Table I. Paleocene insects collected from the Paskapoo Formation, South-Central Alberta. All specimens in University of Alberta Paleontological Collection

Identification	Structures preserved	No. of specimens
LARVAE		
Coleoptera		
Elateridae?	Whole	1
Type A (Noteridae?)	Mostly whole	17
Type B	Mostly whole	8
Type C (Helodidae?)	Mostly whole	12
Unidentified	Incomplete	45
Diptera?	Whole	3
Trichoptera?	Whole	1
Unidentified	Incomplete	8
Total		95
EXUVIAE (larval)		16
NYMPHS		
Odonata–Anisoptera	Abdomen, legs, thorax	4
Ephemeroptera	Whole	1
Total		5
PUPAE		
Diptera		
Tipulidae	Whole	5
ADULTS		
Odonata		
Gomphidae (MW)*	Wing	1
Homoptera		
Cercopidae (KH)*	Whole	1
Cercopidae?	Fragmented	1
Cixiidae (LO'B)* (KH)*	Wing	1
Heteroptera		
Belostomatidae?	Head, thorax, abdomen	1
Pentatomidae?	Head, thorax, abdomen	1
Unidentified	Wing	1
Coleoptera		
Curculionidae (JM)*	Elytron	1
Chrysomelidae (JM)*	Elytra and whole	5
Chrysomelidae-*Donacia* (JM)*	Elytra	2
Tenebrionidae (JM)*	Elytron	1
Dytiscidae (JM)*	Elytra and whole	9
Carabidae (JM)*	Elytra	1
Unidentified	Whole, no legs	3
Diptera		
Tipulidae-*Limnophila* (CA)*	Wing	1
Tipulidae	Wing	1
Unidentified	Whole	1
Hymenoptera		
Formicidae	Fragmented	2
Orthoptera?	Wings	2
Unidentified adults		19
Total		55

*Tentative identification by:
MW — Dr. M.J. Westfall, Jr., University of Florida, Gainesville.
KH — Dr. K.G.A. Hamilton, Biosystematics Research Institute, Ottawa, Ontario.
JM — Dr. J. Matthews, Geol. Survey of Canada, Ottawa, Ontario.
CA — Dr. Charles P. Alexander, Professor Emeritus, University of Massachusetts, Amherst.
LO'B — Dr. Lois O'Brien, Florida Agricultural and Mechanical University, Tallahassee.

Thus far 176 fossil insects have been collected from the two sites (Table I). Among the adults, 40% are in the Order Coleoptera, 11% are Hemiptera, 5.5% Diptera, 3.6% Hymenoptera, 3.6% Orthoptera, and 1.8% Odonata. The remainder (35%) are unidentified, but are almost certainly not Coleoptera. The single adult specimen of Odonata (Fig. 1a) most likely belongs to the Family Gomphidae, but does not exactly resemble any extant genus (M. Westfall, pers. comm.). The specimen of Belostomatidae (Fig. 1b) resembles a member of the genus *Belostoma*, but since neither legs nor mouthparts are visible, identification is tentative.

Excluding exuviae, 65% of the insects collected were immature. Several of the more interesting of these were the only specimens representing groups to which they were assigned. One was a small (8 mm) larva (UAPC5570) with an unsclerotized abdomen which possibly has gill-like protrusions and a sclerotized terminal segment. Each thoracic segment is covered by a sclerotized plate; the metanotum appears reduced. These characteristics suggest it is a species of Trichoptera, although definitive characters, such as legs, are not visible.

Another larva (UAPC5524), an elaterid-like coleopteran, shows extremely well-preserved legs, each with 4 articles (Fig. 2), biforous spiracles, and a prognathous head. Nine abdominal segments are evident; the terminal portion is distorted.

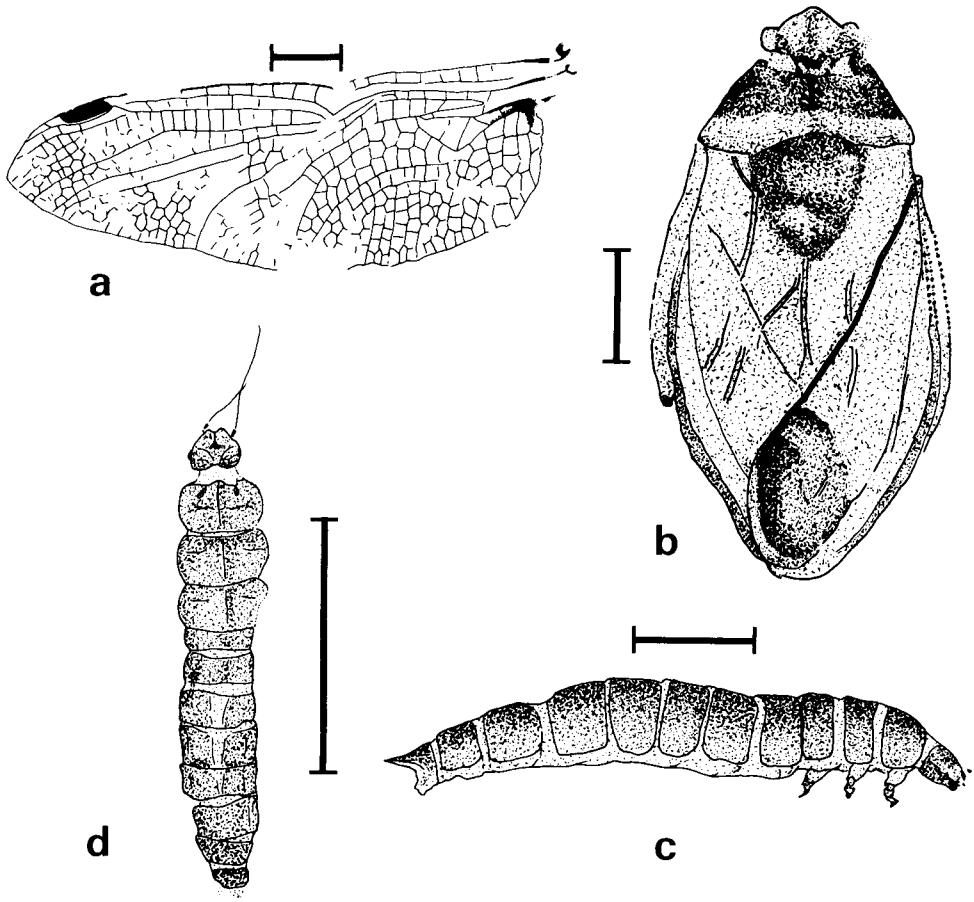
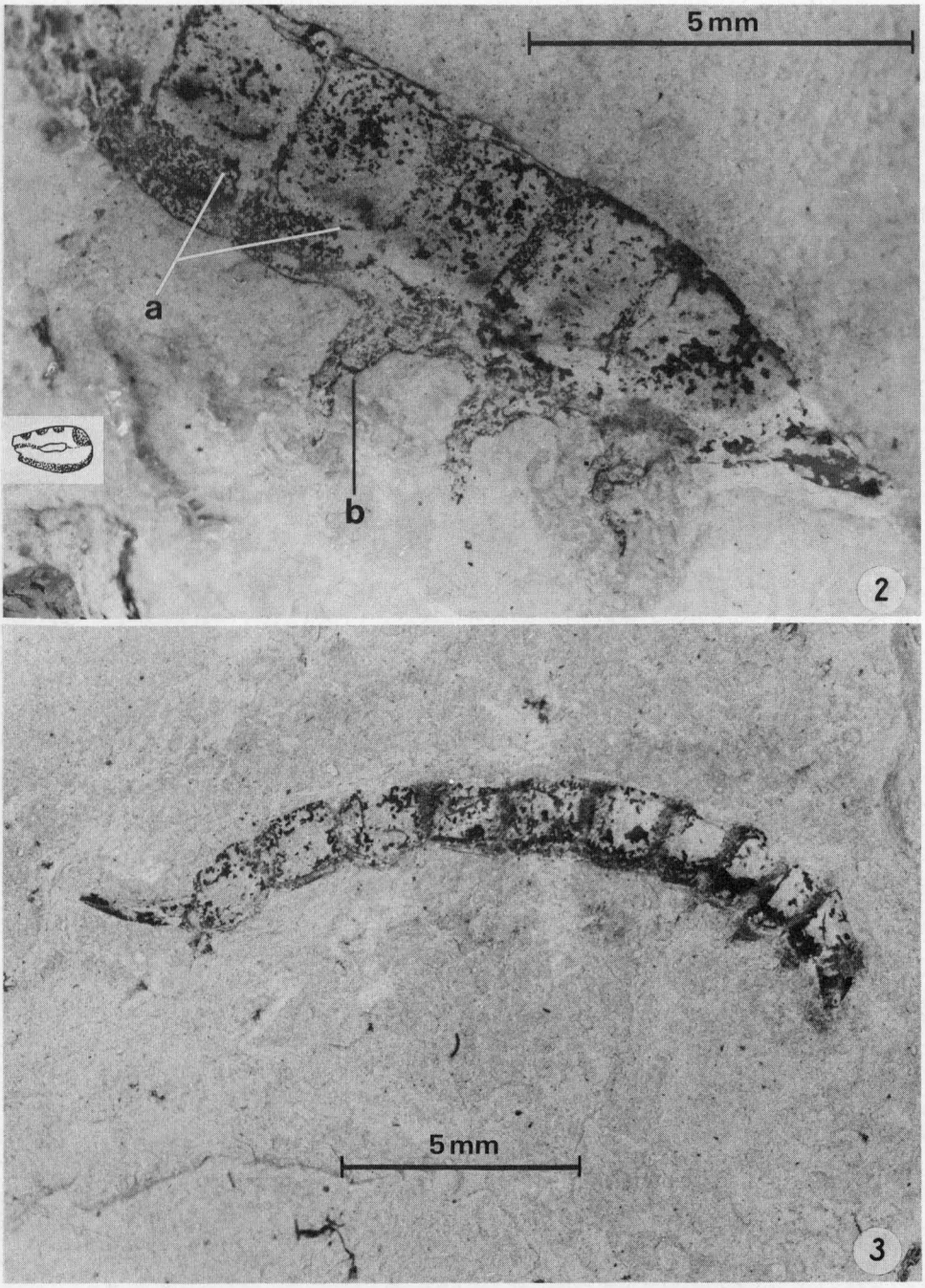


FIG. 1. (a) Odonata, Gomphidae (UAPC5553); (b) Heteroptera, Belostomatidae? (UAPC6150); (c) Coleoptera larva type A (Noteridae?) composite drawing from UAPC6151 and UPAC5526; (d) Coleoptera larva type C (Helodidae?) composite drawing from UPAC5528 and UPAC5518. Drawn with the use of a microscope drawing tube; scale: 5 mm.



FIGS. 2–3. 2, the only specimen collected of an elaterid-like larva. Note biforous spiracles (a) in abdominal pleural region and stout setae on legs (b). Insert shows drawing of spiracle from abdominal segment 2. 3, type B larva. Note short legs and long siphon-like eighth abdominal segment.

One of the few nymphs in the collection is UAPC5569. This small specimen lies ventral side up, concealing wing pads and gills, yet it shows 3 long caudal filaments of equal size, and single claws on long legs. These characteristics place it in the Ephemeroptera.

We believe most of the larvae collected are beetles: they have 3 pairs of jointed thoracic legs, no abdominal prolegs, a distinct, sclerotized head capsule with chewing mouthparts, no evidence of wing pads, and an abdomen as well sclerotized as the thorax. Many of these larvae differ sufficiently to place them in one of three distinct

FIG. 4. Adult Cercopidae. As in many of the adult specimens, the body is badly distorted. Legs rarely preserve well.

groups. The largest group (type A), comprising 17 specimens, has a mean length of 29 mm (range 24.5–33 mm). These larvae have bead-like striations between abdominal segments, short, possibly fossòrial legs (length 2 mm on a 30 mm specimen) and 8 abdominal segments of which the last is pointed, but bears neither hooks nor appendages (Fig. 1c). These most resemble the Family Noteridae.

Another group (type B) comprises eight specimens generally similar to type A specimens except that they are smaller and the eighth (terminal) segment is an elongated siphon-like structure (Fig. 3). A third group (type C) comprises 12 specimens with a mean length of 11.3 mm (range 8.6–13.1 mm). All except two have dorsal or ventral surface up, indicating a flattened shape; most larvae of types A and B have a lateral surface exposed. Type C larvae have 8 abdominal segments, thin legs (length 2.2 mm on a 12.3 mm specimen), and rounded thoracic segments (Fig. 1d). Very elongated antennae on several specimens indicate these larvae belong in the Family Helodidae.

Table I shows that about half of the identified groups are aquatic. The Coleoptera larvae with 8-segmented abdomens are probably aquatic, since it is unlikely so many similar terrestrial forms would fall or be washed into water. Fossils of adult Cercopidae (Fig. 4) and Formicidae represent vegetated sites near the former water body. The depositional environment of these localities must have been very different from that of other major Paleogene localities, most of which were once deep water lakes and in which winged adults predominate. In contrast to those environments, most insects from the Red Deer River sites were preserved in the environment in which they lived — highly productive, shallow water which was either slowly moving or wind-stirred.

None of the identified families has been recorded previously from the North American Paleocene. Our collection may be the earliest record for many groups. All of the families identified from the two sites are represented in American Eocene collections except Belostomatidae, Gomphidae, and Helodidae and all are recorded from Oligocene Florissant collections (Wilson 1978).

We are aware of no other similar concentrations of aquatic larvae and adults from the Tertiary. Further collection and study of these insects could reveal exciting answers to questions of insect evolution and community composition from that time.

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