

# Miocene Fossil Bumble Bee from the Soviet Far East with Comments on the Chronology and Distribution of Fossil Bees (Hymenoptera: Apidae)

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**ABSTRACT** *Bombus vetustus* n. sp. is based on a Miocene fossil from the Soviet Far East. The specimen is a male and differs from recent *Bombus* males in having more long hair on the hind tibia, as well as in other features. Comparative comments list other species of fossil *Bombus*. There are also chronological and geographical comments on fossil bees in general.

**KEY WORDS** Insecta, Apidae, *Bombus*, Miocene

THIS IS AN ACCOUNT of a fossil bumble bee collected by A.P.R. in the Pacific Maritime U.S.S.R. It is a male that cannot be identified with any other species of *Bombus*, but can be placed more precisely among the species of *Bombus* than any other fossil *Bombus*.

The fossil was preserved in diatomites of the Botchi Formation from the upper half of the Miocene period. The deposits accumulated in a lake that existed in an active volcanic area and are now exposed on the left bank of the Botchi River at the mouth of the Mulpa River, 25 km from Grossevitich Village on the western coast of the southern part of the Tatar Strait (Northern Sikhote-Alin Mountains, Sovetskoy-Gavanskiy District, Khabarovsk Region, U.S.S.R.). The fossil-bearing locality was described by Akhmetjev (1973). It yielded various plants (Akhmetjev 1973), fishes (undescribed), Crustacea (undescribed), and insects. Among the latter, the most common are caddisflies (178 specimens found, mostly larval cases [Sukatsheva 1982]). There were also 35 Diptera, 12 Heteroptera, 5 Homoptera, 5 Hymenoptera (1 bee described here, 2 Eumenidae, 2 Pamphiliidae [Rasnitsyn 1983]), 3 beetles, 1 roach, and 1 Neuroptera.

## *Bombus vetustus*, New Species

**Type Material.** HOLOTYPE: #2054/229, part and counterpart impressions of the whole bee in the Paleontological Institute, U.S.S.R. Academy of Science, Moscow.

**Etymology.** From Latin, *vetustus*, old.

**Preservation.** The fossil bee looks like an insect long treated by KOH, or partly decomposed on quiet water, with the abdomen inflated so that the sclerites are separated and body parts and appendages partly displaced (Fig. 1-4). The complete absence of the genitalia and associated structures

is enigmatic. Their full discoloration hardly seems likely. Even if the bee were a female, one would expect some dark coloration to represent the sting and associated structures. Otherwise the preservation is excellent, with each hair seen on some parts of the body and appendages (although hair branching is probably not preserved).

**Morphological Observations.** (Fig. 1-8) Measurements (in mm): body length as preserved, 19.2; life size possibly about 16. Fore wing length, 10.4; head length (height), about 3.8; antennomeres 1-10, lengths 1.4, 0.2, 0.3, 0.3, 0.4, 0.5, 0.5, 0.4, 0.4, and 0.4 mm respectively; ultimate one, 0.6. Fore femur length, 1.9; fore tibia, 1.8; basitarsus, 1.6; midleg equivalents 2.7, 2.7, 2.2, respectively; hind leg equivalents 2.9, 3.9, 2.2, respectively; remaining hind tarsal segments 0.6, 0.4, 0.3, and 0.8. The distended metasoma exaggerates the original size of the insect. No color pattern of the hairs is evident although those of the head and thorax are very dark. The small stigma (Fig. 5) suggests that this is not one of the common groups of short-tongued bees. The small head suggests that it is not a eucerine bee such as *Tetralonia*. This and other anthophorids ordinarily have basitibial plates, which are completely absent in the fossil. That it is a male *Bombus* is indicated by the small head, long scape (unlike *Tetralonia*), the slender hind femur (Fig. 6), the apparently long malar area (not indisputable, because the preservation of the head is not optimal), the stigma, and wing venation. In *Psithyrus*, the only other bombyine genus, the hind tibia is covered with short, dark hairs rather than long hairs as in the fossil. The small first metasomal tergum of *Bombus*, largely vertical with only a short horizontal surface, cannot be indisputably recognized although there is space for it; assuming its presence, there are seven metasomal terga, as in males. The distal wing venation is badly faded and largely invisible in the photographs; the drawings show it better although some features (the apex of the marginal cell, part of the second transverse cubital vein) are not preserved at all. The largely longitudinal and sigmoid first transverse cubital

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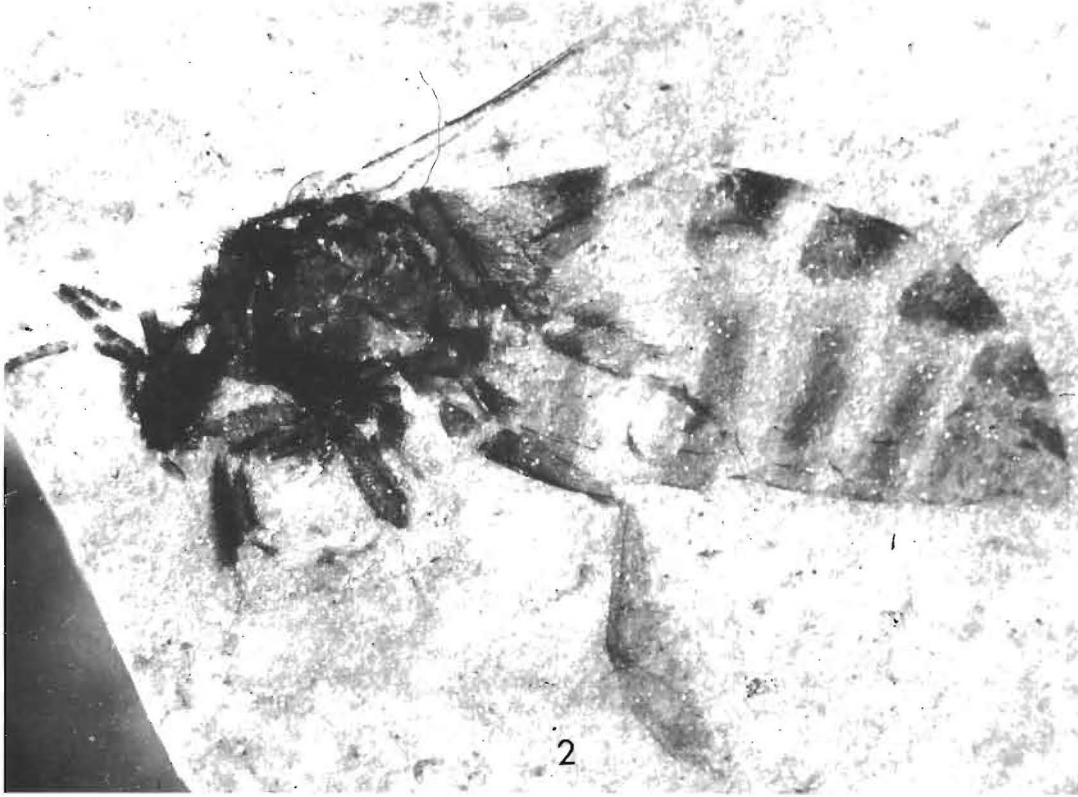
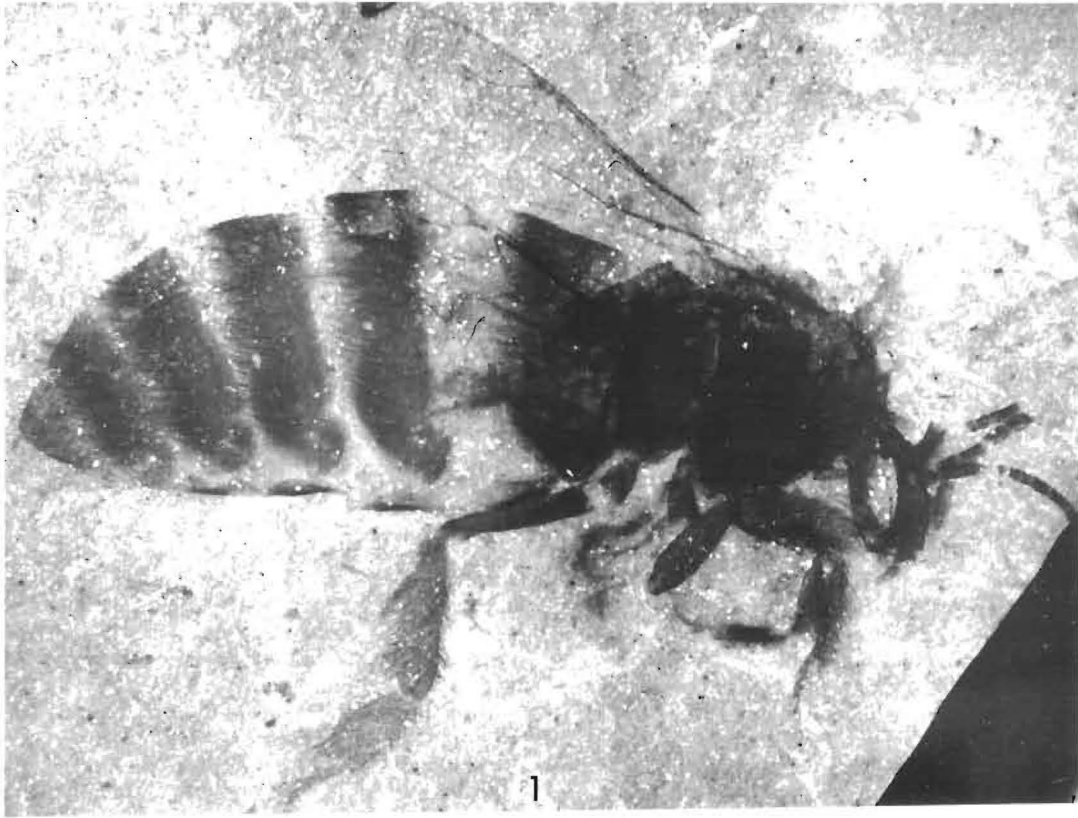


**Fig. 1 and 2.** *B. vetustus*, holotype, part and counterpart impressions. (1) Dorsal and right side view of the fossil. (2) Ventral and left side view.

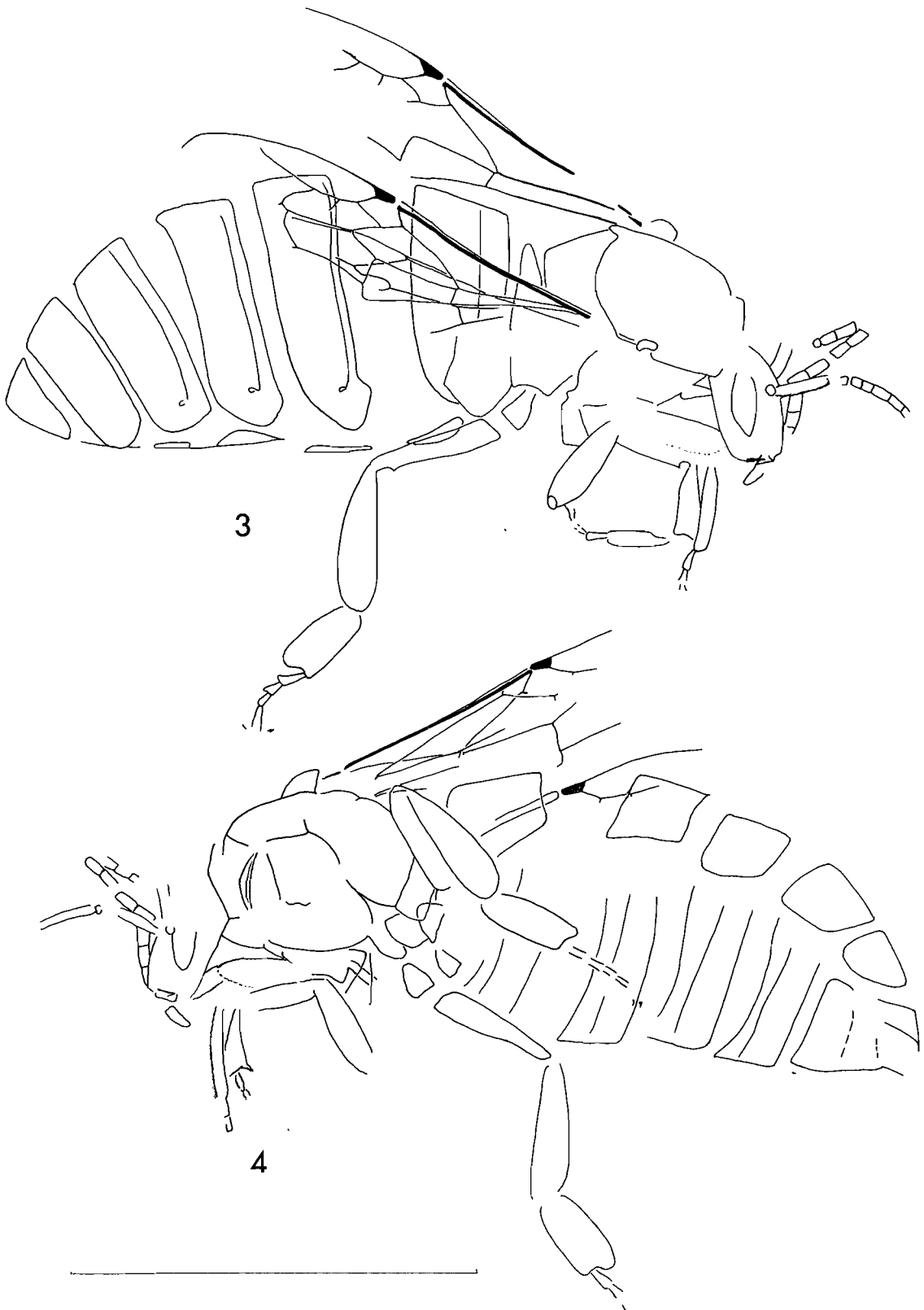


**Fig. 3 and 4.** *B. vetustus*, holotype, outlines corresponding to Fig. 1 and 2. The scale line represents 1 cm. (Drawings by A.P.R.)

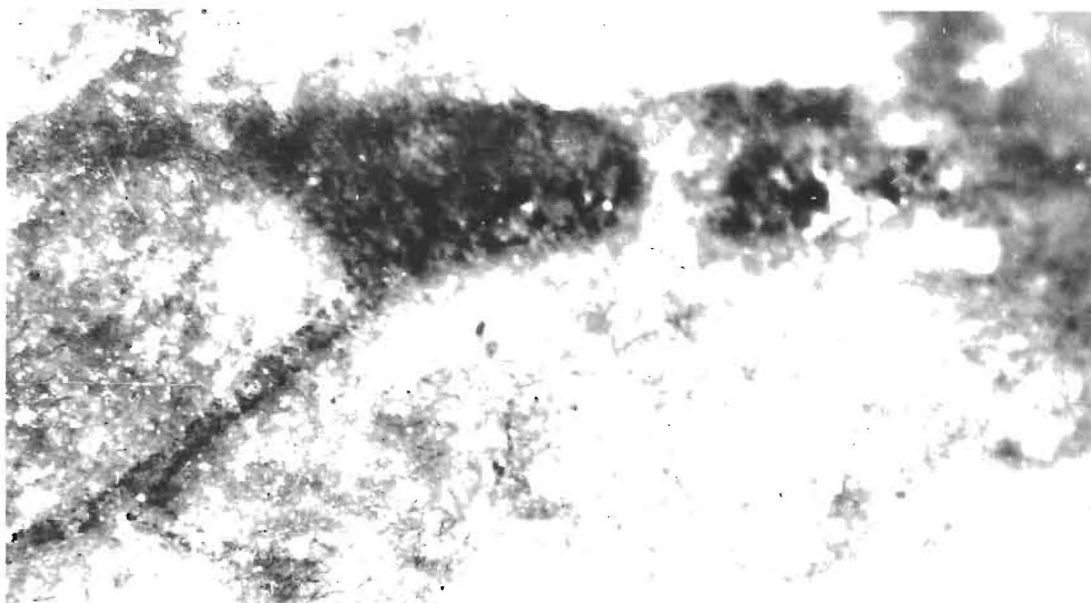


Fig. 5. *B. vetustus*, holotype, stigma from counterpart impression.

vein (second free abscissa of Rs in terminology of Michener [1944]) is partially detectable and is characteristic of *Bombus*.

A possible problem is presented by a minute slender object at the lower end of the head. It is possibly divided into three or four segments, suggesting a palpus. The total length is about as long as one of the larger flagellar segments. If it were the minute and delicate palpus, other parts of the proboscis should be visible near it. In fact, the proboscis is probably in its normal resting position and unidentifiable among the legs under the head and

thorax. Our interpretation is that the "palpus" represents debris of some sort.

As to characters relative to recent species of *Bombus*, *B. vetustus* differs from modern males in the rather long hairs over much of the outer surface of the hind tibia. In many *Bombus* males, there is a smooth or sparsely haired area on the tibia, resembling a corbicula (Sakagami & Ito 1981). However, as shown by those authors, some species such as *B. mendax* Gerstäcker, *B. pomorum* Panzer, and *B. edwardsi* Cresson have the tibial surface uniformly hairy. In these species, however, the long

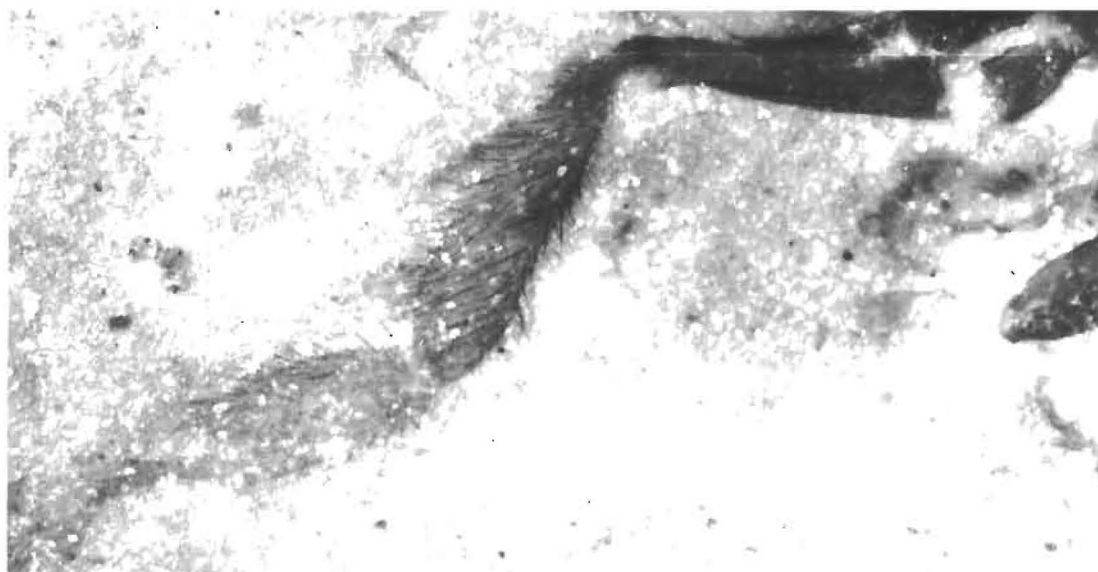


Fig. 6. *B. vetustus*, holotype, right hind leg.

hairs are primarily marginal. The hind tibia of *B. vetustus* is rounded at the apex and thus shaped as in *B. mendax*, *B. edwardsi*, and *B. schrencki* Morawitz, as illustrated by Sakagami & Ito (1981). Most male *Bombus* have the hind tibial apex subtruncate. The hind basitarsus of *B. vetustus* is fully as wide as the tibia, at the apex produced beyond the base of the second tarsal segment. In most male *Bombus*, it is distinctly narrower than the basitarsus, often produced and angulate somewhat beyond the base of the second segment. In response to our questions, M. Ito has pointed out that especially in *B. exul* Skorikov (but also in *B. mendax*), the hind basitarsus is about as broad as the tibia. It is truncate at the apex and does not extend beyond the base of the second segment in both species and in *B. rufocinctus* Cresson. In these recent species the basitarsus is somewhat narrower at the apex than in the middle, whereas in *B. vetustus* the distal half seems to be about parallel sided. The lower half of each flagellar segment is covered with small circular sensilla (Fig. 8), as in *B. rufocinctus*. In many other species, such sensilla are smaller so that the difference between upper and lower surfaces is less obvious.

The following are comments on other fossil *Bombus*. The species included in *Bombus* by Zeuner & Manning (1976) in their review of fossil bees are *B. crassipes* Novak, *B. abavus* Heer, *B. florissantensis* (Cockerell), and *B. proavus* Cockerell. Only the last was considered to be a *Bombus* by Cockerell (1931), who believed that the others were either not *Bombus* or were too poorly preserved and described for placement in *Bombus*. His view seems quite justified. *B. proavus* was from the Miocene of Washington State. It was significantly larger than *B. vetustus* and is probably a female. Our fossil differs from *B. proavus* and most recent *Bombus* in that the second submarginal cell, on the marginal cell, is shorter than the third.

*Bombus luianus* Zhang (1990) from the Miocene of Shandong Province, China, is also a true *Bombus*, apparently a female. It agrees with *B. vetustus* in the abovementioned wing character, but seems to differ in the more truncate stigma. Most of the other characters that might differentiate it from *B. vetustus* probably vary sexually; no legitimate comparison can be made in such characters between the female *B. luianus* and the male *B. vetustus*.

*Bombus pristinus* Unger (1867) from the Miocene of Euboea Island, Greece (a species missed by Zeuner & Manning [1976]) was represented by a single forewing that is suggestive of *Bombus*, but has a much enlarged second submarginal cell, unlike recent or other fossil *Bombus*. Additional information on this site is provided by Bachmayer et al. (1971). Incidentally, Unger attributed the species to Regenhöfer who, however, appears not to have written the comments or prepared the illustration in Unger's work; we conclude that the name must be attributed to Unger.

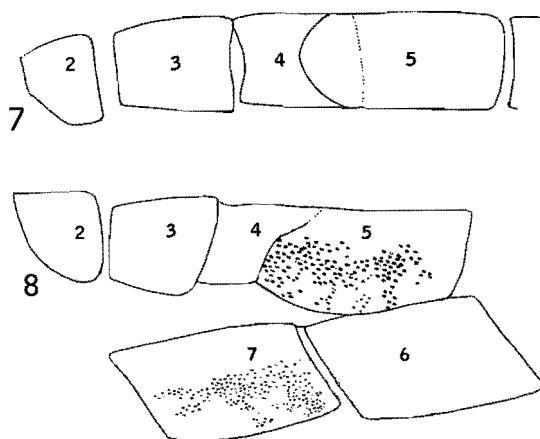


Fig. 7 and 8. *B. vetustus*, holotype. (7) Segments 2–5 of right antenna from below. The dotted line represents the line between segments 4 and 5 from the dorsal side, as seen in the counterpart. (8) Segments 2–7 of left antenna based on both part and counterpart. (Drawings by A.P.R.)

#### Comments on Chronology and Geography of Fossil Bees

A bee is known from the Paleocene of Menat, France (Piton 1940); the age of the insectiferous bituminous shales of Menat is from Russel (1967). Piton's crude drawing of *Probombus hirsutus* shows no corbicula on the hairy hind tibia; the metasoma has six segments and suggests a female but the antennae are shown as 14-segmented (!); the wing venation is badly misinterpreted but has some *Bombus*-like features; as drawn, it differs in other ways from that of any bee. Nonetheless, the fossil was obviously that of a bee, apparently not a *Bombus* and not similar to *B. vetustus*. A number of Upper Eocene bees are known from the Baltic Amber as indicated by Zeuner & Manning (1976). Otherwise, most bee fossils are more recent.

There is one exception, however—*Trigona (Trigona) prisca* Michener & Grimaldi (1988a,b), described from the Upper Cretaceous of New Jersey. The age of the amber in which it was found needs verification. The origin of the amber was indicated by its (old) label. The chemical and physical attributes of the amber were similar to those of amber recently taken from stratigraphically known late Cretaceous sites in New Jersey. Although the bee was very similar to recent neotropical species, the amber did not come from neotropical leguminous tree sources, like that from the Dominican Republic or southern Mexico; it was from araucariaceous conifers such as grew in the late Cretaceous in New Jersey. Details are presented by Grimaldi et al. (1989), and they support the Cretaceous age for the specimen based on similarity to known Cretaceous amber from New Jersey.

Nonetheless, because of the numerous other insects likely to be Tertiary in age associated with

the *Trigona*, A.P.R. in particular believes that this piece of amber must be of more recent age. Thanks to D. A. Grimaldi, A.P.R. was able to study the block containing the *Trigona*; like Grimaldi et al. (1989), he found numerous insect remains in it, including remnants of three stingless bees (possibly conspecific), one emesine bug nymph (Heteroptera: Reduviidae), one acalyprate fly identified as a milichiid by Grimaldi, and four wings of one or more specimens of higher termites (those having only two veins along the costal wing margin and thus belonging to Termitidae or Rhinotermitidae). Such termites are otherwise unknown before the late Eocene (Baltic amber). Similar fossils from stratigraphically dated amber are badly needed to verify or reject the Cretaceous age of *Trigona prisca*.

A comment about the taxonomic placement of *Trigona prisca* is appropriate here. Since contributing to the Michener & Grimaldi (1988a,b) papers, C.D.M. has studied the classification of Meliponinae in greater detail (Michener 1990). His current view is that because of rampant convergence in external characters in various meliponine groups, the true position of *T. prisca* must be viewed as dubious, even though it was originally placed in *Trigona* s. str. with which it agrees in toothed mandibles and other external characteristics except the probably simple hairs of the posterior margin of the hind tibia. In the latter feature it resembles the Oriental subgenus *Lepidotrigona* and perhaps *Papuatrigona*. Thus, there is nothing in its external characters to exclude it from the genus *Trigona* in spite of its antiquity. The problem is that the same can be said of the African genus *Dactylurina*, yet the worker gonostyli and male genitalia, both exposed only by dissection, show that *Dactylurina* is only distantly related to *Trigona*, but belongs to a group of African genera. Presumably *Dactylurina* and *Trigona* have converged in external features. (*Dactylurina* does not have toothed mandibles and other features of the subgenus *Trigona* s. str.) The problem is accentuated by the realization that in the Cretaceous when *T. prisca* was living, its location (New Jersey) was not far from Africa, where *Dactylurina* now lives.

The geographical distribution of bee fossils also has some potentially interesting aspects. The bee fossil record has been reviewed by Zeuner & Manning (1976); only a few fossils are not included there. Such additions to their treatment come from Paleocene of Menat, France (Piton 1940); Oligocene of Ruby River, Montana (Becker 1961, 1965; for dating see Wilson [1978]); the Miocene of Kumi, Greece (Unger 1867, Bachmayer 1971); Bohemia (Riha 1973); Caucasus (undescribed specimens in the Paleontological Institute in Moscow); Soviet Far East (the specimen described here); Iki Island, Japan (Fujiyama 1970); and Shandong Province, China (Zhang 1989a,b; 1990); also from Quarternary copal of unknown origin (Moure & Camargo 1978). Taking all the data into consideration we note that

the overwhelming majority of the fossil bees come from Europe west of 25°E, from eastern China, and from central and western North America. Although not all other areas are explored for Tertiary insects well enough to consider the absence or rareness of bees as meaningful, some negative data seem worth mentioning. In particular, their extreme rareness in the rich Caucasian Miocene insect faunas and in Paleocene to Miocene faunas from the Soviet Far East, and their complete absence from the intervening area (which yielded several inferiorly ranked Tertiary insect assemblages) imply that all this territory was poorly populated by bees during the Tertiary. The reason for this deficiency is obscure; accidents of fossilization rather than lack of bees are probably the explanation.

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