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Baisococcus victoriae gen. et sp. n. — a Lower Cretaceous coccid *(Homoptera, Coccinea)*

[With plates I—II and 5 text-figs]

Baisococcus victoriae* gen. et sp. n. — czerwiec z dolnej kredy *(Homoptera, Coccinea)

Abstract. *Baisococcus victoriae* gen. et sp. n. from Siberian (Zabaikalia) Lower Cretaceous (Neocomian) deposits is described and illustrated on the basis of a single male specimen. The endoplalus, tubular ducts and their wax products, antennae, anterior margins of wings and some sclerites of head, thorax and abdomen are relatively well preserved in this fossil coccid which seems to be close to the recent *Xylococculus*, but shares also some characteristics with *Orthezia, Marchalina, Neosteingelia* and *Callipappus*. Current problems and prospects of coccid paleontology are briefly discussed.

I. INTRODUCTION

The taxonomic status of the Triassic *Mesococcus asiatica* BEKKER-MIGDISOVA, originally described in the coccids, is controversial (BEARDSLEY, 1969; SCHLEE, in HENNIG, 1981), thus the oldest known fossils that certainly belong to the *Coccinea* are those of *Eomatsucoccus (Matsucoccidae)* discovered in the Lower Cretaceous deposits in Southern Siberia (KOTEJA, 1988). In the present paper another fossil coccid, found in the same deposits, is described and illustrated.

The lacustrine sediments, about 80 m thick, consisting of various fine-grained materials and containing abundant plant and animal remnants, were discovered on the left bank of the river Vitim, 9 km below the mouth of the Baisa Creek, east of the lake Baikal (Southern Siberia, 53° N/122° E). The fossils in question were found in marl, in bed 31, among the 45 distinguished in these deposits, and are estimated as Neocomian (Lower Creataceous), about 125—115 mill. years old (KRASSILOV, BUGDAEVA, 1982, and records cited herein).

Information on the state of preservation of the *Baisa* coccid fossils and methods of their examination and description has been provided in an earlier paper (KOTEJA, 1988). "Cocc" followed by a number refers to numerals of fossils in the "Catalogue of fossil scale insects" being prepared by the author.

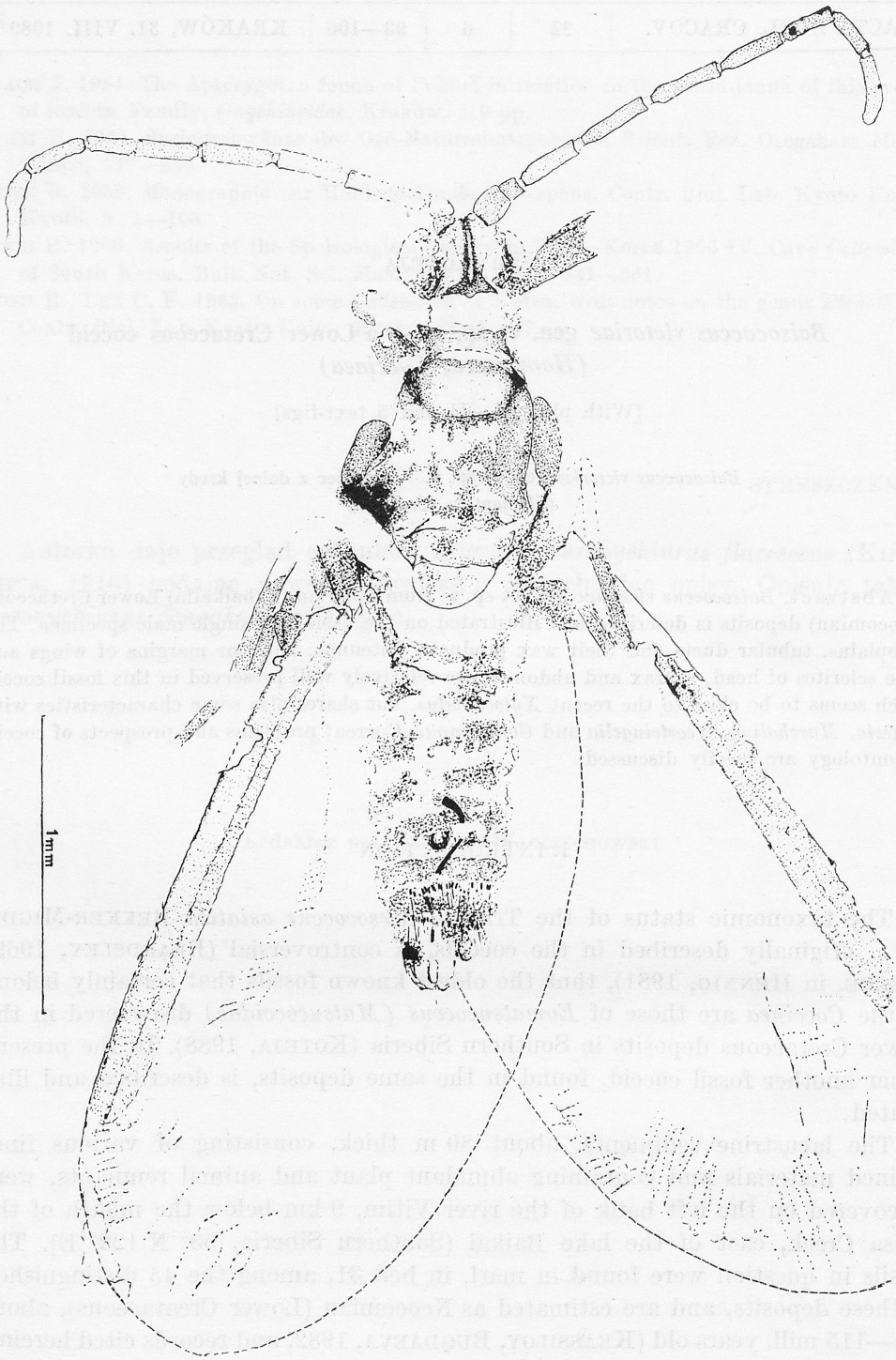

Fig. 1. *Baisococcus victoriae* sp. n., Cocc 166, holotype, ♂; total aspect of dorsum viewed from the interior of the body, i. e., left body side is on the right side of drawing. Drawing based on cuticular remnants and sculpture of deposit; invisible or obscure details drawn with a broken line

Material for this study was provided by Dr I. D. SUKACHEVA and Dr Yu. A. POPOV from the Paleontological Institute, Academy of Sciences, Moscow; Dr SUKACHEVA provided also information on the deposits, fossils, literature records, etc., for which I am very grateful. I am also greatly indebted to Prof. Dr J. W. BEARDSLEY, College of Tropical Agriculture and Human Resources, Honolulu, for his kindness to discuss various aspects of the coccid phylogeny and valuable suggestions.

II. DESCRIPTION

Baisococcus gen. n., ♂

Etymology: Baisa, a stream and site in which the fossil was found.

Type species: *Baisococcus victoriae* sp. n., ♂; monotypic.

Baisococcus is an archeococcid *(Orthezioidea)* with compound eyes; strong dorsal midcranial ridge and middorsal plate; well developed prothoracic collar; strongly sclerotized mesothoracic terga (without central membrane); short mesopostphragma; parallelsided, well sclerotized abdomen (at least on venter); wing as long as body, marginal thickening and subcostal complex sclerotized, not reaching wing apex; antenna filiform, parallelsided, 9-segmented, considerably shorter than wing; two unpaired pore-tube plates on abdominal apex, each bearing about 20 distinctive, strongly sclerotized ducts; with an eversible endophalus reaching about half length of abdomen.

Baisococcus may be related to *Xylococculus* and, to a lesser degree, to *Marchalina*, *Neosteingelia* and *Callipappus*.

Distribution: Siberia.

Host relationship: presumably *Coniferae*.

Age: Lower Cretaceous (Neocomian); 115—125 mill. years; presumably extinct.

Baisococcus victoriae sp. n., ♂

Etymology: The species is named in honour of my mother Victoria.

Holotype: Cocc 166, ♂; Paleontological Institute, Academy of Sciences, Moscow, No. 3064/4601; Baisa, 1979, bed 31; Buryat. ASSR, Eravnenskij Distr.; Cretaceous, Neocomian; Zaza Formation (for more information see Introduction). No other material available.

Description: Body about 2550 µm long, 670 µm wide at mesothorax. Head broadly heart-shaped, about 300 µm long, 450 µm wide. Midcranial ridge strongly sclerotized (cuticle black) consisting of two parallel ridges running close to each other along the entire dorsum; posterad the ridges extend to form a transverse plate. Adjacent area (middorsal plate) sclerotized, but to a much lesser degree than the midcranial ridge. Ocular sclerites strongly sclerotized; remnants

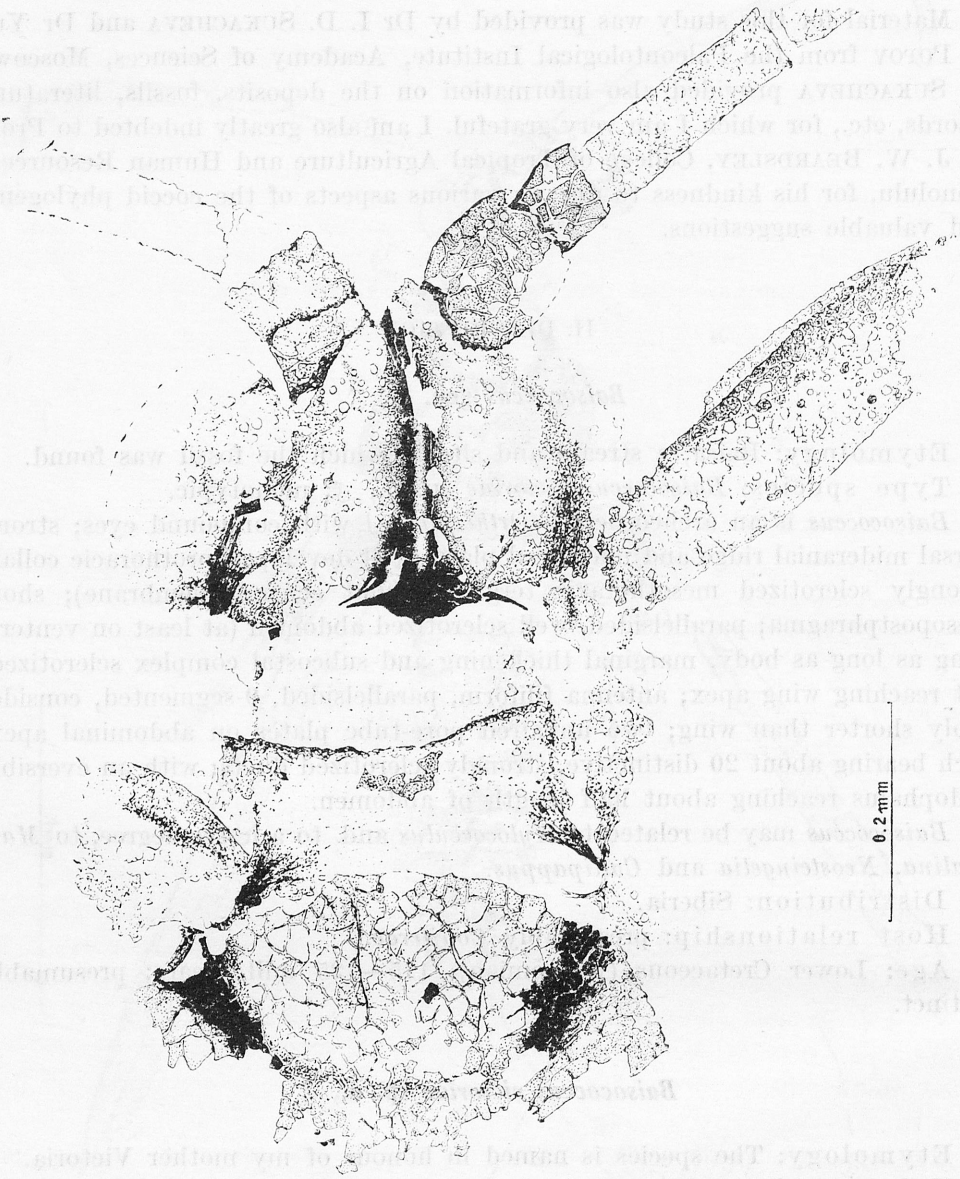

Fig. 2. The same as on Fig. 1; head, dorsal. Very strongly sclerotized cuticular pieces black; white circles — setal sockets or pores; clear polygonal spots — places from which the cuticle is entirely removed; remants of membraneous cuticle marked with scattered dots. In addition to actual dorsal structures, also remnants of ventral structures are drawn. e. g., the pieces on medial part of prothoracic collar presumably represent remnants of prosternum

of compound eyes indistinct; no traces of simple eyes. Ventral sclerites not preserved.

Antennae well preserved; right (left on drawing) partly buried within the deposit; filiform, 9-segmented, 1900 μm long. Scape barrel-shaped, definitely

Fig. 3. The same as on Fig. 1; thorax, dorsal. Cuticular pieces on the region of scutellum, between scutellum and mesopostnotum, and elsewhere on scutum and prescutum, belong to the ventral side and/or to some internal sclerites

Fig. 4. The same as on Fig. 1; abdomen, dorsal. Tergites are the light sclerites, the darker ones, greatly removed — sternites; in clear places no cuticular remnants are preserved

longer than the cylindrical pedicel; flagellar segments cylindrical, all subequa in width; lengths in μm: scape 105 (of the same width), pedicel 82 (75 wide) segment III — 195, IV — 315, V — 345, VI — 210, VII — 195, VIII — 180, IX — 270; all flagellar segments about 60 μm wide.

Neck distinct. Prothoracic collar (dorsal plate) well developed, with lateral ridges. Prescutum broadly subpentagonal, 180 μm long, 330 μm wide, strongly sclerotized, with a very strong (cuticle black) prescutal suture. Scutum, although not all preserved, strongly sclerotized throughout, without any medial membrane described in the *Monophlebidae* and numerous other coccids. Scutellum not preserved; its shape and structure obscured by remnants of ventral sclerites; presumably represented by a narrow transverse rectangle, rather than a triangle occurring in many archeococcids. Mesopostnotum, separated from scutellum by a large membrane with a delicate sculpture, greatly removed or burried within the deposit. Postalares very strongly sclerotized, of obscure shape. Metanotum seems to be represented by a large rectangular sclerite which is almost entirely buried. Ventral sclerites not preserved. The large oval sclerites that can be seen on the sides of scutum (Fig. 3) presumably represent mesepisterna.

Only fragments of legs preserved; nothing definite can be said on their size and shape. Wings 2550 μm long, presumably about 1100 μm wide; marginal

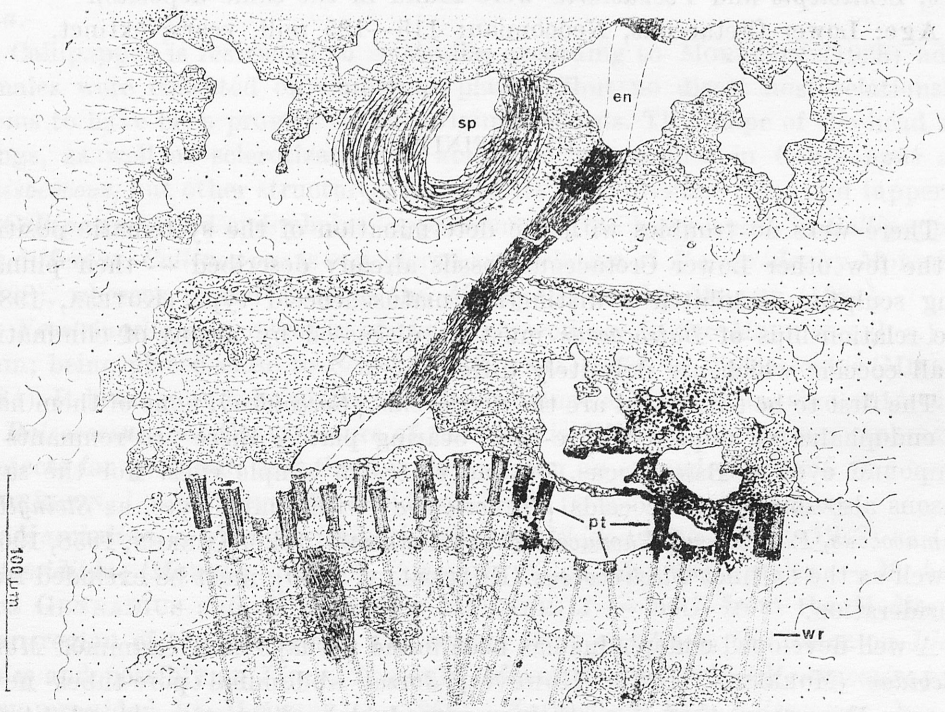

Fig. 5. The same as on Fig. 1; portion of abdomen with remnants of sperm bundles *(sp)*, endophalus *(en)*, anterior row of pore-tubes *(pt)* and their wax products (wax rods, *wr*)

thickening and subcostal complex sclerotized, abrupted far from the wing apex; neither posterior wing margin nor any folds (veins) preserved; there are only traces of the wing disc elsewhere. Halteres not preserved.

Abdomen parallelsided; sternites represented by strong transverse plates; tergites similar, but weaker. Anterior (presumably VIth tergite) pore-tube cluster consisting of a row of 22 tubes; in the posterior one (VIIth tergite) only 14 tubes are preserved on one body side, but their acual number was perhaps also about 20. The tubes are 24 μm long, 9—12 μm wide, strongly sclerotized, with inner wall provided with 4 or 5 longitudinal ridges which correspo nd with the loculi of the multicular pores from which the tubes have evolved. Proximal pieces of all waxy rods produced by the tubular glands are well preserved. Only traces of penial sheath can be recognized; its actual structure remains obscure.

Large pieces of the S-shaped eversible endophalus are preserved; its anterior end (in protracted position) reaches the midlength of abdomen. Although it is said to be membraneous ("fleshy") in the recent species, its remnants in Baisococcus are dark-brown, almost black. Perhaps it is an effect of fossilization, because the preserved sperm bundles are also very dark.

Distribution: Siberia (Zabaikalia).

Host relationship: Presumably *Coniferae* (remnants of *Podozamites*, *Elatides*, *Schizolepis* and *Pseudolarix* were found in the same deposits).

Age: Lower Cretaceous, Neocomian; 115—125 mill. years; extinct.

III. AFFINITIES

There were no troubles with the determination of the systematic position of the few other Lower Cretaceous fossils already described — their pinnate wing sculpture exhibited a distinctive matuscucoccid type (KOTEJA, 1988). The relationships of *Baisococcus* must be discussed by means of elimination of all coccids which are definitely different.

The first to be eliminated are the neococcids *(Coccoidea)*: none of them have an endophalus or unpaired pore-tube bearing plates; there are remnants of compound eyes in Baisococcus, but no traces of simple eyes. For the same reasons also some archeococcids *(Orthezioidea)* with simple eyes, as *Steingelia*, *Stomacoccus*, *Pityococcus*, *Phenacoleachia* (MORRISEN, 1928, THEREN, 1958, 1962), as well as the exitinct *Electrococcus* (BEARDSLEY, 1969), must be excluded from consideration.

A well-developed endophalus has been found perhaps in all examined *Monophlebidae* (MORRISEN, 1928). However, dorsal abdominal pore-tubes never occur in this group; they (i. e., their wax products) are functionally substituted with the so called "fleshy tassels", here. Also remnants of the strong midcra-

nial, preocular and preoral ridges, which form a characteristic double cross in the *Monophlebidae*, must have been preserved, if they actually have existed in *Baisococcus*. Eventually, the scutum bears a central membrane in the *Monophlebidae*, whereas in *Baisococcus* it is definitely absent.

One or two unpaired pore-tube plates occur in the *Ortheziidae*. The head in this family is well separated from thorax, the head sclerites are represented by heavy plates, and the scutum is solid. However, the antennae, although 9-segmented as in *Baisococcus*, are much longer than the body in the *Ortheziidae*, and an endophalus is lacking (KOTEJA, 1986).

Pore-tube plates, and in some genera also an endophalus, occur in the *Margarodidae* s. str. (*Porphyrophora*, *Margarodes* and relatives), but the head is intimately fused with the thorax (neck is lacking) and the antennae are very short (about half wing length), with 7 stout articles (HADZIBEJLI, 1966).

Among the *Coelostomidiidae* (a subfamily in MORRISEN'S system), which certainly represent a heterogenic assemblage (MILLER, 1984), there are genera (*Ultracoelostoma*, *Coelostomidia*, both from New Zealand) with endophalus and a sort of tubular pores, but with the abdomen entirely membraneous, the head with a characteristic double cross of ridges and the scutum with a membraneous medial part, characters occurring also in the *Monophlebidae* (MORRISON, 1928).

The other potential relatives of *Baisococcus*, on which only a fragmentary information exists, are *Xylococculus*, *Neosteingelia*, *Callipappus* and *Marchalina*.

Callipappus is restricted to Australia; according to MORRISON (1928) adult females were collected on numerous plants, "but no direct host relationship seems to have been proved" in the original records. The shape of the head and wings, as well as sclerotization of abdomen, are similar in *Callipappus* and *Baisococcus*, but other structures, particularly the antennae (long and tappering in *Callipappus*) and endophalus (approximating the body length in *Callipappus*) are different. *Callipappus* is considered as a relative of *Margarodes* by MORRISON (1928), whereas placed close to the *Monophlebidae* by MILLER (1984).

Neosteingelia is a member of the *Margarodinae* in the MORRISON (l. c.) system; being placed close to *Steingelia* (KOTEJA, 1974) or *Xylococculus* (MILLER, 1984). It bears pore-tube plates and the antennae and wings are similar to those in *Baisococcus*, but the structure of the head is different, the mesopostphragma projects far posterad; and there is no mention on an endophalus in this coccid (MORRISON, l. c.); it lives on deciduous trees in the Nearctic region.

Marchalina is placed within the *Monophlebidae* (VAYSSIÈRE, 1923) or *Coelostomidiidae* (MORRISON, 1928). Currently it indludes two species — *M. hellenica* GENNADIUS and *M. caucasica* HADZIBEJLI — both from the Mediterranean region of the Palearctic. The former lives on *Pinus*, the latter on *Picea*, *Abies* and possibly on *Pinus*. The only information on male (*M. caucasica*) has been provided by HADZIBEJLI (1969). *Marchalina*, like *Baisococcus*, has an eversible endophalus of identical structure and size (opinion based on drawing)

and two pore-tube bearing plates. The antennae (9-segmented in *Baisococcus*, 10-segmented in *Marchalina*) and wings are similar in these genera. There is also a prothoracic plate in *Marchalina* (drawing) which may correspond with the prothoracic collar in *Baisococcus*. However, the head is weakly sclerotized dorsally and the abdomen markedly expanded in *Marchalina* (on drawing). The anterior pore-tube plate bears over 100 tubes in *Marchalina*, about 20 in *Baisococcus*, which, obviously, may be a species level characteristic.

Of special interest, as potential relatives of *Baisococcus*, are the *Xylococcidae* This group, affiliated with the *Matsucoccidae* at various taxonomic levels until quite recently, is represented by the Palearctic *Xylococcus* (with 3 or 4 species), the Nearctic *Xylococculus* (with 4 species) and two unidentified forms from the Neotropical region.

Baisococcus shares with *Xylococcus* and *Xylococculus* the structure of wing, antenna, head, thorax, abdomen, endophalus and pore-tubes. Other characteristics are unknown in either the fossil or recent forms, and the differences e. g., the 9-segmented antenna in *Baisococcus*) seem to be of minor significance.

In addition to the morphological similarity of adult males, the following evidence should be emphasized:

— Both *Xylococcidae* and *Matsucoccidae* bear several very primitive features, occupy the same regions, and only they alone (assuming that *Baisococcus* is related to *Xylococcidae*) were found in Lower Creataceous deposits.

— The *Matsucoccidae* adhere to the ancestral gymnosperm host (recent species are confined to *Pinus*), but they radiated into a number of ecological, morphologically similar, forms (about 30 species in the recent fauna) and are also very abundant among the fossils (about half of the Tertiary amber inclusions).

— The *Xylococcidae* infest angiosperms *(Fagaceae, Betulaceae, Tiliaceae* and *Mimosaceae)*, except one species which lives on gymnosperms *(Cupressus)*; they have a prolonged development cycle; live within bark in pseudogalls, and are represented by two morphological forms in adult female stage — with well-developed legs and antennae *(Xylococculus)*, and apodeous *(Xylococcus)*. Except *Baisococcus*, no other fossil forms are known which could be affiliated with the *Xylococcidae*.

The above evidence indicates that the evolutionary patterns of the two groups — *Xylococcidae* and *Matsucoccidae* — the only coccids found in Lower Creataceous deposits, are fairly different. Because of the extreme morphological specialization in female, biological and ecological peculiarities, association with angiosperms and lack of intermediate fossils, it would be very difficult to connect the recent *Xylococcidae* with *Baisococcus*, if not for the morphological similarity of males, presence of legs in female *Xylococculus*, and the gymnosperm host of *X. macrocarpae*.

Obviously, the derivation of the recent *Xylococcidae* from *Baisococcus* is

only a hypothesis, currently the best one in my opinion, and is based mainly on analogy with the *Matsucoccidae* which (males) have remained unchanged morphologically since the Lower Creataceous.

IV. NOTES

1. Scale insect fossils have generally been ignored until quite recently "simply because of a feeling that conclusions concerning them would be merely guesses and unworthy of serious consideration" (FERRIS, 1941). The source of this pessimistic feeling was in the assumption that fossils can provide only poor information. However, studies on coccid amber inclusions revealed that many and minute details could be examined, even such which have never been noted on recent specimens (KOTEJA, 1984).

The present study shows that also the compression fossils may provide information that is worthy of serious consideration; for instance, the membraneous endophalus, sperm bundles, tubular derm glands and their wax products are well preserved in the specimen currently described, and this information was quite sufficient to place it within the coccid system. Our problems with the placement of many recent genera, particularly among the archeococcids, are exactly the same.

2. Obviously, "we would almost certainly not be able to differentiate among species on the basis of fossil specimens", as claimed by FERRIS (l. c.). However, I think that it is no matter whether specimens that lived 120 mill. years ago belonged to one or more species within the same genus. The purpose of coccid paleontlogy is to trace the origin and radiation of major branches, the evolution of their host relationships and other ecological adaptations. The tracing of the fossils back and back in the time is an indispensable condition of any reliable reasoning on the scale insect phylogeny. The only thing we need is a large number of fossils.

3. The above statement is not quite right; we need also accurate and detailed descriptions of recent males. To compare two forms, the information of at least one of them must be complete. Unfortunately, our knowledge of males (which are mainly represented among the fossils) of the recent groups is meagre, with the exception of a few neococcid families; for instance, there is not even a mention on the structure of thorax in the monograph of margarodids s. l. by MORRISON (1928), and this paper, on the other hand, is the only one that provides any information on many archeococcid groups.

4. Some general suggestions on the evolution and phylogeny of scale insects that arose from the discovery of matsucoccids in the Lower Cretaceous deposits had already been presented (KOTEJA, 1985, 1988). The present findings support the suggestions that the coccids must have been represented by several branches in Mid-Mesozoic, that the morphological structure of at least some of

them was very close to the recent ones, and that they must have lived on gymnosperm host plants.

However, going back, we will once meet specimens that are not similar to the recent coccids, i. e., forms with two pairs of wings, with functional mouth parts, many tarsal joints, two claws, etc. The problem is whether we will be able to recognize scale insect ancestors in these forms.

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STRESZCZENIE

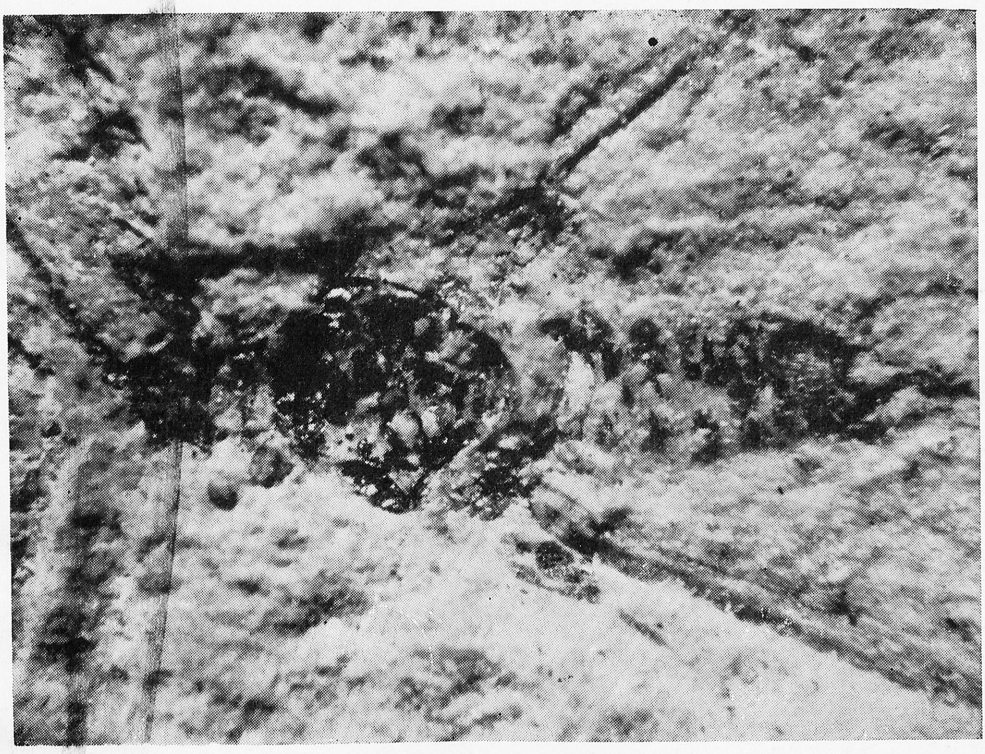
Baisococcus victoriae gen. et sp. n. opisany na podstawie jednego odcisku z dolnokredowych pokładów z okolic Bajkału jest obok *Eomatsucoccus* najstarszym znanym czerwcem. W szczątkach zachowały się duże fragmenty głowy, tułowia i odwłoka, czułki i skrzydła oraz endofalus, gruczoły woskowe wraz z wydzielinami i wiązki plemników. *Baisococcus* wykazuje pewne podobieństwa do współczesnego *Xylococculus*, a w mniejszym stopniu również do *Orthezia*, *Marchalina*, *Neosteingelia* i *Callipappus*.

Redaktor pracy: prof. dr J. Pawłowski

Plate I

Baisococcus victoriae gen. et sp. n., Cocc 166, holotype; a — photographed in dry conditions, b — moistened with ethyl alcohol

Phot. J. Koteja



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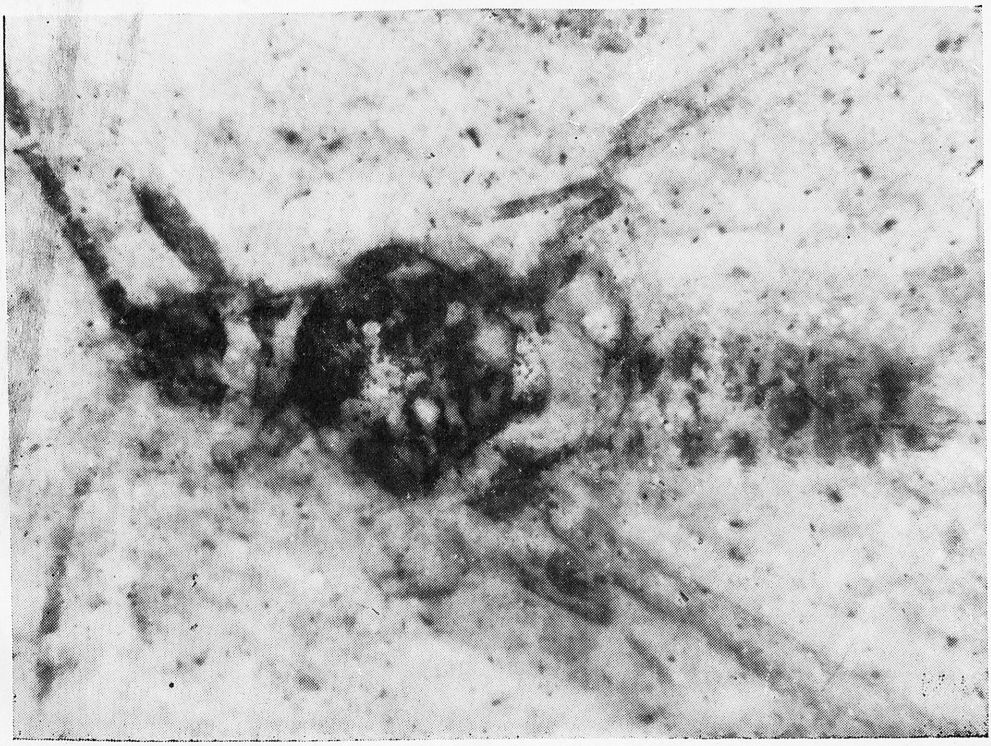

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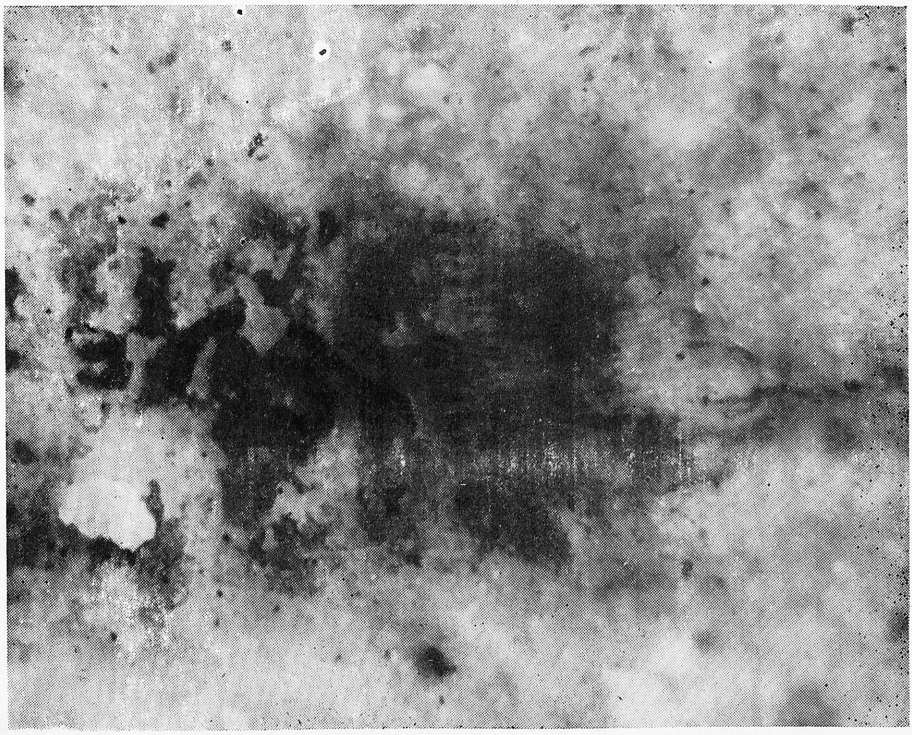
J. Koteja

Plate II

Baisococcus victoriae gen. et sp. n., Cocc 166, holotype; a — portion of abdomen with a coil of sperm bundles, endophallus and tubular ducts, b — the same, enlarged

Phot. J. Koteja



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