Early Permian insects from Saar-Nahe Basin of Odernheim town site, Rheinland-Pfalz in Germany (Insecta, Grylloblattida, Blattinopseida)

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ABSTRACT
New insect fossils from Early Permian lacustrine deposits of Odernheim town site (Saar-Nahe Basin, Rheinland-Pfalz, Germany) are attributed to Eurytilonidae (Grylloblattida) and Blattinopsidae (stem group of Dictyoptera). *Oborella germanica* n. sp. is based on fore- and hindwing venation pointing out difficulties of generic separation between *Blania* Kukalová, 1964 and *Oborella* Kukalová, 1964. In addition, as first revisors of the genus *Blania*, we consider it as a junior synonym of *Oborella*, because the holotype of the type species *O. matura* Kukalová, 1964 is a better preserved specimen than that of *Blania*. We also describe another species, *Oborella brauckmanni* n. sp. Two Blattinopsidae are also described but not named for their incomplete state of preservation, although one is related to *Glaphyrophlebia* and could well correspond to a new species for its very long stem of posterior radius.

KEY WORDS
Eurytilonidae,
Blattinopsidae,
Oborella,
Blania,
Early Permian,
Germany,
new synonymy,
new species.

RÉSUMÉ
Nouveaux insectes fossiles (Insecta, Grylloblattida, Blattinopseida) du Permien inférieur du bassin de Saar-Nahe (Odernheim ville), Allemagne.
De nouveaux insectes fossiles du Permien inférieur d'Odernheim ville (bassin de Saar-Nahe, Rheinland-Pfalz, Allemagne) sont attribués aux Euryptilonidae (Grylloblattida) et aux Blattinopsidae (groupe souche des Dictyoptera). *Oborella germanica* n. sp. est fondée sur la nervation des ailes antérieures et postérieures, mettant en évidence les difficultés à séparer les genres *Blania* Kukalová, 1964 et *Oborella* Kukalová, 1964. De plus, en tant que premiers réviseurs de ce genre, nous considérons le genre *Blania* comme un synonyme junior d'*Oborella*, car l'holotype de son espèce-type, *O. matura* Kukalová, 1964, est mieux conservé que celui de *Blania*. Nous décrivons aussi une autre espèce, *Oborella brauckmanni* n. sp. Deux Blattinopsidae sont aussi décrits mais non nommés à cause de leur état de conservation incomplet, bien que l'un d'entre eux soit proche de *Glaphyrophlebia* et puisse correspondre à une espèce nouvelle à cause de sa très longue partie basale de radius postérieur.

MOTS CLÉS
Euryptilonidae,
Blattinopsidae,
Oborella,
Blania,
Permien inférieur,
Allemagne,
synonymie nouvelle,
espèce nouvelle.

INTRODUCTION

The grylloblattid family Euryptilonidae Martynov, 1940 currently comprises 14 described genera from the Permian of Europe, Asia, and North America (Aristov 2002). These insects are mainly known after their forewing structures, the bodies and hindwings being rare and generally rather poorly preserved. Among them, the two closely similar genera *Oborella* Kukalová, 1964 and *Blania* Kukalová, 1964 are known from the Early Permian of the world famous Obora insect site (Letovice Formation, Bačov and Obora horizons, Sakmarian/Early Artinskian) in the Czech Republic (e.g., Kukalová 1964; Kukalová-Peck & Willmann 1990; Dostál & Prokop 2009). Pešek (2004) provided the most comprehensive data on lithostratigraphy of this locality in Boskovice graben. The present discovery of fossil insects based on fore- and hindwings from the Early Permian of the Saar-Nahe Basin similar in venation pattern to insects known from Obora in Boskovice graben is of interest for the knowledge of the intrageneric diversity and limits between the genera in grylloblattid insects.

MATERIAL AND METHODS

The Saar-Nahe Basin is a Late Variscan intermontane basin situated in southwestern Germany and northeastern France. Its rapid subsidence and aggregation of sediments started in the Late Pennsylvanian (Namurian/Westphalian) and continued until Early Permian (Autunian) (Schäfer 2001; Rössler & Schneider 2006). Lake Odernheim was one of larger lakes that covered almost half of the Saar-Nahe Basin area about 40 km^2. Fossils preserved in black shales are known by arthropods, bivalves and mainly vertebrates such as fish and amphibians (Boy 1976, 2003). Based on the insect zonation of Schneider & Werneburg (2006), the Odernheim black shale (Meisenheim Formation) belongs to the *Spiloblattina odernheimensis* zone (no. 10) (Lower Rotliegend, Early Sakmarian). The world-famous Obora insect site from Sakmarian/Early Artinskian of the Boskovice graben (Bacov horizon, Letovice Formation) belongs to the "*Syscioblatta* n. sp. from Obora – *Moravamylacris kukalovae* zone" (no. 11) (Schneider & Werneburg 2006).

The fossil specimens preserved as gently pyritized yellow imprints in black shales were observed under a stereomicroscope OLYMPUS SZX-9 in dry state and under film layer of ethyl alcohol. The venation patterns were drawn directly using a stereomicroscope with a camera lucida and finally readjusted to the photograph scales using image-editing software (Adobe Photoshop). Photographs were made using a digital camera Olympus 5050 connected to the stereomicroscope.

We follow the wing vein nomenclature and systematics proposed by Storozhenko (1998, 2002).

The type material is housed at the Muséum national d'Histoire naturelle, Paris, Collection de Paléontologie (MNHN.F).

ABBREVIATIONS

Abbreviations of wing venation symbols throughout the text and the figures are given as:

AA	analis anterior;
AP	analis posterior vein;
CuA	cubitus anterior;
CuP	cubitus posterior;
MA	media anterior;
MP	media posterior;
RA	radius anterior;
RP	radius posterior;
ScP	subcosta posterior;
vb	vein-bow.

SYSTEMATIC

Order GRYLLOBLATTIDA Walker, 1914
Clade LEMMATOPHORINA Storozhenko, 1997
Family EURYPTILONIDAE Martynov, 1940
Genus *Oborella* Kukalová, 1964

Blania Kukalová, 1964: 101, 102 n. syn.

Oborella germanica n. sp.
(Figs 1; 2)

MATERIAL. — Holotype: MNHN.F.A31034 (a fore- and a hindwing few millimeters apart from one another). Paratype: MNHN.F.A31035 (a fore- and a hindwing few millimeters apart from one another).

DIAGNOSIS. — 13-14 crossveins in forewing costal area, in one or two rows; RP forked; MA simple; MP forked; CuA with two main branches, anterior one forked and posterior one simple.

ETYMOLOGY. — Named after Germania, Latin name for Germany.

TYPE LOCALITY. — Odernheim town, Saar–Nahe Basin, Rheinland-Pfalz, Germany.

TYPE STRATA. — Early Permian, Rotliegend, Meisenheim Formation, Odernheim Subformation, Odernheim lake horizon (L-O8 or M8 respectively), lacustrine black shales.

DESCRIPTION

Holotype (Figs 1A, B; 2A,B).

Forewing with costal margin slightly convex and rounded apex; originally with a pattern of coloration (see Fig. 2A, B); length of forewing fragment about 11.2 mm, probable total length about 11.3 mm, width in widest part 3.8 mm; costal area 0.70 mm wide; ScP straight, apically deflected but reaching costal margin 3.0 mm from wing apex; area between costal margin and ScP rather broad in midwing bearing about 12 cross-veins, all simple except for five of them secondarily branched; R nearly straight, RA and RP separating at about ⅓ of wing length from base; RA simple and straight, ending on anterior margin 2.1 mm from wing apex; RA and RP area irregular widest at about midwing with six cross-veins; RP bifurcated in distal third of wing, ending with two branches just above wing apex; stems of M and R very close running parallel for a short distance, M divided into MA and MP 0.5 mm basal of separation of RA and RP; MA simple, nearly straight, ending close to wing apex; area between RP and MA with nine cross-veins; base of MP about 3.1 mm from wing base, bifurcated about midwing and reaching posterior wing margin with two branches; MP area rather narrow with seven crossveins between MA and MP; CuA basally strongly diverging from CuP towards M, connected to it for 0.4 mm, and with two basal branches, first distally forked again and second simple and straight; CuP simple and nearly straight; area between CuA and CuP with one row of cells (five of them being preserved).

Hindwing costo-basal part preserved, with pattern of colouration similar to that of forewing; length of fragment 7.5 mm, width 2.9 mm; costal area much narrower than in forewing, 0.34 mm wide, with nine simple crossveins; ScP ending on costal margin, shorter than in forewing; base of RP close to wing base, 1.8 mm apart; preserved part of RA simple and straight; basal stem of RP 4.5 mm long, first fork of RP preserved; six preserved crossveins between RA and RP; stem of M straight, forked into MA and MP 3.8 mm from wing base, well distal of base of RP; preserved part of MA simple; MP forked; basal stem of Cu not preserved, CuA forked, CuP simple and straight, anal veins not preserved.

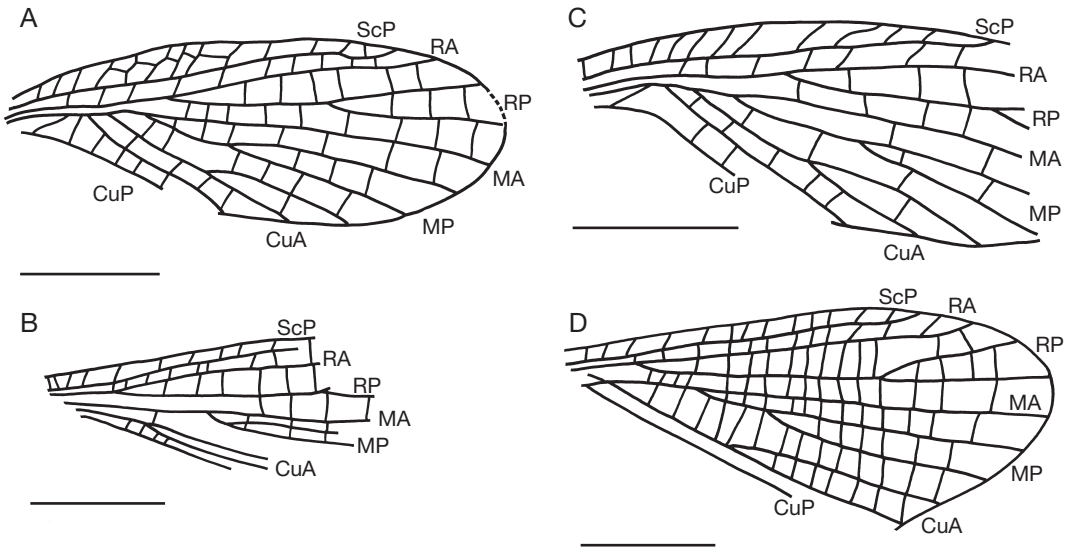

FIG 1. — *Oborella germanica* n. sp.: **A**, **B**, drawings of holotype fore- and a hindwing venation (MNHN.F.A31034); **C**, **D**, drawings of paratype fore- and a hind wingvenation (MNHN.F.A31035). Scale bars: 3 mm.

Paratype (Figs 1C-D; 2C)
Length of forewing fragment about 8.7 mm, probable total length about 11.5 mm, width in widest part 3.8 mm. Forewing differing from that of holotype as follows: costal area with only one row of cells but with oblique crossveins in distal part mainly. Hindwing more complete than that of holotype, length of fragment 10.8 mm, width 5.1 mm, adding the following information: ScP ending on costal margin 3.4 mm from wing apex; RA with an apical short fork, ending 2.2 mm from wing apex; RP with two branches; MA simple, MP forked; CuA with a deep fork, basally connected to median stem; CuP simple, parallel to CuA.

DISCUSSION

In the holotype the fore- and hindwings are very close to each other, showing that they probably correspond to the same specimen. The same situation occurs for the paratype. The great similarity in wing venation of both fore- and hindwing supports an attribution of the holotype and paratype to the same species. Following the key of Storozhenko (1998: 65-67) *Oborella germanica* n. sp. can be attributed to the family Euryptilonidae Martynov, 1940 (Lemmatophorina *sensu* Storozhenko 1998: 81) and to the genera *Blania* Kukalová, 1964 and *Oborella* Kukalová, 1964. These genera are currently separated on the basis of the number of crossveins in forewing costal area 11-12 in *Blania* versus 16-19 in *Oborella* (Kukalová 1964). *Oborella germanica* n. sp. has 13-14 such crossveins but of rather different pattern in the holotype and paratype (two rows of crossveins versus one row of oblique elongate crossveins). Therefore *O. germanica* n. sp. makes the "link" between the two genera and can be easily separated from all previously described species of both genera on the basis of this character. We consider that the separation between *Blania* and *Oborella* no longer stands. Thus we propose to synonymize the two genera. As first revisors, we choose to consider *Blania* as a junior synonym of *Oborella* because the holotype of the type species *O. matura* Kukalová, 1964 is a better preserved specimen than that of *Blania*.

Oborella germanica n. sp. can be separated from *O. matura*, *O. rusticana* Kukalová, 1964, and *O. inexpectata* Kukalová, 1964, all described from Obora by the presence of RP ending with

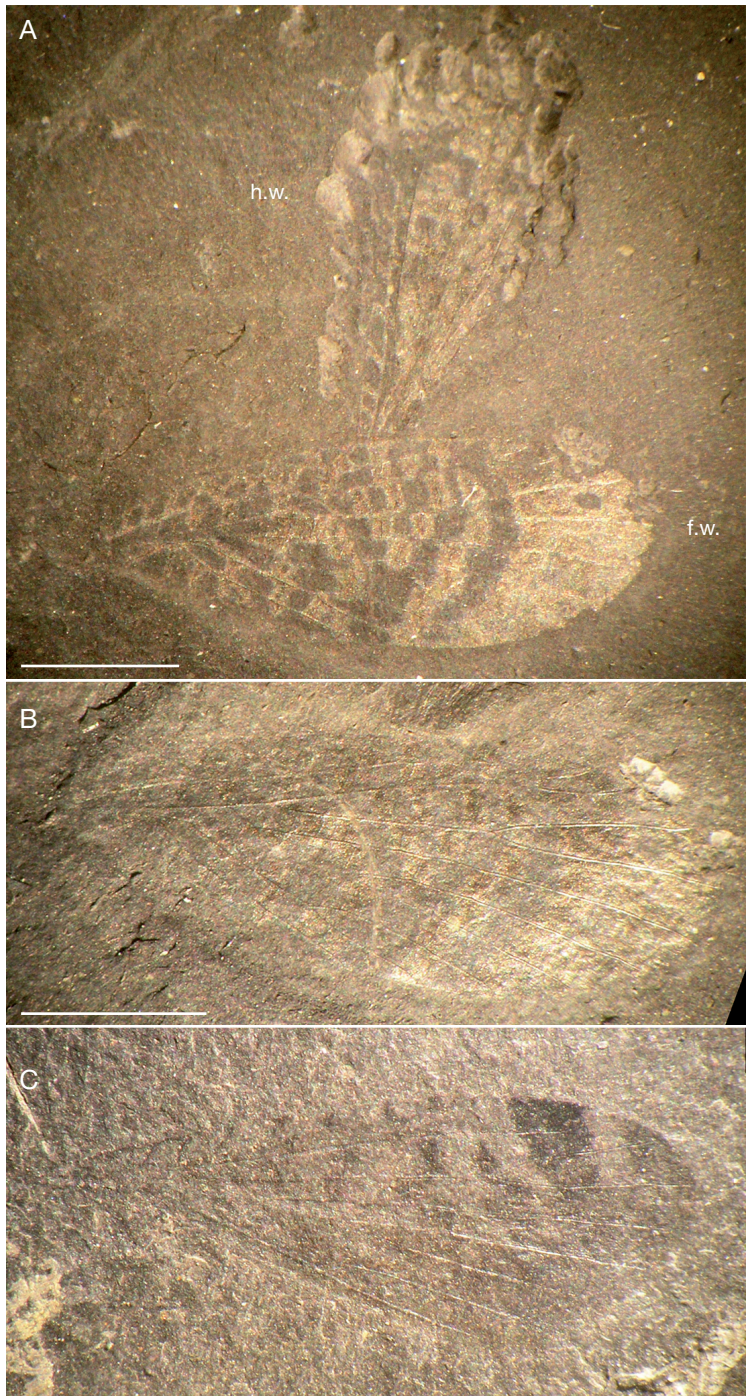

FIG 2. — *Oborella germanica* n. sp.: **A**, photograph of holotype fore- (**f.w.**) and hindwing (**h.w.**) venation (MNHN.F.A31034); **B**, detail photograph of holotype forewing venation (MNHN.F.A31034); **C**, photograph of paratype hindwing venation (MNHN.F.A31035). Scale bars: 3 mm.

only two branches instead of being pectinated with three or more terminal branches. Furthermore, *O. germanica* n. sp. differs from *O. rotunda* (Kukalová, 1964) and *O. oviformis* (Kukalová, 1964) by the presence of MA simple instead being deeply forked. Finally *O. falsa* (Kukalová, 1964) differs from *O. germanica* n. sp. by well separated stem of M and CuA in basal part instead of their partial connection.

Oborella germanica n. sp. shows rather well preserved hindwings, which is of interest for the knowledge of the wing venation in Euryptilonidae. In this family, the hindwing structures are currently poorly known (Storozhenko 1998, 2002; Aristov 2002). Among the other lemmatophorine families except in Daldubidae Storozhenko, 1996, CuA is reaching median stem and fused with it for a short distance, as in *O. germanica* n. sp. Another interesting character is the absence of contact between RP and MA in the hindwing of *O. germanica* n. sp., unlike in Daldubidae, Atactophlebiidae, and Lemmatophoridae.

Oborella brauckmanni n. sp.
(Figs 3; 4)

MATERIAL. — Holotype MNHN.F.A31044 (two forewings superimposed).

DIAGNOSIS. — Crossveins in forewing costal area simple, short and in one row; RP forked; MA simple; MP forked; CuA with two main branches, both simple.

ETYMOLOGY. — Named after Prof. Carsten Brauckmann, specialist on Palaeozoic insects.

TYPE LOCALITY. — Odernheim town, Saar–Nahe Basin, Rheinland-Pfalz, Germany.

TYPE STRATA. — Early Permian, Rotliegend, Meisenheim Formation, Odernheim Subformation, Odernheim lake horizon (L-O8 or M8 respectively), lacustrine black shales.

DESCRIPTION

Forewing with costal margin slightly convex and rounded apex; without visible pattern of colouration, maybe due to problem of preservation, also some crossveins hardly visible; length of preserved part of wing 7.0 mm, max. width 2.8 mm; ScP straight, apically deflected but reaching costal margin 3.1 mm from wing apex; area between costal margin and ScP rather broad in midwing with nine preserved simple cross-veins; R nearly straight, RA and RP separating at about 3.0 of wing length from base; simple RA nearly straight, and ending on anterior margin 0.8 mm from wing apex; RA and RP area irregular widest at about midwing; RP bifurcated in distal third of wing, ending with two branches just above wing apex; M divided into MA and MP about 2.2 mm basal of separation of RA and RP; MA simple, nearly straight, ending close to wing apex; area between RP and MA with cross-veins; MP reaching posterior wing margin with two branches; MP area rather narrow; CuA with two basal branches, both simple and straight; CuP and anal area not preserved.

DISCUSSION

This fossil looks very similar to *Oborella germanica* n. sp. from the same outcrop and level. The more accurate difference between *O. brauckmanni* n. sp. and the other species of *Oborella* is the anterior branch of CuA simple instead of being deeply forked. Other differences with *O. germanica* n. sp. are: fork of MP at the level of base of RP instead of being in a more distal position, and apex of ScP more distant from apex of RA than in *O. germanica* n. sp.

Clade BLATTINOPSEIDA Bolton, 1925
Family BLATTINOPSIDAE Bolton, 1925

gen. et sp. indet.
(Figs 5-8)

MATERIAL. — MNHN.F.A31047 (antero-median part of a forewing); MNHN.F.A31048 (anterior part of a forewing).

TYPE LOCALITY. — Odernheim town, Saar–Nahe Basin, Rheinland-Pfalz, Germany.

TYPE STRATA. — Early Permian, Rotliegend, Meisenheim Formation, Odernheim Subformation, Odernheim lake horizon (L-O8 or M8 respectively), lacustrine black shales.

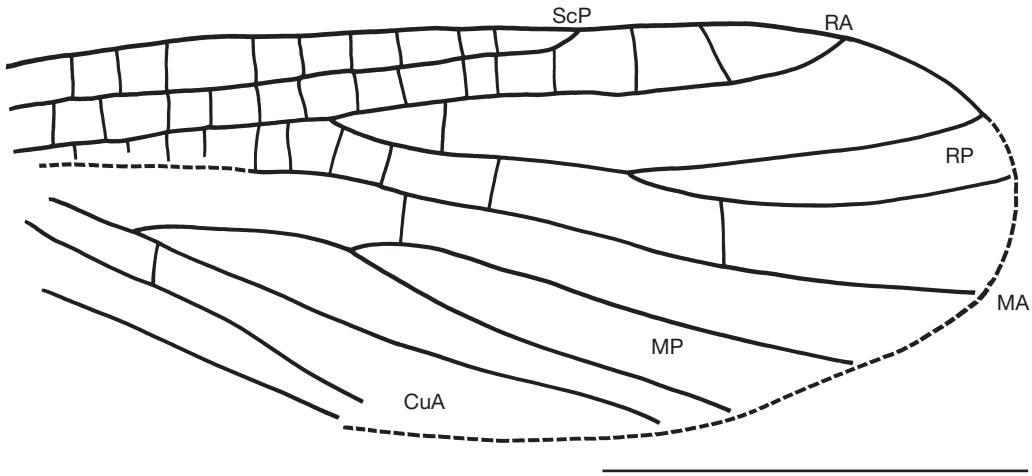

FIG. 3. — *Oborella brauckmanni* n. sp., drawing of forewing venation (holotype MNHN.F.A31044). Scale bar: 3 mm.

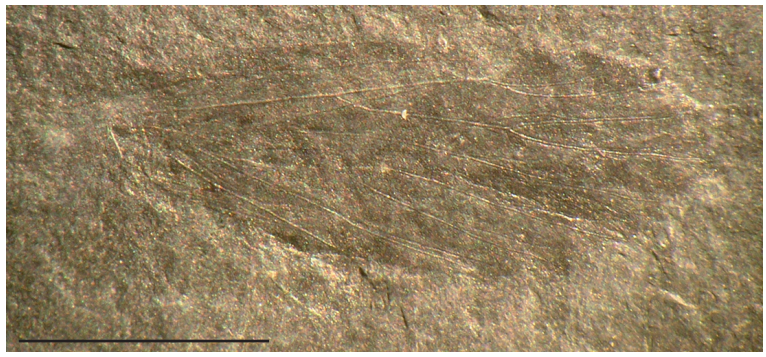

FIG. 4. — *Oborella brauckmanni* n. sp., photograph of forewing venation (holotype MNHN.F.A31044). Scale bar: 3 mm.

DESCRIPTIONS

Specimen MNHN.F.A31047 (Figs 5; 6)

Length of fragment 8.0 mm, width 5.6 mm; costal area 0.9 mm wide; area between ScP and RA 0.83 mm wide; RA simple; base of RP 3.7 mm from wing base; stem of RP very short, RP with a least five branches; M with only one stem emerging from Radius near wing base, and at least two distal branches; a strong oblique crossvein between M and CuA; CuA with at least three distal branches; CuP simple; area between CuA and CuP very broad, with four rows of cells.

Specimen MNHN.F.A31048 (Figs 7; 8)

Length of fragment 15.5 mm, width 4.6 mm; costal area 0.98 mm wide; area between ScP and RA 1.1 mm wide; RA simple; base of RP 4.4 mm from wing base; stem of RP very long, 1.7 mm long, RP with a least about 11 branches, presence of longitudinal furrows between branches of RP; M with two stems emerging from radius, one near wing base and second near base of RP; a strong oblique crossvein between M and CuA; area between CuA and CuP probable broad.

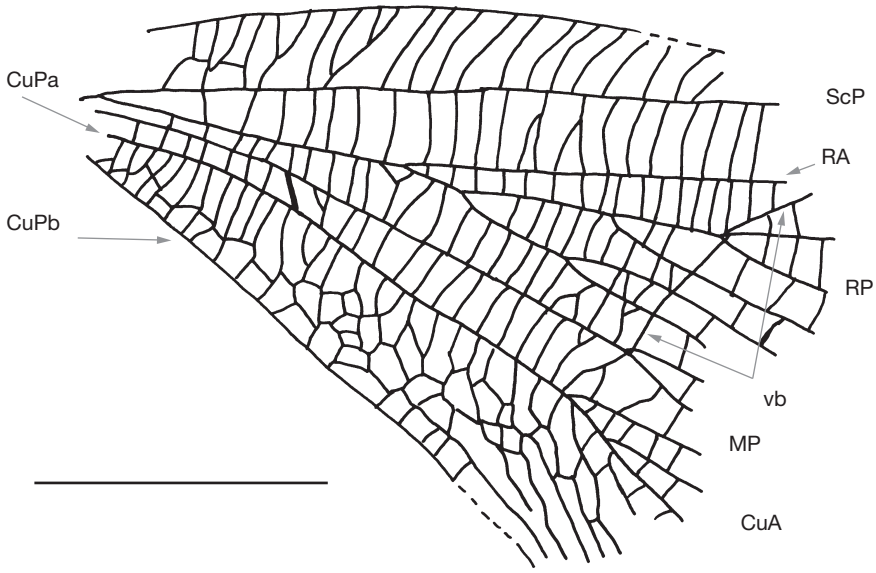

Fig. 5. — Blattinopsidae Bolton, 1925, gen. et sp. indet., drawing of forewing venation (MNHN.F.A31047). Scale bar: 3 mm.

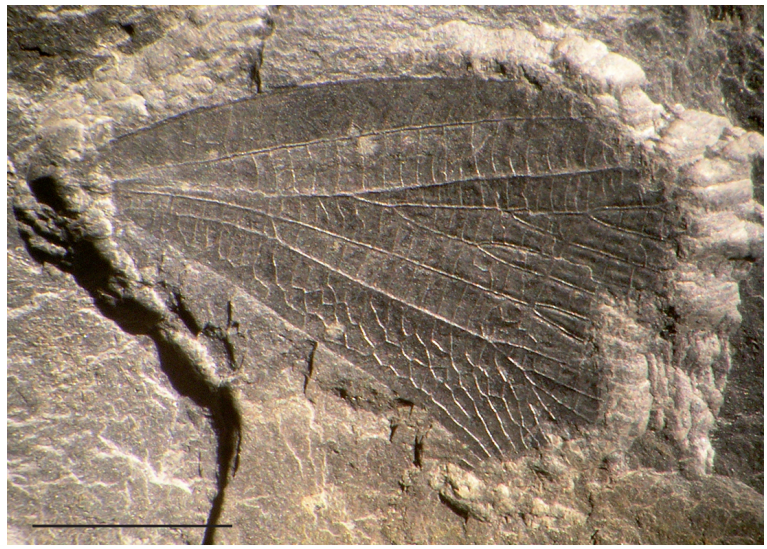

Fig. 6. — Blattinopsidae Bolton, 1925, gen. et sp. indet., photograph of forewing venation (MNHN.F.A31047). Scale bar: 3 mm.

Discussion

These two forewing fragments correspond to Blattinopsidae for the broad area between ScP and R; RP with many posterior branches, presence of a vein-bow (visible in specimen MNHN.F.A31047); CuA closely parallel with posterior branch of M; a distinct brace between CuA and M (Béthoux & Nel 2002). All the characters of the wing venation of specimen MNHN.F.A31048 are typical of blattinopsids of the two genera *Blattinopsis* Giebel,

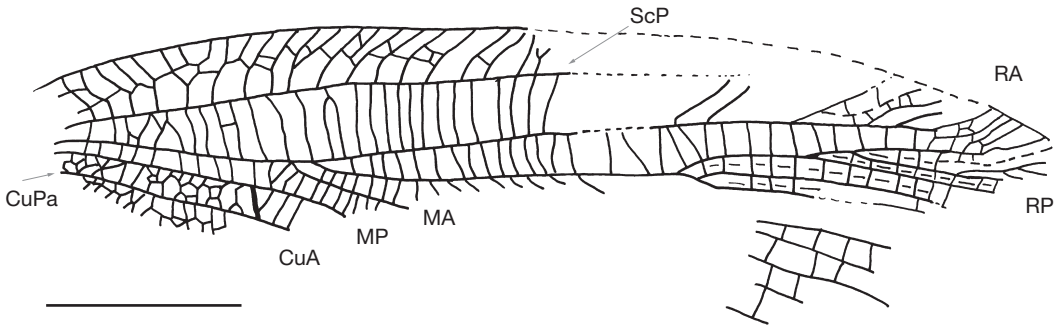

FIG. 7. — Blattinopsidae Bolton, 1925, gen. et sp. indet., drawing of forewing venation (MNHN.F.A31048). Scale bar: 3 mm.

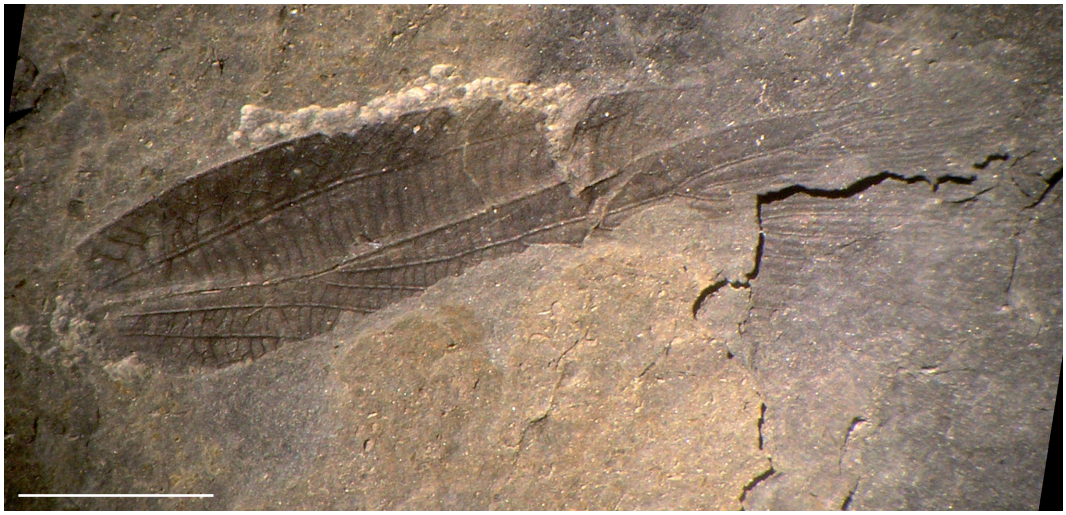

FIG. 8. — Blattinopsidae Bolton, 1925, gen. et sp. indet., photograph of forewing venation (MNHN.F.A31048). Scale bar: 3 mm.

1867 and *Glaphyrophlebia* Handlirsch, 1906 for the presence of only one branch of M emerging from R and broad area between ScP and RA. The differences between these two genera are weak and few and concern the area between the branches of RP, i.e. presence versus absence of longitudinal furrows between branches of RP. These are not visible in specimen MNHN.F.A31047. Thus it is not possible to prefer one of these genera for this fossil.

Specimen MNHN.F.A31048 has such furrows between the branches of RP, thus it could be related to *Glaphyrophlebia*. It has two branches of media emerging separately from radial stem, but this character is present in other representatives of *Blattinopsis* and other genera (Hörnschemeyer & Stapf 2001). Nevertheless, it has a very particular structure, unique among the Blattinopsidae, i.e. a very long stem of RP. This would support an attribution to a new species of *Glaphyrophlebia*, but we prefer not to name it for its very incomplete state of preservation.

In addition two species based on fragmentary wings (*Blattinopsis arnhardi* Müller, 1977, *Blattinopsis tardefurcata* Müller, 1977) were described from the Lower Rotliegend of the locality Sperbersbach-Schmücke (near Oberhof village, Suhl district) in the Thuringian Forest Mts (Müller 1977). *Blattinopsis arnhardi* differs from MNHN.F.A31047 in the fork

of MP close to base of RP. *Blattinopsis tardefurcata* differs from it in the presence of numerous small cells in area between CuA and CuPb.

CONCLUSION

New insect specimens are described from Early Permian deposits of Odernheim (Saar-Nahe Basin, Rheinland-Pfalz, Germany) and attributed to Euryptilonidae (Grylloblattida) and Blattinopsidae (possible stem group of Dictyoptera). *Oborella germanica* n. sp. is based on fore- and hindwing venation pointing out difficulties of generic separation between *Blania* and *Oborella*. Therefore we consider *Blania* as a junior synonym of *Oborella* because the holotype of the type species *O. matura* Kukalová, 1964 is a better preserved specimen than that of *Blania*. We also describe another species *O. brauckmanni* n. sp. and two representatives of Blattinopsidae are also described but not named due to their incomplete state of preservation, although one is related to *Glaphyrophlebia* and could well correspond to a new species for its very long stem of RP.

The diverse entomofauna of Obora compared to the nearly exclusive blattid-dominated entomofauna of the Early Permian in the Boskovice graben below the Obora horizon and compared to the equally blattid-dominated entomofaunas of the other European basins was, with the exception of the Lodève Basin, so far a mystery (e.g., Schneider 1984a, b; Béthoux *et al.* 2007). The discovery of grylloblattids in the Upper Lower Rotliegend of the Saar-Nahe Basin, taxonomical and in age very close to Obora, could serve as a key for increasing understanding of the dynamics of entomofaunas in relation to climatic and environmental changes during the Permian (Rössler & Schneider 2006).

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