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First North American species of the European genus *Archaemegaptilus* from the Upper Carboniferous Pottsville Formation of northern Alabama (Palaeodictyoptera: Archaemegaptilidae)

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Abstract. A new palaeodictyopteran (Palaeodictyoptera: Palaeodictyoptera) taxon is described based on a nearly complete hind wing found in the Pottsville Formation (Upper Carboniferous) of Bibb County, Alabama. *Archaemegaptilus blakelyi* Beckemeyer & Engel, new species, is the sixth insect genus and species described from the Pottsville of Alabama and the second palaeodictyopteran from those deposits. It is the third valid species assigned to the family Archaemegaptilidae. Previously known species are *A. kiefferi* Meunier, from the Combray of France and *A. schloesseri* Brauckmann *et al.*, from the Hagen-Vorhalle of Germany.

INTRODUCTION

The Carboniferous insect fauna of Alabama is small, comprised of five species (Beckemeyer & Engel, 2011). Another specimen has recently been discovered and deposited in the collection of The University of Alabama Museum of Natural History. Like the earlier taxa, it is a well preserved wing of a large palaeopterous insect that we place here in the family Archaemegaptilidae. Carpenter (1992) characterized Ar-

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chaemegaptilidae as a “little-known family”. It was established based on a distal hind wing fragment (*Archaemegaptilus kiefferi* Meunier, 1908) from the Commeny deposits. Later, Lameere (1917) noted that Meunier had not used the obverse specimen (which was more complete) for his reconstruction. Subsequently, Kukulová (1969) made a new drawing which showed more of the wing venation, including the course, from base to tip, of all the major longitudinal veins save the anal complex. She revised the family, but also assigned *Dictyoneurella perfecta* Laurentiaux, 1949 to Archaemegaptilidae, using its characters in her diagnosis of the family (Kukulová, 1969). This same author later moved *D. perfecta* to the Megasecoptera (Kukulová, 1975). Brauckmann *et al.* (2003) described a second species of *Archaemegaptilus* Meunier, *A. schloesseri* Brauckmann *et al.*, from a specimen that included most of the body and four wings. The addition of a new species from Alabama, described herein as *A. blakelyi* n. sp., extends the range of the Archaemegaptilidae from Europe (Commeny, France and Hagen-Vorhalle, Germany) to North America.

MATERIAL AND METHODS

The insect fossil described in this paper is from the Early Pennsylvanian (Westphalian A) Pottsville Formation in northern Alabama. It was collected at the Cahaba Little River Retreat in Bibb County. The collection location is marked in figure 1 in relation to the collection site of other Pottsville Formation insects (Beckemeyer & Engel, 2011); additional details regarding the Pottsville Formation may be found in that reference.

The specimen was photographed with a digital macro camera (Nikon Coolpix L830). In addition, photomicrographs using a Nikon 990 digital camera with external strobe flash (Nikon SB-26) were made to provide venation details. Flash orientation was optimized to show details of interest. Image processing software (Adobe Photoshop Elements 10 and XARA Designer Pro 7.1.1.1.17261) was used to overlay images as required to produce the final reconstruction drawings of wing shape and venation. The classification followed is generally that of Grimaldi & Engel (2005) except as noted.

SYSTEMATIC PALEONTOLOGY

Family Archaemegaptilidae Handlirsch, 1919

Genus *Archaemegaptilus* Meunier, 1908

Archaemegaptilus blakelyi Beckemeyer & Engel, new species

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(Figs. 2–3)

DIAGNOSIS: The straight costal margin suggests that the fossil is that of a hind wing. There is a slight chance this could be a forewing based on the somewhat smaller anal area, but if the wings are *A. schloesseri* are anything to judge by (*e.g.*, figures in Brauckmann *et al.*, 2003), then identification as a hind wing is likely accurate. Following the arguments of Prokop & Ren (2007), arising from the work of Riek (1976) and Sinitshenkova (2002). The following venation characters allow attribution of this fossil to superfamily Eugereonoidea: veins CuA and MA simple; ScP terminating near the wing apex; reduced or absent archaedyctyon; CuP and MP branched; wing length more than 2.5 times wing width. The following additional characters allow attribution to family Archaemegaptilidae (Prokop & Ren, 2007, Table 1): anterior wing margin nearly

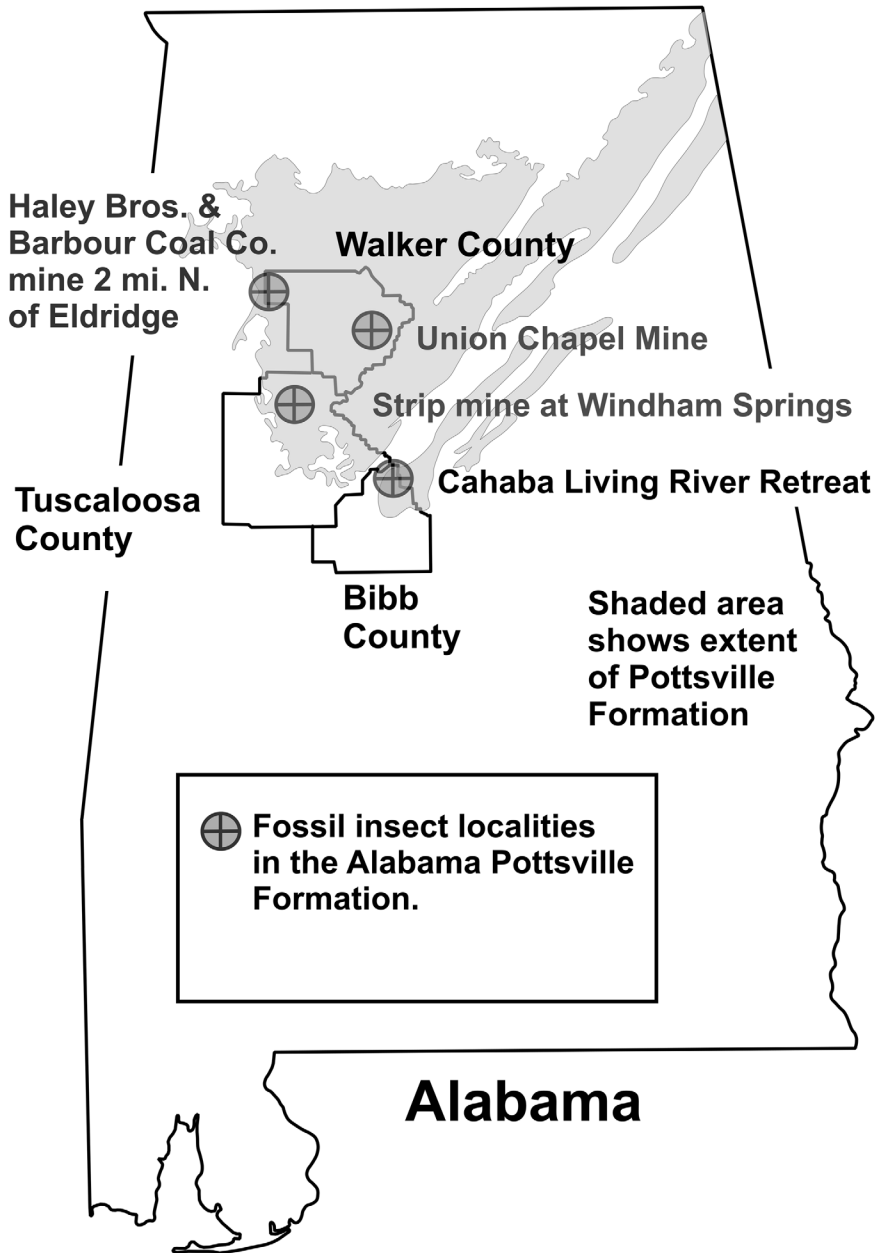
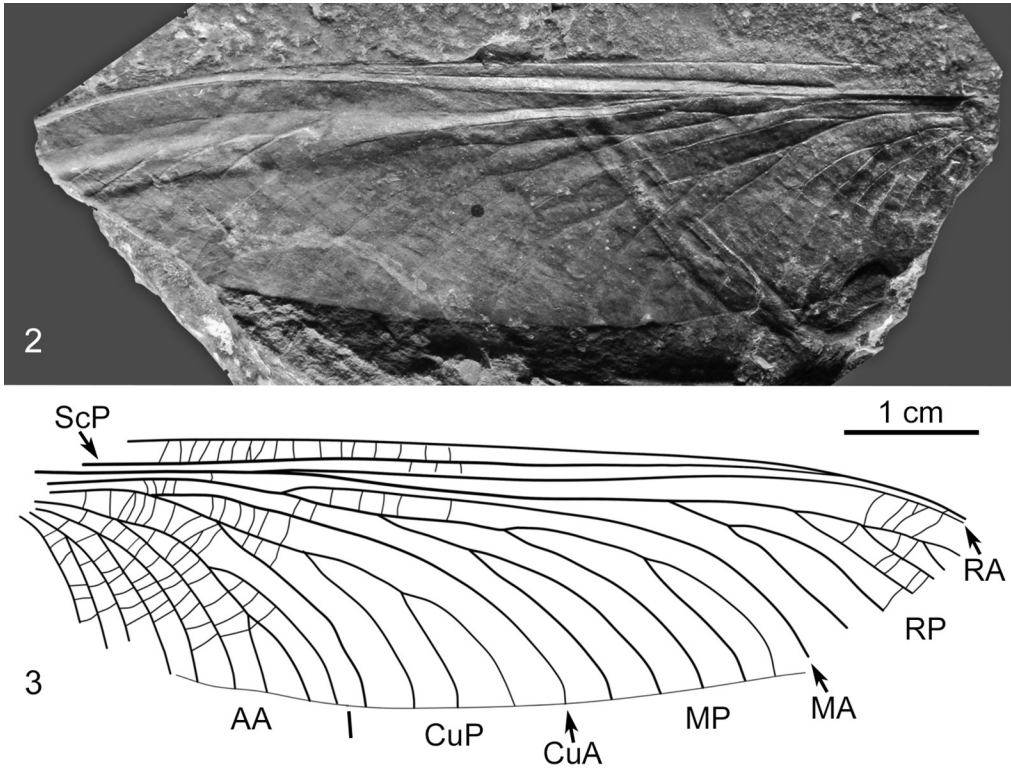


Figure 1. Map depicting occurrence of northern Alabama Pottsville Formation fossil insects including *Archaemegaptilus blakelyi*, new species, which was found in Bibb County. Shaded area shows extent of Pottsville Formation (modified from Beckemeyer & Engel, 2011).

straight; wing elongate and broadest at mid wing rather than basally; zigzagged intercalary veins absent; RP with more than four (six) branches; MA and MP fork slightly distal to RA and RP fork; MA not braced with RP; MP deeply bifurcated with more



Figures 2–3. Likely hind wing of *Archaeamegaptilus blakelyi*, new species (all to the same scale). 2. Photograph of holotype (PI2015.0017.001); Bibb County, Alabama; Early Pennsylvanian (Westphalian A), Pottsville Formation (specimen is in ventral aspect). 3. Illustration of reconstructed venation.

than four (5) branches; CuA not braced with M; CuP with four branches. Venation is remarkably consistent with the other two known species of *Archaeamegaptilus*, but the new species is differentiated by size, by greater slenderness of the wing and by simpler cross-venation.

DESCRIPTION: Hind wing. Length as preserved, 70 mm; estimated complete length, 80 mm; width 20 mm, length four times width. Nearly complete wing, all major longitudinal veins preserved, missing approximately 5% of wingtip and distal 15% of posterior wing margin, 10% of wing base, and almost 20% of basal posterior margin; costal margin straight, greatest width at midwing; ScP terminates near 85% wing length, apparently terminating into C; RA and RP separate at 31% wing length, RA simple, course of RA beyond termination of ScP nearly contiguous with costal margin of wing; RP forks dichotomously just basal to 70% wing length, with six branches apparently terminating on posterior wing margin; MA & MP fork slightly distal (33%) to level of separation of RA & RP; MA simple, narrow space but no brace between MA and stem of RP, MA terminates on posterior margin just distal to 82% of wing length; MP forks dichotomously just beyond 43% wing length, all forks deep, five branches reaching posterior margin; CuA and CuP separate at 21% wing length, CuA simple, approaches M, then turns posteriorly; no brace between CuA and M, CuA terminates on posterior margin just basal to 60% wing length; CuP forks at 27% wing length, four pectinate branches reaching posterior margin of wing; AA1 forks dichotomously, an-

Table 1. Distance of venation landmarks from wing base as percentage of total wing length for known species of *Archaemegaptilus* Meunier. Venation nomenclature as depicted in figure 2. AA1 is the most anterior branch of the anal vein. ScP terminates on the costal margin. AA1, CuA, and MA terminate on the posterior margin of the wing. Data based on estimated position of wing base using published venation drawings (Kukalová, 1969: 477, fig. 46 for *A. kiefferi* Meunier, and Brauckmann *et al.*, 2003: 25, fig. 8 for *A. schloesseri* Brauckmann *et al.*).

	Species / Wing				
	<i>blakelyi</i>	<i>kiefferi</i>	<i>schloesseri</i>		
	HW	HW	LHW	RHW	RFW
AA1 forks	0.18	0.16	0.23	0.19	0.16
Cu forks	0.21	0.22	0.18	0.16	0.22
CuP forks	0.27	0.34	0.23	0.31	0.34
R forks	0.33	0.34	0.30	0.31	0.34
M forks	0.33	0.34	0.27	0.29	0.34
MP forks	0.43	0.43	0.38	0.40	0.43
RP forks	0.69	0.66	0.59	0.68	0.66
AA1 terminates	0.38	0.38	0.39	0.38	0.38
CuA terminates	0.59	0.60	0.59	0.59	0.60
MA terminates	0.82	0.87	0.82	0.86	0.87
ScP terminates	0.85	0.95	0.86	?	0.95
Max width	0.24	0.27	0.36	0.33	0.27

terior branch forking twice more so that a total of four branches reach posterior margin, most anterior branch terminates on posterior wing margin at 38% wing length; 2nd and 3rd anal veins deeply forked, stems of four anal veins preserved, at least nine branches reach posterior margin of wing; possible portion of anal brace present at extreme base of fragment (supporting assignment to Palaeodictyoptera); crossveins poorly preserved except in basal quarter and extreme distal portion of wing, mostly entire with little reticulation, no apparent archedictyon.

HOLOTYPE: PI2015.0017.001 (Fig. 2), University of Alabama Museum of Natural History, Tuscaloosa, Alabama; partial hind wing in ventral aspect; no counterpart; Pottsville Formation (Pennsylvanian), Cahaba Little River Retreat, Bibb County, Alabama, 2015, D. Blakely, collector.

ETYMOLOGY: The specific epithet is a patronym honoring Mr. Don Blakely, who discovered the fossil and donated it to the University of Alabama State Museum.

DISCUSSION

We note first that Brauckmann *et al.* (2003) included *A. ferreirai* Pinto, 1995 in *Archaemegaptilus*. However, Martins-Neto (in Martins-Neto *et al.*, 2007) transferred that species to the genus *Taiophlebia* Martins-Neto, 2007 (Eoblattida). *Archaemegaptilus* thus currently comprises only the three species: *A. blakelyi*, *A. kiefferi*, and *A. schloesseri*. All three of these species have quite similar venation. Table 1 contains a comparison of the spanwise location of major venational landmarks (longitudinal vein forkings and terminations) as a percentage of total wing length. These are remarkably similar given

the size and shape variations in the three species. In general, all three species have similar numbers of branches and MP, CuP, and AA are all deeply forked. Both *A. blakelyi* and *A. kiefferi* had six branches of RP, *A. schloesseri* four (HW and FW). Branches of MP: *A. kiefferi*, six, *A. schloesseri* five to seven, *A. blakelyi* five; branches of CuP: *A. kiefferi* four, *A. schloesseri* five to six, *A. blakelyi* four.

Archaemegaptilus blakelyi differs from the other two species in size: estimated wing length of 80 mm vs. 105 mm for *A. kiefferi* and 37 mm (FW) and 31 mm (HW) for *A. schloesseri*, and in slenderness of the wing: length to width ratio of 4.0:1 vs. 3.7:1 for *A. kiefferi* and 3.7:1 (RFW), 2.8:1 (LHW), and 3.0:1 (RHW) for *A. schloesseri*. The wingtip shape of *A. kiefferi* differs from the other two species in appearing blunter.

The cross-venation varies between the three species. The type species, *A. kiefferi*, appears to have simple crossveins basally and between major veins, but extensive archaedictyon is found between the branches of RP and MP distally. *Archaemegaptilus schloesseri* has simple venation more widespread, with some reticulation, with less development of archaedictyon, and thus a finer-appearing network of crossveins. In *A. blakelyi*, no evidence of archaedictyon was evident, and the crossveins preserved were fine and predominantly simple. In all the specimens, the crossveins appear to be poorly preserved.

Archaemegaptilus blakelyi also differs in that CuA, after forking from the stem of Cu, has a pronounced kink rather than smoothly curving posteriorly; this does not appear to be an artifact of preservation. The apparent closeness of the stem of RP to MA in *A. blakelyi*, however (Figs. 2–3), does appear to be caused by an artifactual folding of the wing membrane between the two veins.

With the addition of this species to the Pottsville Formation palaeoentomofauna, the known taxa remain exclusively palaeopterous and rather large in size. We hope that further exploration of the Pottsville Formation will continue to add to our knowledge of the Paleozoic insects of Alabama.

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Pharciphyzelus lacefieldi Beckemeyer & Engel, 2011

NOVITATES PALEOENTOMOLOGICAE

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