

THE TRIGONOTARBID ARACHNID *ANTHRACOMARTUS VOELKELIANUS* (ANTHRACOMARTIDAE)

Jason A. Dunlop: Institut für Systematische Zoologie, Museum für Naturkunde der Humboldt-Universität zu Berlin, Invalidenstraße 43, D-10115 Berlin, Germany. E-mail: jason.dunlop@rz.hu-berlin.de

Ronny Rößler: Museum für Naturkunde, Theaterplatz 1, D-09111 Chemnitz, Germany

ABSTRACT. *Anthracomartus voelkelianus* Karsch 1882 from the Pennsylvanian (Langsettian) of Nowa Ruda, Poland was listed in a 1953 monograph by Petrunkevitch as an *incertae sedis* species with type material possibly in Dresden. *Anthracomartus voelkelianus* is the type species of the genus *Anthracomartus* Karsch 1882 and historically one of the first described examples of the extinct order Trigonotarbita. It is a pivotal species for resolving the systematics of both *Anthracomartus* and a number of poorly defined, probably congeneric, taxa within Anthracomartidae. Karsch's figured types were overlooked by Petrunkevitch, but have been traced to a repository in Berlin and are redescribed here. Additional type material from Dresden and Wrocław could not be traced. One of Karsch's figured Berlin specimens is regarded here as the holotype of *A. voelkelianus*, but his other figured fossil is evidently not conspecific and is tentatively referred here to *Trigonotarbus* sp. (Trigonotarbitidae).

Keywords: Trigonotarbita, Anthracomartidae, fossil, Pennsylvanian, Poland, systematics

Trigonotarbita is a group of diverse Palaeozoic arachnids recorded from late Silurian to early Permian strata, but occurring most frequently in the Coal Measures of Europe and North America. *Anthracomartus voelkelianus* Karsch 1882 was described from Pennsylvanian age rocks of Silesia (SW Poland) and is significant as the type species of *Anthracomartus* Karsch 1882, itself the type genus of Anthracomartidae Haase 1890. The systematics of this family are poorly resolved—see e.g. Dunlop & Horrocks (1996)—mostly due to Fritsch (1901, 1904) and Petrunkevitch (1945, 1949, 1953) erecting both genera and species based on what appear to be superficial and/or preservational differences. *Anthracomartus voelkelianus* is potentially the senior synonym of some of the more dubious anthracomartid species and restudy of the type material is a necessary starting point for a revision of the Anthracomartidae. There are, however, discrepancies between Karsch's (1882) two figured specimens and between Karsch's and Haase's (1890) figures of what is ostensibly the same fossil. This raises the following questions: were Karsch's original specimens conspecific, and was Fritsch's new

species, *A. granulatus* Fritsch 1904, based on some of Karsch's material? Petrunkevitch (1953) overlooked repository data in the literature, missed the opportunity to study at least some of the relevant fossils, and considered both these species to be *incertae sedis*. In this paper we aim to identify Karsch's original material and to redescribe the available type material of *A. voelkelianus*.

PREVIOUS WORK

Original descriptions.—Karsch (1882) described new fossil arachnids from the Silesian Coal Measures, above the 7th seam of the 'Rubengrube, bei Neurode, Schlesien' (= Ruben mine, near Nowa Ruda, Silesia). This locality is in southern Poland, SE of Wrocław near the border with the Czech Republic. Stratigraphically, the fossils come from the 'Schatzlarer Schichten' (= the Žacléř formation). Karsch established *Anthracomartus voelkelianus* as a new genus and species referred to a new, extinct arachnid order, Anthracomarti. Karsch named the fossils after Mr. Völkel, the pit foreman and collector of the specimens. He noted that the 'small number' of specimens were in the possession of a Mr. Schumann in Dresden, and that they were

made available to Karsch by Prof. Dames and Mr. Weiss. A repository for these fossils was not given.

Anthracomartus voelkelianus was briefly mentioned by Scudder (1884) and was subsequently redescribed and reinterpreted by Haase (1890) who, in contrast to Karsch, identified dorsal and ventral surfaces. Haase (1890, p. 645) stated (correctly) that the two specimens figured by Karsch were in the collection of the Geological Survey (formerly the Königlich-Preußische Geologische Landesanstalt) of Berlin and were lent to him (i.e., Haase) by Dames, who was director of the Geology-Palaeontology Institute of the Museum für Naturkunde (MfN) and who also worked freely for the Survey (W. Lindert, pers. comm.). Furthermore, Haase (p. 646) stated that the 'Gegendruck' (= counterpart) of Karsch's fig. 1 was in the Mineralogical Museum of Dresden, which implies that the type series was divided between at least two institutions (see also below). Haase (1890, pl. 30, fig. 9) claimed to have figured the Berlin specimen (the part) of Karsch's fig. 1, but whereas Karsch's illustration shows a fossil with a quadrate carapace and a leg, Haase's shows one with a more rounded carapace and no leg.

In his monograph of Paleozoic arachnids, Fritsch (1904) included an inverted copy of Karsch's (1882, fig. 1) illustration of *A. voelkelianus*—in Fritsch's version the leg is on the left side—and noted that the cuticle of this species is finely granulated. Note that the Czech author Anton Frič is sometimes cited under this Czech spelling of his name but, like many non-Germans in the Austro-Hungarian empire, published the papers mentioned here under the Germanized spelling 'Fritsch'. Fritsch (1904, p. 40) also created a new species, the somewhat broader *A. granulatus*, based on material in Dresden which he implied was described as *A. voelkelianus*, i.e., '... ein Exemplar das *A. Völkelianus* Fig. 2. bezeichnet war...'. Fritsch based his new species and the reconstruction (his fig. 48) on a number of specimens, but this reference to 'Fig. 2' is confusing. It could mean the fig. 2 of Karsch's plate, but this particular fossil is in Berlin (see below). It could refer to the counterpart of Karsch's fig. 2 specimen, but this specimen has been reported from Wrocław (see below). No locality for *A. granulatus* is stated, but the material is probably

also Silesian, and was described as being from 'outside Bohemia'. *Anthracomartus granulatus* was differentiated from *A. voelkelianus* on the grounds that it was shorter and wider with very clear granulation. Both species were listed in the monographs of Pocock (1911) and Petrunkevitch (1913).

In a review of the Pennsylvanian arachnids from Silesia, Schwarzbach (1935) mentioned a Westphalian age for the Rubengrube type locality. Schwarzbach noted that Karsch's type series of *A. voelkelianus* was not in Wrocław (formerly Breslau), except for the counterpart of the one figured by Karsch (1882, fig. 2). Schwarzbach cited a repository number, No. 556, for this specimen in the Geological Institute of Wrocław, which implies that Karsch's original material was divided between Berlin, Dresden and Wrocław. Schwarzbach also noted that it was uncertain whether the specimens in Karsch's two figures belonged together. Presumably he was questioning whether they were conspecific, since the literature already implied that each of Karsch's figured specimens consisted of a part and counterpart and that the specimen in Karsch's fig. 1 ended up in Berlin and Dresden (Haase 1890) while Karsch's fig. 2 ended up in Berlin and Wrocław. Schwarzbach also noted another Wrocław specimen (no. 555) as having been collected by Völkel, further supporting the idea that the original Rubengrube material ended up in more than one institution. Although originally labelled as *A. voelkelianus*, based on its wide body Schwarzbach referred no. 555 to *A. granulatus*.

Petrunkevitch's monographs.—Petrunkevitch (1949) recognized the significance of *A. voelkelianus* as the type species of *Anthracomartus*, and discussed the differences between Karsch's and Haase's interpretations (see also above). He concluded that the specimen matching Karsch's (1882, fig. 1) must be regarded as the holotype and questioned whether Karsch's two specimens were conspecific and if Karsch (fig. 1) and Haase (pl. 30, fig. 9) had actually figured the same fossil. Petrunkevitch did not study the original material, and remarked that he was unable to obtain permission to visit Dresden during a post-war tour of European museums. Correspondence in the MfN, Berlin reveals that in 1951 Petrunkevitch wrote to Alfred Kästner (then at the MfN) to ask if someone from Berlin could

visit Dresden and establish the identity of the type from the material there seen by Karsch; himself a former curator in the MfN, Berlin.

Curiously, Petrunkevitch did not ask Kästner about the Karsch types cited as being in Berlin and Wrocław. It appears that Petrunkevitch simply overlooked the repository details in Haase (1890) and Schwarzbach (1935) and assumed that all the types of both *A. voelkelianus* and *A. granulatus* were in Dresden (see also Petrunkevitch 1953), as implied by a cursory reading of both Karsch (1882) and Fritsch (1904). The unfortunate irony is that the specimens figured by Karsch were all the time in the Geological Survey of Berlin (see below), a building located at Invalidenstraße 44, adjacent to Kästner in the MfN (Invalidenstraße 43). Kästner contacted the 'Staatliches Museum für Tierkunde', Dresden, but the paleontology department there was unable to locate types of either species. Consequently, Petrunkevitch (1953, p. 68) regarded *A. voelkelianus* as an *incertae sedis* species, citing it as 'Carboniferous of Silesia. (In Dresden?)'. In fact the entire genus *Anthracomartus* became an *incertae sedis* taxon as a result of Petrunkevitch's (1953) revision, although Petrunkevitch (1955a) appeared to revalidate the taxon in the *Treatise on Invertebrate Paleontology*, listing it among the other anthracomartid genera but without any detailed discussions. An outline drawing based on Karsch's (1882, fig. 1) was included by Petrunkevitch (1955a), but since then there has been no further mention of *A. voelkelianus* in the literature.

METHODS

The Königlich-Preußische Geologische Landesanstalt is now included in the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), Hannover (branch Berlin) and in 1996 the collections were moved from Invalidenstraße to a new repository at Wilhelmstraße 25–30, D-13593 Berlin. Both the type catalogues of Dienst (1928, p. 125), and more recently Daniels et al. (1998, p. 39), confirm that Karsch's material is present in this collection.

The BGR, Berlin fossils consist of the two specimens actually figured by Karsch (1882) in his original description. Both match Karsch's original illustrations, i.e. the appendages are on the correct side, and have the re-

pository numbers 09446 (Karsch's fig. 1) and 09447 (Karsch's fig. 2). The only difference is that in the original plates the specimens were drawn on larger, squarer slabs of matrix with associated plant material. The actual slabs (Figs. 1, 2) are smaller and irregular and do not look to have been trimmed, thus it appears that a certain amount of artistic licence was used in the illustrations (W. Lindert, pers. comm.). This is not to say that the drawings of the animals themselves are inaccurate (they are actually very good) only that there is a discrepancy concerning the matrix.

Specimens 09446 and 09447 are the only examples of *A. voelkelianus* in the BGR, Berlin collection. The building of the 'Geologische Landesanstalt' was damaged in the war, material was lost (W. Lindert, pers. comm.) and thus it is possible that additional specimens were originally present. Neither specimen exactly matches Haase's (1890, pl. 30, fig. 9) illustration, supposedly also of 09446, and it remains unclear what Haase actually drew. Although Petrunkevitch (1949) tended towards the idea that Haase drew a different fossil (perhaps now lost), we suspect that Haase's figure could also be based on 09446, but with the leg omitted and a different emphasis to Karsch's, more accurate, version.

Unfortunately, the material cited by Schwarzbach in Wrocław could not be traced. Martin Schwarzbach was associated with the geological institute of the University of Wrocław before the war and later material from this institute passed to the Muzeum Geologiczne (Geological Institute, Wrocław University: Cybulskiego 30, 50–205 Wrocław: A. Pacholska, pers. comm.). However, a lot of material is known to have been lost during the war, no inventory books were preserved and no fossil arachnids could be traced in the Muzeum Geologiczne collections (A. Pacholska, pers. comm.). The Wrocław material, including the possible counterpart of Karsch's figured specimen, therefore appears to be lost. Furthermore, the material cited by Haase (1890) as being in Dresden could not be traced either. In the State Museum of Mineralogy and Geology of Dresden there are several slabs with plant fossils from the Nowa Ruda site collected at the end of the 19th century. No arachnid remains could be found in them (L. Kunzmann, pers. comm.). During World War II the complete Paleozoic collec-

tion was moved to Pillnitz for safe keeping, thus loss of specimens during that time appears unlikely.

Anthracomartus voelkelianus was compared to other anthracomartid material, principally in the Natural History Museum, London (BMNH) and the National Museum Prague (NMP). The types of *A. buchi* (Goldenberg 1873) and *A. hageni* (Goldenberg 1873)—both poorly preserved, isolated trigonotarbid opisthosomas—were examined in the palaeontological institute of the University of Bonn (repository numbers IPB Guthörl 5 & 6), but the type of *A. granulatus* could not be found in Dresden (L. Kunzmann, pers. comm.). Specimens were drawn under alcohol using a *camera lucida*. All measurements are in mm.

GEOLOGICAL SETTING

The type material of *A. voelkelianus* comes from the Lower Silesian coal basin. This makes up a portion of the Intra-Sudetic basin, the largest geological unit in the Middle Sudetes. The Pennsylvanian sedimentary succession of the Intra-Sudetic basin is distinctly differentiated into several complexes of different clastic material composition, color and paleontological inventory (Bossowski et al. 1995). The first lithostratigraphic subdivision was proposed in the 19th century and was based on informal mining terminology. The sediments of the Žacléř formation, from which the *A. voelkelianus* fossils were obtained, were accumulated under a fluvio-lacustrine regime and represent sub-environments of river channels of low and high sinuosity. In the vicinity of Nowa Ruda the lower (Langsettian age) portion of the Žacléř formation is dominated by fine-grained clastics that contain as many as 20 coal seams. The origin of the coal-bearing sequence, whose thickness reaches 160 m, was peat swamp development in extended alluvial plains. The upper (Duckmantian age) portion of the Žacléř formation is as much as 230 m thick and is composed primarily of coarse-grained clastics. Today it is difficult to say exactly where the 7th seam of the 1882 terminology should be placed within the sequence. All indications point to the lower Žacléř formation (upper Langsettian age, [= Westphalian A]) in recent terminology.

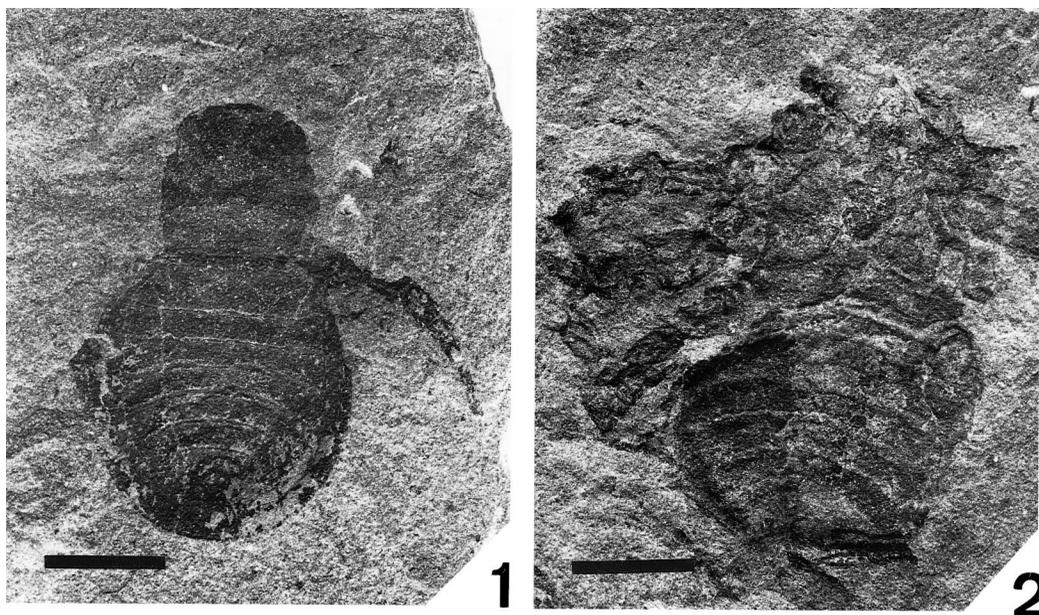
SYSTEMATIC PALEONTOLOGY

Order Trigonotarvida Petrunkevitch 1949

Remarks.—Petrunkevitch (1949) divided Anthracomarti into two orders: Anthracomartida and Trigonotarvida. The features he used to separate these taxa were rejected by Dunlop (1996) as either misinterpretations of the fossils or as insufficient grounds for maintaining distinct orders. They were reunited under the more clearly defined Trigonotarvida, with Anthracomartidae representing one family, diagnosed on tergites divided laterally into 5 plates as opposed to 3 plates in all other trigonotarbids (see Dunlop 1996 for further discussions).

Family Anthracomartidae Haase 1890

Remarks.—Following Petrunkevitch (1953, 1955a), the family Anthracomartidae includes nine valid genera. Two of these, *Brachypyge* Woodward 1878 (known only from an opisthosoma) and *Maiocercus* Pocock 1911 are both distinct in having a scalloped opisthosomal margin (see also Dunlop & Horrocks 1996). Most of the remaining genera: *Promygal* Fritsch 1901, *Brachylycosa* Fritsch 1904, *Coryphomartus* Petrunkevitch 1913, *Pleomartus* Petrunkevitch 1945, *Cleptomartus* Petrunkevitch 1949, *Cryptomartus* Petrunkevitch 1949 and *Oomartus* Petrunkevitch 1953 were based on specimens which were either originally, or at some stage (Pocock 1910), referred to *Anthracomartus*; an *incertae sedis* taxon in Petrunkevitch's (1953) scheme. In his key in this paper, Petrunkevitch diagnosed the anthracomartid genera based mostly on carapace morphology, but provisional work suggests that many of the supposed differences between the carapaces are preservational artifacts, typically based on missing features and strongly influenced by whether the fossils were compressed to a greater or lesser extent in shales or preserved more three-dimensionally in ironstone concretions. The taxonomy of the flattened Nýřany material in Prague is especially suspect and includes specimens, probably identified by Petrunkevitch, (NMP A/165b & A/22b) where the part and counterpart have been assigned to different genera. This study revalidates *Anthracomartus*, rediagnosed below based on the redescription of the genotype. *Anthracomartus*



Figures 1–2.—Photographs of Karsch's fossils housed in the BGR, Berlin. Both from the Pennsylvanian (Langsetian) of the Ruben mine, Nowa Ruda, Intra-Sudetic basin, Poland. 1, No. 09446, holotype of *A. voelkelianus*; 2, No. 09447, a specimen which is not the counterpart of, nor even conspecific with, 09446 and which is referred here to? *Trigonotarbus* sp. Scale = 5 mm.

is potentially the senior synonym of some of these poorly diagnosed anthracomartid genera.

Anthracomartus Karsch 1882

Type species.—*Anthracomartus voelkelianus* Karsch 1882

Included species.—*Anthracomartus granulatus* Fritsch 1904, *A. buchi* (Goldenberg 1873) and *A. hageni* (Goldenberg 1873), the latter two species both *nomina dubia*.

Emended diagnosis.—Anthracomartids with a smooth opisthosomal margin, lacking the marginal scalloping seen in *Brachypyge* and *Maiocercus*. The status of the remaining anthracomartid genera (see above) is questionable and merits revision.

Remarks.—The two Goldenberg species were referred to *Anthracomartus* by Guthörl (1934), but they are based on poor specimens (IPB Guthörl 5 & 6) which are effectively unidentifiable (Petrunkevitch 1953). Both are regarded here as *nomina dubia*. To date, we have been unable to trace the type of *A. granulatus*, supposedly in Dresden (see above), thus we have been unable to confirm its generic affinities.

Anthracomartus voelkelianus Karsch 1882
Figs. 1, 3

Anthracomartus Völkelianus Karsch 1882: 560–561, pl. 21, fig. 1; Scudder 1884:14, 17; Haase 1890: 645–646. Pl. 30, figs. 8, 9; Fritsch 1904: 40, fig. 47.

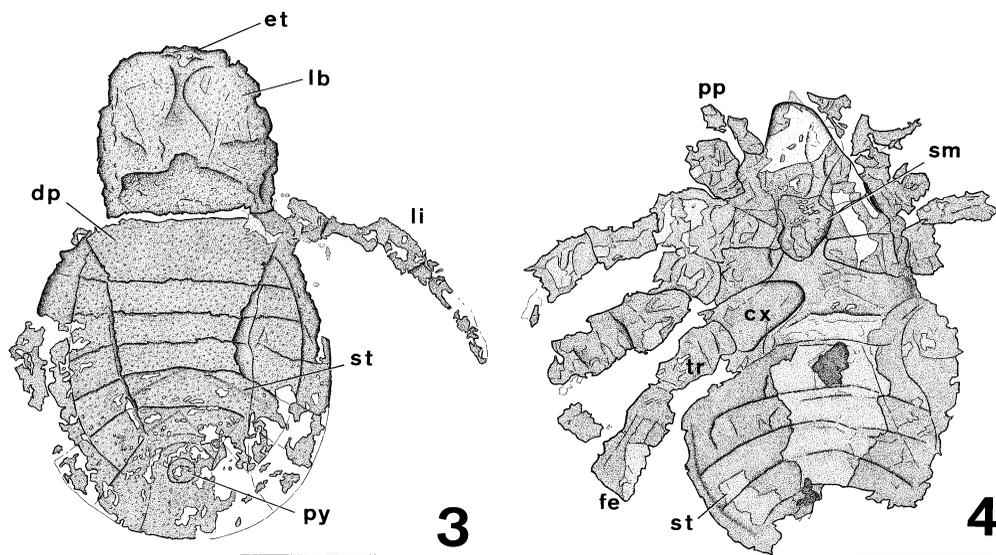
Anthracomartus vökelianus Karsch: Pocock 1911: 3–4, 63; Schwarzbach 1935: 5; Petrunkevitch 1949: 195–198, figs. 192, 193; Petrunkevitch 1953: 58, 68; Petrunkevitch 1955a: 107, fig. 67 (1).

Anthracomartus voelkelianus Karsch: Petrunkevitch 1913, pp. 94, 99.

Material.—BGR, Berlin No. 09446 (Holotype). From the 'Rubengrube', Nowa Ruda, Intra-Sudetic basin, Poland. Pennsylvanian (Langsetian). Not BGR, Berlin No. 09447 (see below).

Emended diagnosis.—Carapace with slightly bilobed anterior region divided by median sulcus. Opisthosoma broadly oval, almost circular in outline, but slightly longer than wide and widest midway along its length. Based on published descriptions, the opisthosoma of *A. granulatus* is wider than long.

Description.—Only carapace, opisthosoma and one leg preserved in dorsal view with



Figures 3–4.—Camera lucida drawings of the specimens shown in Figs. 1–2. Abbreviations: cx = coxa, et = probable median eye tubercle, fe = femur, lb = anterior lobe on carapace, li = limb, pp = pedipalp, py = pygidium, sm = sternum, st = sternites (superimposed through onto dorsal surface in Fig. 3), tr = trochanter. Scale = 5 mm.

some ventral features superimposed posteriorly (Figs. 1, 3). Total length 18.0. Whole specimen with a somewhat granular appearance, in places resolved into a distinct pattern of tiny tubercles. Carapace subquadrate, 6.1 long, 6.6 wide, slightly rounded at anterolateral corners. Carapace with slight relief, but margins on all sides irregular and full depth of carapace obscured within matrix. Carapace with somewhat bilobed appearance in anterior half; lobes approximately symmetrical. Posterior half of carapace somewhat depressed. Carapace lacks lateral eye tubercles and projecting anterior clypeus seen in more three-dimensionally preserved anthracomartids (Dunlop 1996; Dunlop & Horrocks 1996), but small, raised area near anterior margin consistent with median eye tubercle. Single, almost complete, but rather poorly preserved, leg occurs on right side, total length c. 9. Individual podomeres indistinguishable, probably leg IV judging from its position.

Opisthosoma broadly oval, slightly longer (11.7) than wide (11.2). Cuticle preserved as dark regions (best seen under alcohol) but preservation patchy in posterior region and towards margins of opisthosoma. Characteristic anthracomartid tergite pattern, including a large diplotergite (segments 2 + 3) and divi-

sion of most tergites into 5 plates with median plate wider than lateral plates, clearly visible, at least anteriorly. Posterior segmentation less distinct because ventral elements (sternites which are distinctly angled on the midline) are superimposed. Outline of circular pygidium (ventral, diameter 1.0) impressed through onto dorsal surface.

Remarks.—Karsch (1882) did not designate a type from among his ‘small number’ of specimens which implies a series of syntypes. However, since only two of these fossils have been positively identified, and since they appear not to be conspecific (see below), we regard the Berlin specimen corresponding to Karsch’s fig. 1 as the holotype; see also comments by Petrunkevitch (1949, p. 198). If more of the original Rubengrube material is subsequently identified and confirmed to be *A. voelkelianus* then BGR, Berlin No. 09446 may have to be redesignated as a lectotype.

An adequate diagnosis of both the genus and species is difficult without a revision of the anthracomartids and an assessment of the characters used to define taxa. Despite their apparent diversity in the literature, anthracomartid fossils are morphologically rather homogeneous. Furthermore, we are cautious about relying too heavily on reduction (e.g.,

absence of eyes or ornament) and/or proportion-based characters (e.g., length–width ratios) in material which has potentially been distorted during preservation. That said, provisional observations of other anthracomartid fossils suggest that gross morphological carapace ornamentation and the shape of the opisthosoma (i.e., circular, oval or pear-shaped) may be useful characters. This information has therefore been used in the diagnosis above.

Trigonotarbidae Petrunkevitch 1949

?*Trigonotarbus* sp. Pocock 1911

Figs. 2, 4

Anthracomartus Voelkelianus Karsch 1882: 560–561, pl. 21, fig. 2.

Material.—BGR, Berlin No. 09447. From the Rubengrube, Nowa Ruda, Poland. Pennsylvanian (Langsettian). Reported counterpart (Geologisches Institut in Breslau [= Wrocław], No. 556) missing, presumed lost.

Description.—Incomplete specimen preserved in ventral view. Total preserved length 16.6. Prosoma subtriangular, converging to blunt point anteriorly. Mouthparts not preserved, but a series of subtriangular coxae, increasing in size from anterior to posterior, surrounds relatively large, heart-shaped sternal element. Proximal limb elements present, best preserved on left side, but incomplete. Pedipalps poorly preserved. All legs robust with somewhat rounded trochanters and short proximal podomeres; probably femora and patellae, although podomere boundaries mostly not clearly defined (Fig. 4). Opisthosoma incomplete, but preserved outline suggests it was almost circular (diameter c. 9.5.) in life; posterior, including pygidium, missing. At least five opisthosomal sternites visible, all lacking ornamentation and gently procurved with angle of procurvature increasing posteriorly.

Remarks.—As previous authors have hinted, this fossil cannot be the counterpart of 09446 (described above), nor is it conspecific with it. The proportions of the prosoma and opisthosoma, and of the appendages, are significantly different (compare Figs. 1 & 3 with 2 & 4). BGR 09447 cannot even be included in Anthracomartidae, a family which characteristically preserves a number of sharply angled ventral sternites in front of the pygidium (see also above; Fig. 2). The corresponding sternites in BGR 09447 are smoothly procur-

ved (Figs. 3, 4) and overall this fossil, with an apparently triangular prosoma ending in a bluntly rounded ‘snout’, is much more like examples of the family Trigonotarbidae; compare with figures in Pocock (1911) and Petrunkevitch (1949, 1955b). BGR 09447 is tentatively referred to the genus *Trigonotarbus*. In size and general shape BGR 09447 resembles the French Stephanian species *Trigonotarbus arnoldi* Petrunkevitch 1955b, but since the Rubengrube fossil is only incompletely known from a rather poorly preserved ventral surface we are reluctant to assign it to a species.

ACKNOWLEDGMENTS

We thank Wolfgang Lindert (BGR, Berlin) for providing specimens in his care and valuable information on the history of the BGR material, Lutz Kunzmann (State Museum of Mineralogy and Geology of Dresden) for information on their collections and Antonina Pacholska (Muzeum Geologiczne, Wrocław) for information on the Breslau University material. Stephan Shultka (MfN, Berlin) and Andrzej Wiktor (Wrocław) helped track down repositories. We thank the reviewers for comments on the manuscript and Martin Sander (IPB), Andrew Ross (BMNH) and Vojtech Turek (NMP) for access to material in their collections.

LITERATURE CITED

- Bossowski, A., A. Ihnatowicz, K. Mastalerz, L. Kuroski & G.J. Nowak. 1995. Intra-Sudetic Depression. Pp. 142–147. *In* The Carboniferous System of Poland. (A. Zdanowski & H. Zakova, eds.). Polish Geological Institute, Warszawa.
- Daniels, C.H.v., A. Heinke, C. Heunisch, W. Lindert & T. Wiese. 1998. Wissenschaftliche Originale in den Sammlungen BGR/NLfb, Hannover und BGR, Berlin. Bundesanstalt für Geowissenschaften und Rohstoffe, Berlin.
- Dienst, P. 1928. Zusammenstellung der im Geologischen Landesmuseum zu Berlin aufbewahrten Originale. I. Paläozoologischer Teil. Preußische Geologische Landesanstalt, Berlin.
- Dunlop, J.A. 1996. Systematics of the fossil arachnids. *Revue suisse de Zoologie*, hors série:173–184.
- Dunlop, J.A. & C.A. Horrocks. 1996. A new specimen of the Carboniferous trigonotarbid arachnid *Maiocercus celticus* (Pocock 1902) from Lancashire, UK. *Proceedings of the Yorkshire Geological Society* 51:23–31.
- Fritsch, A. 1901. Fauna der Gaskohle und der Kalk-

- stein der Permformation Böhmens, vol. 4, fasc. 2, pp. 56–63 (sometimes cited as 1899).
- Fritsch, A. 1904. Palaeozoische Arachniden. Privately published with support from the Imperial Academy, Vienna. Dr. Eduard Grégr, Prague.
- Karsch, F. 1882. Ueber ein neues Spinnenthier aus der schlesischen Steinkohle und die Arachniden der Steinkohlenformation überhaupt. *Zeitschrift der Deutschen geologischen Gesellschaft* 34: 556–561.
- Goldenberg, F. 1873. Fauna saraepontana fossilis. Die fossilen Thiere aus der Steinkohlenformation von Saarbrücken, Saarbrücken 1:12.
- Guthörl, P. 1934. Die Arthropoden aus dem Karbon und Perm des Saar-Nahe-Pfalz-Gebietes (Arachnoidea, pp. 34–44). *Abhandlungen der preußische geologischen Landesanstalt, N.F.* 164: 1–219.
- Petrunkevitch, A.I. 1913. A monograph of the terrestrial Palaeozoic Arachnida of North America. *Transactions of the Connecticut Academy of Arts and Science* 18:1–137.
- Petrunkevitch, A.I. 1945. Palaeozoic Arachnida of Illinois. An inquiry into their evolutionary trends. *Illinois State Museum, Scientific Papers* 3(2):1–72.
- Petrunkevitch, A.I. 1949. A study of Palaeozoic Arachnida. *Transactions of the Connecticut Academy of Arts and Science* 37:69–315.
- Petrunkevitch, A.I. 1953. Paleozoic and Mesozoic Arachnida of Europe. *Memoirs of the Geological Society of America* 53:1–122.
- Petrunkevitch, A.I. 1955a. Arachnida. Pp. 44–175, *In* *Treatise on Invertebrate Paleontology, Pt. P, Arthropoda 2* (R. C. Moore, ed.). Geological Society of America and University of Kansas Press, Lawrence.
- Petrunkevitch, A.I. 1955b. *Trigonotarbus arnoldi*, a new species of fossil arachnid from Southern France. *Journal of Paleontology* 29:475–477.
- Pocock, R.I. 1910. Notes on the morphology and generic nomenclature of some Carboniferous Arachnida. *Geological Magazine, Decade 5, 7*: 505–512.
- Pocock, R.I. 1911. A monograph of the terrestrial Carboniferous Arachnida of Great Britain. *Monographs of the Palaeontographical Society, London*, 84 pp.
- Schwarzbach, M. 1935. Spinnentiere (Arachnoidea) aus dem schlesischen Oberkarbon. *Jahresberichten der Geologischen Vereinigung Oberschlesiens* 1935:1–8.
- Scudder, S.H. 1884. A contribution to our knowledge of Paleozoic Arachnida. *Proceedings of the American Academy of Arts and Sciences* 20:13–22.
- Woodward, H. 1878. Discovery of the remains of a fossil crab (Decapoda Brachyura) in the Coal-Measures of the environs of Mons, Belgium. *Geological Magazine, Decade 2, 5*:433–436.

Manuscript received 10 May 2001, revised 28 November 2001.