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SHORT NOTE – NOTA BREVE

A TRIGONOTARBID ARACHNID FROM THE UPPER CARBONIFEROUS OF THE SAN GIORGIO BASIN, SARDINIA

PAUL A. SELDEN [1] & GIAN LUIGI PILLOLA [2]

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Abstract. A trigonotarbid arachnid from the Upper Carboniferous (Westphalian D) of San Giorgio Basin, Sardinia, is described and referred to *Anthracomartus voelkelianus* Karsch, 1882, the type genus of the family Anthracomartidae. The occurrence extends the range of this arachnid order outside of the major Euramerican coal basins and into the western Mediterranean region. This is the first pre-Miocene arachnid from Italy to be described.

Riassunto. L'aracnide trigonotarbide del Carbonifero superiore (Westfaliano D) proveniente dal Bacino di San Giorgio (Iglesias) è stato riferito ad *Anthracomartus voelkelianus* Karsch, 1882, il genere tipo della Famiglia Anthracomartidae. La presenza di questo taxon in Sardegna estende la distribuzione dell'Ordine Trigonotarbida al di fuori del classico bacino carbonifero Euroamericano verso il Mediterraneo occidentale. Inoltre, *Anthracomartus voelkelianus* è il più antico aracnide pre-miocenico, descritto formalmente, proveniente dal territorio italiano.

Introduction

Trigonotarbida is an extinct order of arachnids which are currently known from the late Silurian (Přídolí: c. 414 Ma) to the early Permian (Asselian: c. 290 Ma) (Dunlop 1996a; Rößler 1998; Rößler et al. 2003). They occur most frequently in Upper Carboniferous rocks of Europe and North America, where they may be one of the commoner arachnids in Coal Measures ecosystems. They are much more frequent than spiders, for example, in these assemblages. Around 70 trigonotarbid species have been described, although this is probably an over-estimate since most recent revisions have resulted in numerous synonyms (e.g. Rößler 1998). Trigonotarbids resemble spiders, but lack silk-producing spinnerets, and have a characteristic morphology of opisthosomal tergites divided into median and lateral plates. Trigonotarbids are sister to all the other members of Pantetrapulmonata: (Trigonotarbida (Araneae (Amblypygi (Uropygi Schizomida)))) (Shultz 2007). They were almost certainly ambush predators on other arthropods. Well-preserved Devonian examples have mouthparts which indicate that they were predatory, they were not venomous, and digestion was preoral as in many modern arachnids (Shear et al. 1987; Dunlop 1994). One family of trigonotarbids, Anthracomartidae, had been placed in its own order, Anthracomartida by Petrunkevitch (1949). However, following the suspicion expressed by Shear et al. (1987) that Anthracomartida may be synonymous with Trigonotarbida, differing only in that, in the former, the opisthosomal tergites are divided into 5 plates, while in the latter there are only 3, Trigonotarbida and Anthracomartida were reunited under the former name by Dunlop (1996b).

The majority of described Carboniferous trigonotarbids have been found at classic Westphalian localities like the Saarland of Germany, the British Middle Coal Measures, Mazon Creek in the USA and Nýrany in the Czech Republic. One is known from the Iberian peninsula (Selden & Romano 1983), but none has hitherto been reported from Italy. Indeed, this is the first de-

1 Paleontological Institute and Department of Geology, University of Kansas, 1475 Jayhawk Boulevard, Lawrence, Kansas 66045, USA *and* Department of Palaeontology, Natural History Museum, London SW7 5BD, UK. E-mail: selden@ku.edu
2 Dipartimento di Scienze della Terra, Università di Cagliari, via Trentino 51, 09127 Cagliari, Italia. E-mail: pillolag@unica.it

scription of a fossil arachnid older than Miocene from Italy. There is a record of two specimens of spiders in Quaternary (Mindel-Riss interglacial) diatomite from the Rome area (Bottali 1975), spiders have been reported from Oligocene Sicilian amber (Skalski & Veggiani 1990), and a mite was described from Miocene disodile (brown coal) deposits of Melilli, Sicily (Pampaloni 1902). The occurrence of the specimen described here was reported by Del Rio & Pittau (1999) and Benedetti et al. (2002) and the specimen was figured by Del Rio et al. (2002).

Geological setting

The specimen described here comes from the upper third of Unit B of the San Giorgio Formation (Upper Carboniferous: Westphalian D-Early Stephanian) in a large section between the SS130 road and the former mine, near the town of Iglesias, south-west Sardinia (Del Rio et al. 2002) (Fig. 1). It is preserved in pale grey lime mudstone with abundant plant remains (mainly the sphenopsid *Annularia spinulosa*). The fossil (Figs 2, 3) is an almost complete specimen preserved in dorsal view, although the appendages are incomplete, and some on the left side are missing altogether. The specimen appears as a coalified replacement on the mudstone, and is surrounded by many plant remains preserved in the same manner.

Methods

The specimen was studied under a Leica MZ16 stereomicroscope, drawn using a camera lucida attachment on the microscope, and photographed with a Canon 5D digital camera and 50 mm macro lens. The final drawing and photographs were prepared for publication using the Adobe CS3 software suite.

Systematics

Order **Trigonotarbida** Petrunkevitch, 1949

Family Anthracomartidae Haase, 1890

Remarks. The specimen is referred to this family of trigonotarbids on the basis that it bears the diagnostic character of opisthosomal tergites divided into 5 plates, rather than 3 in other trigonotarbid families.

Genus *Anthracomartus* Karsch, 1882

Remarks. The genus *Anthracomartus* is diagnosed on the presence of a smooth opisthosomal margin, rather than scalloped as seen in other anthracomartid genera (Dunlop & Rößler 2002).

Anthracomartus voelkelianus Karsch, 1882

Figs 2, 3

2002 *Anthracomartus* Del Rio et al., p. 228, fig. 5(3).

Material: Single specimen (part only), number MPC 11969, in the Palaeontological Museum of Carbonia, Sardinia.

Description. Only parts of the carapace, opisthosoma and a few leg podomeres preserved in dorsal view. Length of preserved carapace and opisthosoma 15.0. Cuticle surface tuberculate over all visible (dorsal) and exposed part of ventral surfaces; tubercles in rows on femora. Carapace subquadrate, but anterior and lateral edges broken, so original shape not known, 5.1 long, 7.1 wide as preserved. Carapace posterior edge straight. Carapace surface slightly raised, with central depression; margin of raised area procurved in front of posterior margin. Carapace raised area falls away at distinct, straight, transverse scarp immediately in front of eyes.

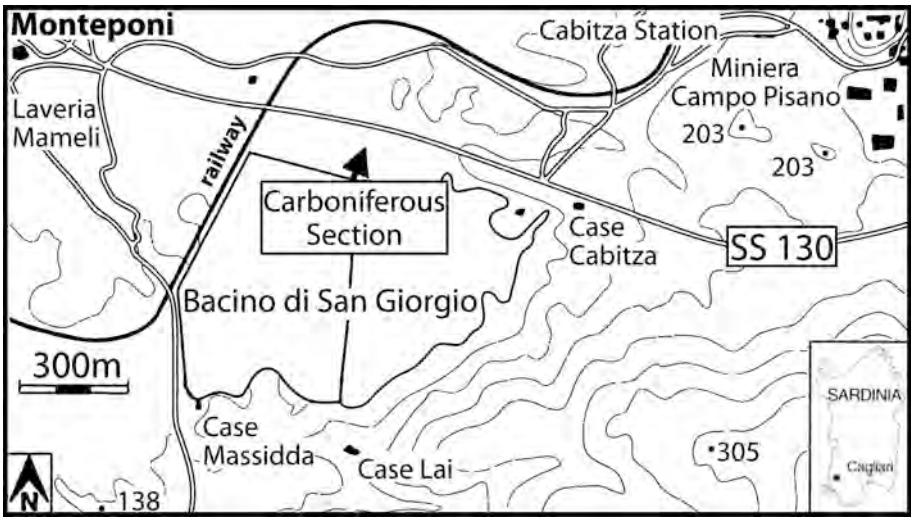

Fig. 1 - Location map of the Upper Carboniferous San Giorgio section.

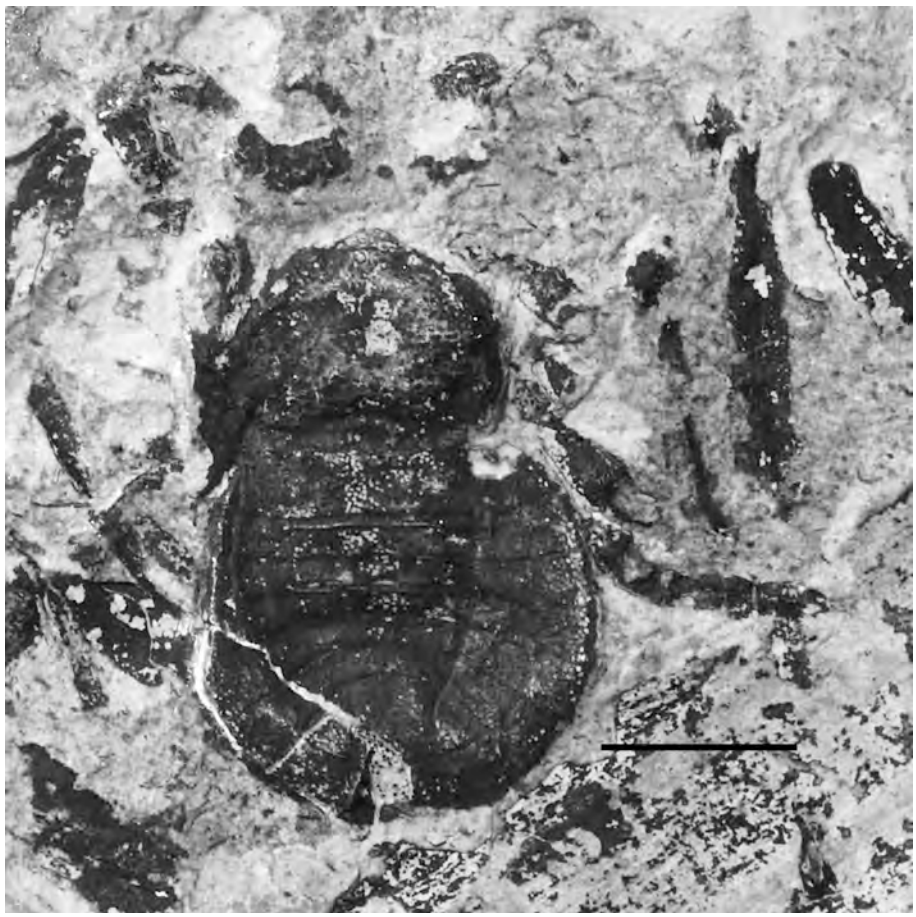

Fig. 2 - *Anthracomartus voelkelianus* Karsch, 1882 from the Upper Carboniferous San Giorgio Basin, Sardinia, specimen MPC 11969; photographed under alcohol. Scale bar: 5 mm.

Small, triangular part of carapace (clypeus) visible in front of eyes. Pair of eyes visible at anterior edge of raised area, on raised eye tubercle. The existence of additional, lateral eyes (as seen in some trigonotarbids) cannot be confirmed. Proximal parts of appendages III-VI (walking legs 1-4) preserved on right side; part of anterior appendage (pedipalp?) and a more posterior leg preserved on left side. Individual podomeres barely distinguishable, but first rather longer articles emerging from beneath body, bearing rows of tubercles, presumed to be femora. Opisthosoma broadly oval, slightly wider (10.1) than long (9.9). Characteristic anthracomartid tergite pattern, including a short tergite 1, large diplotergite (segments 2 + 3) and division of most tergites into five plates with median plate wider than lateral plates. Anterior borders of anterior tergites straight, but become progressively more strongly procurved posteriorly from tergite 7. Median plate of tergite 9 2-3 × as long as other tergites, with recurved posterior margin; tergite 10 only a median plate. Small piece of internal ventral cuticle visible where parts of tergites 9 and 10 broken.

Remarks. The specimen is referred to *Anthracomartus voelkelianus* Karsch, 1882 with the following reasoning. In the *Treatise on Invertebrate Paleontology*, Petrunkevitch (1955) recognized nine genera of anthracomartids. Two of these, *Brachypyge* Woodward, 1878 and *Maiocercus* Pocock, 1911, have distinctly scalloped opisthosomal margins whereas our specimen shows a smooth opisthosomal outline. The remaining genera were defined principally on carapace morphology. These genera were defined on carapace shape yet, in every case, the carapace edge is missing, poorly defined, or subject to preservational artefacts. Indeed, Dunlop & Rößler (2002) pointed to a specimen in the National Museum in Prague in which part and counterpart of the same specimen had been identified to different genera, possibly by Petrunkevitch himself. Moreover, nearly all of the types of these genera have been, at one time or another, been referred to *Anthracomartus*. Consequently, Dunlop & Rößler (2002) validated the genus *Anthracomartus*, based on a redescription of the genotype, and postulated that the poorly defined genera listed by Petrunkevitch (1955) would become synonyms of *Anthracomartus* when restudied. One such which resembles our specimen to a greater degree than most is *Pleomartus palatinus* (Ammon, 1901), from the upper Carboniferous of Germany. Like the Sardinian specimen, the preserved part of the carapace and the opisthosoma are wider than long. However, the body tubercles in *P. palatinus* are arranged in distinctive polygons (Ammon 1901, fig. 3). Moreover, Ammon's figure 2

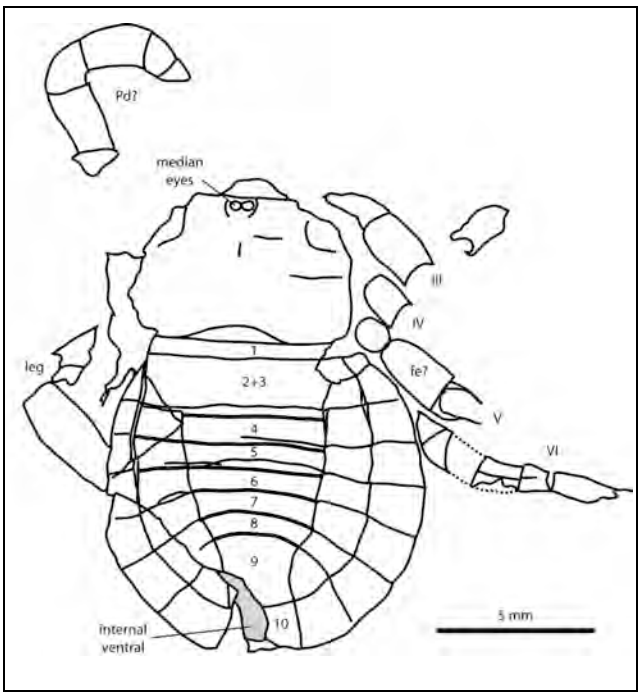

Fig. 3 - *Anthracomartus voelkelianus*, camera lucida interpretive drawing for Figure 2.

shows *P. palatinus* to have an anteriorly broadening carapace whereas in *Anthracomartus*, including our specimen, the carapace narrows anteriorly.

Dunlop & Rößler (2002) included four species in *Anthracomartus*, two of which, *A. buchi* (Goldenberg, 1873) and *A. hageni* (Goldenberg, 1873), they considered *nomina dubia* because the specimens are too poor to be identifiable. This leaves two potentially recognizable species in the genus: the type *A. voelkelianus* Karsch, 1882, and *A. granulatus* Fritsch, 1904. *A. granulatus* supposedly has a little more granular cuticle and its opisthosoma is wider than long. The holotype of this species was lost (Dunlop & Rößler 2002), but has since been rediscovered in Dresden (J. Dunlop, pers. comm. 2009) but has yet to be redescribed. In the Sardinian specimen, the opisthosoma is slightly wider than long, but the differences in measurement are so slight that they fall into the margin of error expected by preservational artefacts. The granulation of the Sardinian specimen is certainly distinct but not greatly different from that shown by the type of *A. voelkelianus* (Dunlop & Rößler 2002, figs. 1, 3). Until the holotype of *A. granulatus* is redescribed, shown to differ from the genotype, and the Sardinian specimen can be compared with it, we consider our specimen to belong in *A. voelkelianus*.

Discussion

The biota of unit B of the San Giorgio basin is dominated by diverse plant remains and palynomophs. Body fossils are represented by a unique arachnid, described herein, and a blattoid wing (Del Rio et al. 2002, and cited references). A trackway, assigned to *Salichnium* (*Saurichnites*) *heringi* (Geinitz, 1885) by Fondi (1980), and other ichnofossils also occur. The latter are scarce and consist of tetrapod footprints, chiefly preserved as casts of manus-pes couples or isolated footprints belonging to three different morphotypes, and tiny arthropod tracks and trails (Pillola et al. 2004). The composition of this biota, together with the taphonomic and sedimentological features of Unit B, suggests a palustrine environment, which can be easily compared with similar deposits of other Western Mediterranean Variscan intracratonic basins. The peculiarity consists on the fact that, despite the paucity of faunal remains, the small San Giorgio basin is today the sole Upper Carboniferous fossiliferous locality in Sardinia.

The presence of *Anthracomartus voelkelianus* in Upper Carboniferous rocks of Sardinia extends the range of this genus and, indeed, the order Trigonotarbida, to the western Mediterranean Variscan basins. Palaeobiogeographical affinities between south-west Sardinia and the northern Iberian (European) margin have been documented in several papers and point to a common tectono-sedimentary evolution from the early Cambrian to the early Tertiary. The occurrence of a terrestrial animal from the San Giorgio Basin assumes a particular value because, together with the ichnofossils, it provides evidence for the strong connections between the Corsica-Sardinian microplate and the mainland Iberian-central Europe domain, within the Euroamerican continental Realm, during the late Carboniferous.

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