Turkish Journal of Earth Sciences

Volume 20 | Number 2 Article 3

1-1-2011

First Report of a Trilobite in the Carboniferous of Eastern Pontides, NE Turkey

RAİF KANDEMİR

RUDY LEROSEY-AUBRIL

Turkish Journal of Earth Sciences (Turkish J. Earth Sci.), Vol. 20, 2011, pp. 179–183. Copyright ©TÜBİTAK
doi:10.3906/yer-0911-3 First published online 12 October 2010

First Report of a Trilobite in the Carboniferous of Eastern Pontides, NE Turkey

RAİF KANDEMİR[1] & RUDY LEROSEY-AUBRIL[2]

[1] Gümüşhane Üniversitesi, Jeoloji Mühendisliği Bölümü, TR–29000 Gümüşhane, Turkey
(raifkandemir@gmail.com)
[2] Forschungsinstitut Senckenberg, Senckenberganlage 25, D-60325 Frankfurt am Main, Germany

Received 02 November 2009; revised typescript receipt 16 September 2010; accepted 12 October 2010

Abstract: The pre-Mesozoic basement of the Eastern Pontides consists of a Permo–Carboniferous sedimentary sequence including the Çatalçeşme and Hardişi formations. The Çatalçeşme Formation has yielded rich assemblages of fusulinids, corals, gastropods, brachiopods, bryozoans, algae, conodonts and plants. Hitherto trilobites were unknown from this formation; here we report the discovery of a pygidium from a dark grey limestone bed near the top. Trilobites are a minor component of benthic marine communities during the Late Pennsylvanian, and to our knowledge, the discovery of this pygidium constitutes the first report of their occurrence in deposits of this age in Turkey. The morphological characteristics of the specimen, especially the number of axial rings and pleural ribs and the well-defined border (Owens 1983), suggest that it probably belongs to an undescribed species of *Ditomopyge* Newell, 1931 (Ditomopyginae). It also exhibits a distortion of the posterior part of the axis, and a shortening (right side) or a fusion (left side) of some pleural ribs, which is tentatively interpreted as repaired injuries or the results of a developmental dysfunction.

Key Words: Bayburt, Eastern Pontides, trilobite, Ditomopyginae, Carboniferous

Doğu Pontid Karbonifer'indeki İlk Trilobit Bulgusu, KD Türkiye

Özet: Doğu Pontidler'in Mesozoyik öncesi temelini oluşturan Permo–Karbonifer yaşlı çökel kayaları Çatalçeşme ve Hardişi formasyonlarından oluşur. Çatalçeşme Formasyonu fusulinidler, mercanlar, gastropodlar, brakyopodlar, bryozoalar, algler, konodontlar ve bitki fosillerinden oluşan oldukça zengin bir topluluğu içerir. Fakat bugüne kadar bu formasyondaki trilobit varlığı bilinmemekteydi. Bu çalışmada Çatalçeşme Formasyonu'nun üst seviyelerine yakın koyu gri renkli bir kireçtaşı tabakasında, sadece kuyruk kısmıyla temsil edilen, tek bir trilobit örneği bulunmuştur. Trilobitler, Geç Pensilvaniyen süresince bentik denizel toplulukların nadir bir öğesini oluştururlar ve bu örnek Türkiye'de bu yaştaki ilk trilobit bulgusudur. Çatalçeşme Formasyonu'ndan elde edilen örneğin morfolojik özellikleri, özellikle aksiyal halkalar ve plevral kotların sayısı ve iyi-belirlenmiş sınırı, olasılıkla *Ditomopyge* Newell, 1931 cinsine ait (Ditomopyginae) tanımlanmamış bir tür olduğu düşünülmektedir. Örnek ayrıca, eksenin arka bölümünün bükülmüş olması ve bazı plevral kotların sağ bölümde kısalması veya sol bölümde birleşmelerini gösterir. Bu anormallikler, onarılmış yaraları veya muhtemelen, organizmanın gelişmesi sırasındaki işlev bozukluklarının sonuçlarını temsil edebilir.

Anahtar Sözcükler: Bayburt, Doğu Pontidler, trilobit, Ditomopyginae, Karbonifer

Introduction

Near the town of Demirözü, approximately 30 km southwest of Bayburt (Figure 1A, B), a Permo–Carboniferous sedimentary sequence crops out, which is of particular interest as it is the only known representative of Palaeozoic strata in the southern zone of the eastern Pontides. It has attracted the attention of other researchers because of its geological (Okay & Şahintürk 1997), stratigraphical (Ağar 1977; Keskin *et al.* 1989) and palaeontological (Okay & Leven 1996; Çapkınoğlu 2003) importance and because of the presence of coal (Mann *et al.* 1998). Okay & Leven (1996) subdivided the Demirözü Palaeozoic sequence into the Çatalçeşme and Hardişi formations, and documented the fusulinids occurring in the former. Later, Çapkınoğlu (2003) investigated the Çatalçeşme Formation and discovered the first conodont faunas in these Permo–Carboniferous deposits. Here, we describe the first record of a trilobite from the Demirözü Palaeozoic.

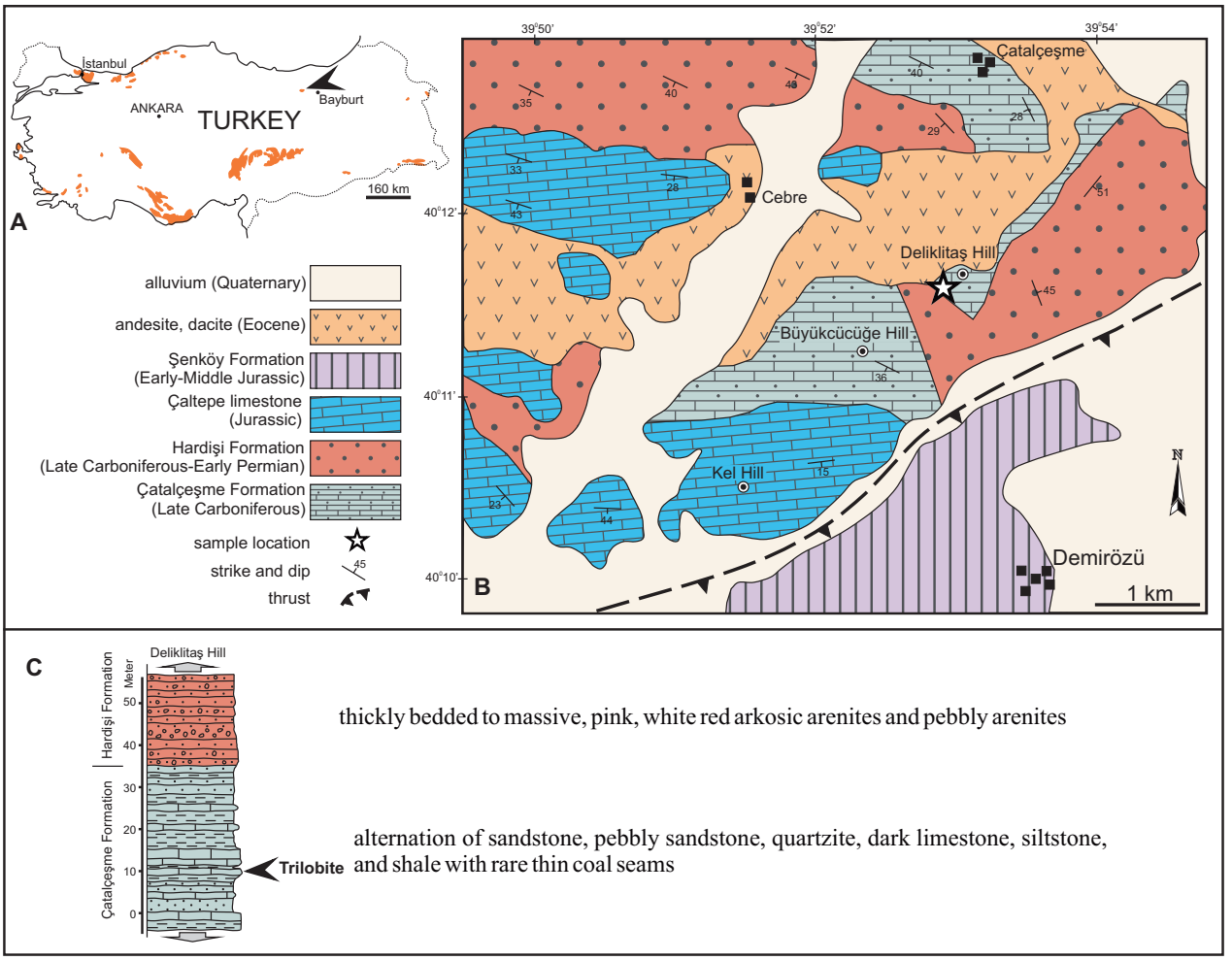

Figure 1. Location of the trilobite bed. **(A)** Map of the Palaeozoic outcrops of Turkey, **(B)** Geological map of the area northwest of Demirözü, Bayburt (from Okay & Şahintürk 1997), **(C)** Location of trilobite horizon within the Çatalçeşme Formation.

Geological Setting and Stratigraphy

The regional geological setting was initially studied by Ketin (1951). The pre-Mesozoic basement of the eastern Pontides consists of various units with different lithologies and tectonic features. These include high-grade metamorphic rocks, Lower Carboniferous granitoids, Upper Carboniferous–Lower Permian shallow marine to terrigenous deposits, and Permo–Triassic low-grade metamorphic rocks. The relationships between these units are poorly known because they are mostly concealed beneath the overlying Mesozoic–Tertiary cover, and affected by Alpine tectonic movements.

The Permo–Carboniferous sedimentary sequence forms the base of the Cebre autochthon (Okay & Şahintürk 1997). The Çatalçeşme Formation comprises a heterogenous series of sandstone, pebbly sandstone, quartzite, dark limestone, siltstone, and shale with rare thin coal seams. Limestones, including the bed that yielded the trilobite pygidium, are medium to thickly bedded, and generally dark grey to black. The thickness of individual limestone horizons ranges from several decimetres to decametres and the overall thickness of the Çatalçeşme Formation is 1000 metres. Okay & Leven (1996) emphasized that there are more than twenty limestone horizons in the sequence. The age of the formation is Desmoinesian–Virgilian (late Moscovian–early Gzhelian) according to fusulinids (Okay & Leven 1996) and Desmoinesian according

to conodonts (Çapkınoğlu 2003). The stratigraphic base of this formation is not exposed but probably overlies the high-grade metamorphic rocks of the Pulur Massif. The contact with the overlying Hardişi Formation is conformable and gradational. The latter consists of about 1000 metres of pink, brown and red terrestrial conglomerates and sandstones. No fossils have been found, but Okay & Leven (1996) suggested that it might be of latest Carboniferous (Gzhelian) to possibly earliest Permian age. The formation is unconformably overlain by the Liassic Çaltepe Formation which consists of carbonate rocks.

Trilobite Occurrence

The Çatalçeşme Formation has yielded rich assemblages of fusulinids (Okay & Leven 1996), conodonts (Çapkınoğlu 2003), corals, gastropods, brachiopods, bryozoans, algae and plants. Here, we report the first known occurrence of a trilobite from this formation, represented by a single pygidium from a dark grey limestone bed near the top (Figure 1B, C) (coordinates: 37575016°E, 4449664°N, 1758)

The pygidium is broadly elliptical in outline, with an entire margin. Its axis is subtriangular, rounded and slightly distorted to the right posteriorly, long [about ninety percent of the length of the pygidium (sag.)] and rather wide [about forty percent of the maximum width of the pygidium (tr.) anteriorly]. It bears fifteen inter-ring furrows which are straight medially and backwardly curved laterally, delimiting fifteen axial rings and a terminal piece. The postaxial field is very short and smooth. The pleural fields are well-differentiated from the pygidial border by strong breaks in slope and they are composed of ten ribs defined by eleven pleural furrows that become increasingly shallow posteriorly. Seven interpleural furrows are present, the anterior two of which reach the pygidial margin. The border is moderately inflated and of sub-equal width everywhere. In lateral view, the axis is rather high anteriorly [about forty percent of the maximum height of the pygidium] while it gently lowers posteriorly although with a steep posterior margin. The post-axial field is steep. In posterior view, the axis is rounded in cross-section. The pleural fields are sub-horizontal adaxially and gently slope downwards abaxially. The ventral side is unknown. The sculpture comprises small tubercles along the posterior margin of each axial ring medially and along the interpleural furrows where the pleural fields start to slope downwards. The border bears discontinuous terrace ridges, each of them running subparallel to the pygidial margin for most of its course before heading towards the pleural field anteriorly. The morphological characteristics of the specimen, especially the number of axial rings and pleural ribs and the well-defined border (Owens 1983), indicate that it probably belongs to an undetermined species of *Ditomopyge* Newell 1931 (Ditomopyginae) (Figure 2).

This specimen is of particular interest as it exhibits abnormal features: distortion of the posterior part of its axis, shortening (right side) or fusion (left side) of some pleural ribs. These multiple malformations might represent repaired injuries or more likely, consequences of malfunctions during the development of the organism (Babcock 2007). They are particularly interesting as they indicate the ability of trilobites to compensate for the consequences of these malfunctions. Indeed, the outlines of the axis and the whole pygidium are normal, which demonstrates they were strongly constrained. Lastly, the specimen apparently possesses two unreleased thoracic segments and therefore it cannot be excluded that, despite its large size, it represents a juvenile stage.

Trilobites are a minor component of benthic marine communities during the Pennsylvanian (Lerosey-Aubril & Feist in press) and to our knowledge, the discovery of this pygidium constitutes the first report of a trilobite of this age in Turkey. Late Palaeozoic trilobites have hitherto been known in this country from the Mississippian of the Eastern Taurides (Frech 1917; Hahn & Hahn 1973) and the Permian of the Western Taurides (Lerosey-Aubril & Angiolini 2009) and the Hazro region (Canuti *et al.* 1970). The Tournaisian faunule described by Frech (1917) is in need of a review but a preliminary study of the original material housed at the Forschungsinstitut Senckenberg (Frankfurt am Main) suggests that it is composed of *Cummingella*, *Linguaphillipsia*, and *Perliproetus*?. The Wordian deposits of Antalya Province have yielded four species of *Pseudophillipsia*: *P.* (*Carniphillipsia*) *kemerensis*, *P.* (*Nodiphillipsia*) aff. *obtusicauda* (Lerosey-Aubril & Angiolini 2009)

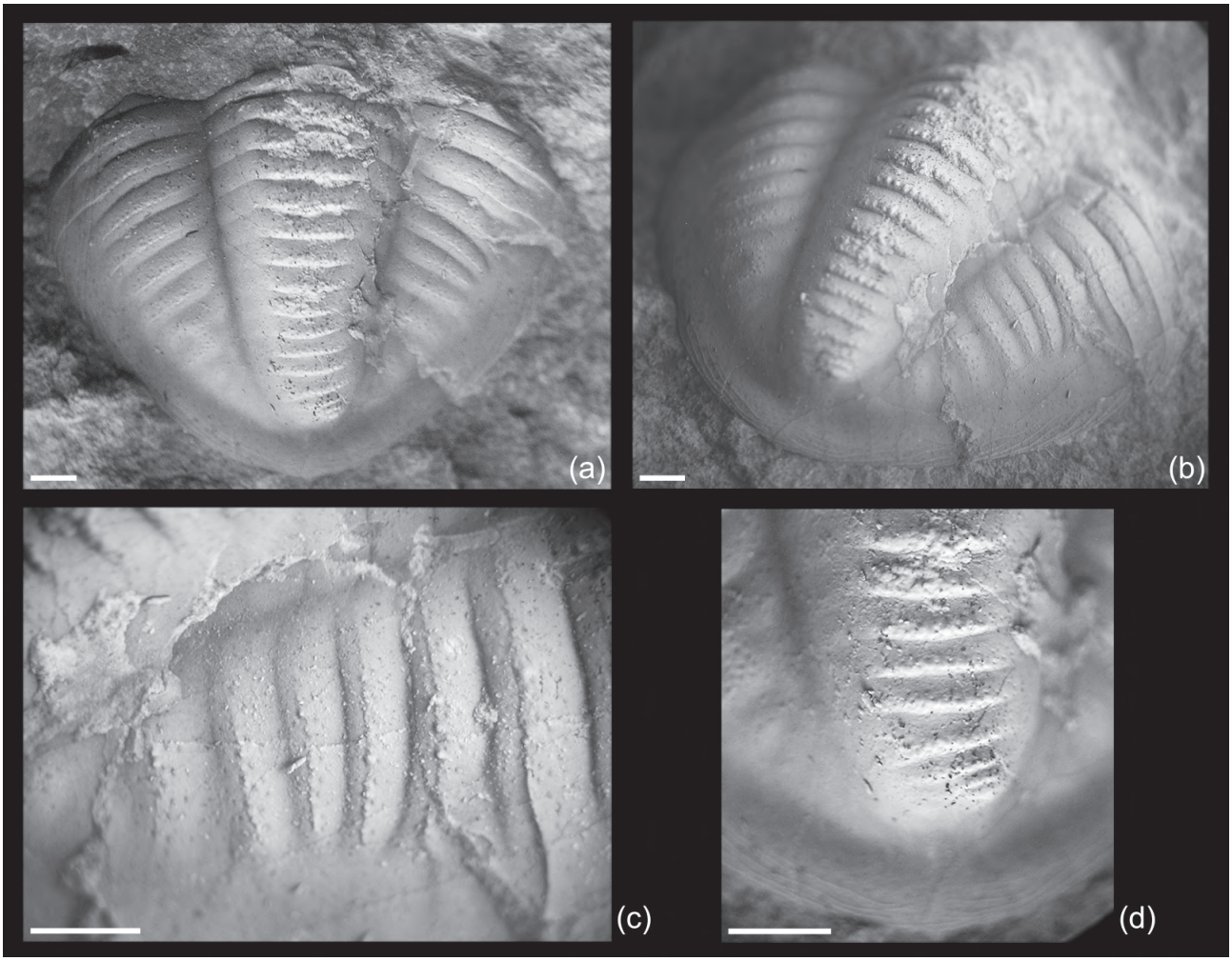

Figure 2. (a)–(d) *Ditomopyge*? sp. indet., pygidium displaying abnormalities in the posterior part of the axis and the right pleural field, Çatalçeşme Formation, Desmoinesian (late Moscovian-?early Gzhelian), vicinity of Demirozu, Eastern Pontides, SMF 86000 **(a)** dorsal view, **(b)** postero-lateral view, **(c)** detail of the right pleural field showing abnormally short ribs with ribs 4–6 shortening (tr.) abaxially while ribs 3 and 7 widening (tr.), **(d)** detail of the posterior part of the axis showing the asymmetrical ring 13 which is twice as wide (exs.) on the left than on the right and how the alignment of following rings is shifted towards the right (Scale bars represent 1 mm).

and two undescribed taxa (work in progress by R. L.-A.). Lastly, Canuti *et al.* (1970) figured a poorly preserved pygidium of an undetermined species of *Pseudophillipsia* from the Permian of the Hazro region. Thus, the discovery of a pygidium in the Early Pennsylvanian of the Pontides fills a gap between previous records of Late Palaeozoic trilobites in Turkey.

Concluding Remarks

This discovery shows that trilobites, although they are rare, occur in the Palaeozoic sequences of the Demirözü region, NE Turkey. The genus *Ditomopyge* ranges from the Early Pennsylvanian (Bashkirian; Carboniferous) to at least the Cisuralian (Artinskian; Permian) and is cosmopolitan throughout its stratigraphical range (Owens & Hahn 1993). During the Lower and Middle Pennsylvanian (Bashkirian–Moscovian), for example, it occurred in the mid-continental US, Alaska, Western Europe (e.g., Spain), the Urals, the Donets and Moscow Basins, and South China. The evolutionary history of Pennsylvanian and Permian trilobites is poorly documented while it is in fact crucial to the understanding of the processes that led to the extinction of these

emblematic Palaeozoic arthropods. Indeed, as recently demonstrated quantitatively (Lerosey-Aubril & Feist in press), a marked drop of trilobite generic diversity associated with a significant restructuring of trilobite communities occurred around the Mississippian/Pennsylvanian boundary. Trilobite communities are then characterized by a relatively low generic diversity and the domination of long-lasting taxa, most exclusively ditomopygines. This major structural change of trilobite communities was apparently triggered by the onset of the ice-house climatic period, which lasted until the mid-Early Permian. The evolutionary history of trilobites therefore exemplifies particularly well how strong has been the influence of climate changes on the diversity and the structure of Late Palaeozoic marine benthic faunas.

Along with few other localities, the eastern Pontides are among the rare localities in the world where Late Palaeozoic trilobites can be found. Any further discoveries in the eastern Pontides will have the potential to enhance our knowledge of the distribution of Late Carboniferous trilobites. The discovery reported herein therefore confirms that fieldwork in Anatolia might produce significant progress towards the understanding of the extinction of trilobites.

Acknowledgements

The authors would like to thank Allart van Viersen and an anonymous reviewer for their critical comments, and also Erdin Bozkurt for his helpful editorial suggestions. We also thank Şenol Çapkınoğlu for his help on the field. The trilobite specimen is housed in the collections of the Forschungsinstitut Senckenberg in Frankfurt am Main (SMF 86000).

References

Ağar, Ü. 1977. Geology of *the Demirözü (Bayburt) and Köse (Kelkit) Region*. PhD Thesis, University of İstanbul, İstanbul, Turkey [in Turkish, unpublished].

Babcock, L.E. 2007. Role of malformations in elucidating trilobite paleobiology: a historical synthesis. *In*: Mikulic, D.G., Landing, E. & Kluessendorf, J. (eds), *Fabulous Fossils – 300 Years of Worldwide Research on Trilobites*, 3–19. New York State Museum Bulletin 507. The University of the State New York, the State Education Department, New York.

Canuti, P., Marcucci, M. & Pirini Radrizzani, C. 1970. Microfacies e microfaune nelle formazioni paleozoiche dell'anticlinale di Hazro (Anatolia sud-orientale, Turchia). *Bollettino della Societa Geologica Italiana* **89**, 21–40.

Çapkinoğlu, Ş. 2003. First records of conodonts from the Permo–Carboniferous of Demirözü (Bayburt), Eastern Pontides, NE Turkey. *Turkish Journal of Earth Sciences* **12**, 199–207.

Frech, F. 1917. Geologie Kleinasiens im Bereich der Bagdadbahn. Ergebnisse eigener Reisen und paläontologische Untersuchungen. *Zeitschrift der deutschen geologischen Gesellschaft* **68**, 1–325.

Hahn, G. & Hahn, R. 1973. Zur Evolution von *Linguaphillipsia* (Trilobita; Unter-Karbon). *Senckenbergiana lethaea* **53**, 479–515.

Keskin, İ., Korkmaz, S., Gedik, İ., Ateş, M., Gök, L., Küçümen, O. & Erkal, T. 1989. *Geology of the Region Around Bayburt*. Mineral Research and Exploration Institute of Turkey (MTA) Report no: **8995** [in Turkish, unpublished].

Ketin, İ. 1951. Bayburt yöresinin jeolojisi [Geology of Bayburt region]. *İstanbul Üniversitesi Fen Fakültesi Mecmuası* **16**, 113–127.

Lerosey-Aubril, R. & Angiolini, L. 2009. Permian trilobites from Antalya Province, Turkey, and enrollment in Late Palaeozoic trilobites. *Turkish Journal of Earth Sciences* **18**, 427–448.

Lerosey-Aubril, R. & Feist, R., in press Quantitative approach of diversity and decline in late Palaeozoic trilobites. *In*: Talent, J.A. (ed), *Global Biodiversity, Extinction Intervals and Biogeographic Perturbations Through Time*. Springer Publishing, MS 27 pp., 6 figures.

Mann, U., Korkmaz, S., Boreham, C.J., Hertle, M., Radke, M. & Wilkes, H. 1998. Regional geology, depositional environment and maturity of organic matter of Early to Middle Jurassic coals, coaly shales, shales and claystones from the Eastern Pontides, NE Turkey. *International Journal of Coal Geology* **37**, 257–286.

Newell, N.D. 1931. New Schizophoriidae and a trilobite from the Kansas Pennsylvanian. *Journal of Paleontology* **5**, 260–265.

Okay, A.I. & Leven, E.J. 1996. Stratigraphy and paleontology of the Upper Palaeozoic sequence in the Pulur (Bayburt) region, Eastern Pontides. *Turkish Journal of Earth Sciences* **5**, 145–155.

Okay, A.I. & Şahintürk, Ö. 1997. Geology of the Eastern Pontides. *In*: Robinson, A.G. (ed), *Regional and Petroleum Geology of the Black Sea and Surrounding Region*. American Association of Petroleum Geologists Memoir **68**, 291–311.

Owens, R.M. 1983. A review of Permian trilobite genera. *Special Papers in Palaeontology* **30**, 15–41.

Owens, R.M. & Hahn, G. 1993. Biogeography of Carboniferous and Permian trilobites. *Geologica et Palaeontologica* **27**, 165–180.