The problematic *Hadimopanella, Kaimenella, Milaculum* and *Utahphospha* identified as sclerites of Palaeoscolecida

INGELORE HINZ, PETR KRAFT, MICHAL MERGL AND KLAUS J. MÜLLER

LETHAIA

Hinz, I., Kraft, P., Mergl, M. & Müller, K. J. 1990 04 15: The problematic *Hadimopanella, Kaimenella, Milaculum* and *Utahphospha* identified as sclerites of Palaeoscolecida. *Lethaia*, Vol. 23, pp. 217–221. Oslo. ISSN 0024-1164.

Hadimopanella Gedik, 1977, *Kaimenella* Märss, 1988 and *Milaculum* Müller, 1973 have been established on the basis of isolated elements of unknown origin. Recently, the latter genus has been tentatively related to the Agnatha (van den Boogaard 1988). By contrast, Bendix-Almgreen & Peel (1988) assigned *Hadimopanella* to the chordate stock but definitely excluded it from vertebrates. Well-preserved worm-like organisms of Palaeoscolecida Conway Morris & Robison, 1986 are known from the Lower Cambrian to the Lower Ordovician. They have their outer surface covered with a pattern of sequin-like sclerites which evidence the systematic affiliation with the isolated sclerites mentioned above. Based on similar structures on the outer surface, *Utahphospha* Müller & Miller, 1976 is considered to belong to the same group. □ *Early Palaeozoic fossils, Palaeoscolecida, isolated sclerites, phosphatization.*

Ingelore Hinz and Klaus J. Müller, Rheinische Friedrich-Wilhelms-Universität, Institut für Paläontologie, Nussallee 8, 5300 Bonn 1, Federal Republic of Germany; Petr Kraft, Přídovědecká fakulta Univerzity Karlovy, Albertov 6, 128 43 Praha 2, Czechoslovakia; Michal Mergl, Pedagogická fakulta, třída 1. máje 51, 306 19 Plzeň, Czechoslovakia; 15th December, 1989.

During recent decades, limestones have been increasingly investigated for phosphatic fossils by the application of etching techniques with diluted acetic acid. In particular, residues from the Early Palaeozoic yield a large variety of isolated sclerites of different systematic origin. Although many of them are enigmatic, they constitute an important component of the according faunal associations. Some of the genera apparently belong to the class Palaeoscolecida (Conway Morris & Robison 1986).

Representatives of this group were described as early as the 19th century under the name *Protoscolex* Ulrich, 1878. As *Palaeoscolex* Whittard, 1953, the next findings were reported from the Tremadocian of Shropshire. Since then, similar material has been noted from numerous other localities and formations. All specimens hitherto described are preserved in shale. They are worm-like organisms characterized by quite tight annuli. Parallel to the individual annuli, the outer surface bears a specific pattern of paillette-like sclerites which have been interpreted as papillae (Bather 1920; Whittard 1953; Conway Morris & Robison 1986). Whittard's (1953) assumed presence of chaetae on top of the papillae would strongly support an annelidan affinity. As they had not observed chaetae, Conway Morris & Robison (1986) assigned those forms only tentatively to annelids.

In the following, several genera which are considered to represent isolated palaeoscolecidan parts are briefly discussed: *Hadimopanella* Gedik, 1977 = *Lenargyrion* Bengtson, 1977 (junior synonym) has been repeatedly reported from all over the world (Gedik 1977, 1981, 1989; Bengtson 1977; van den Boogaard 1983, 1989; Peel & Larsen 1984; Berg-Madsen 1985; Gadzicki & Wrona 1986, Wrona 1987; Hinz 1987; Märss 1988). The sclerites have a plain lower and a convex, ornamented upper surface (Fig. 1D). They consist of a fibrous core also comprising the marginal rim and a dense capping. Usually, the isolated sclerites occur in quantity and display considerable variation in size. The only known assemblage with hadimopanellids of different size in quite an irregular and loose arrangement was described by Wrona (1987). It possibly represents a fragmentary scleritome, which is confirmed by our specimen with preserved cuticle and differently sized sclerites adjacently placed within (Fig. 1F). Van den Boogaard (1983) illustrated an extremely

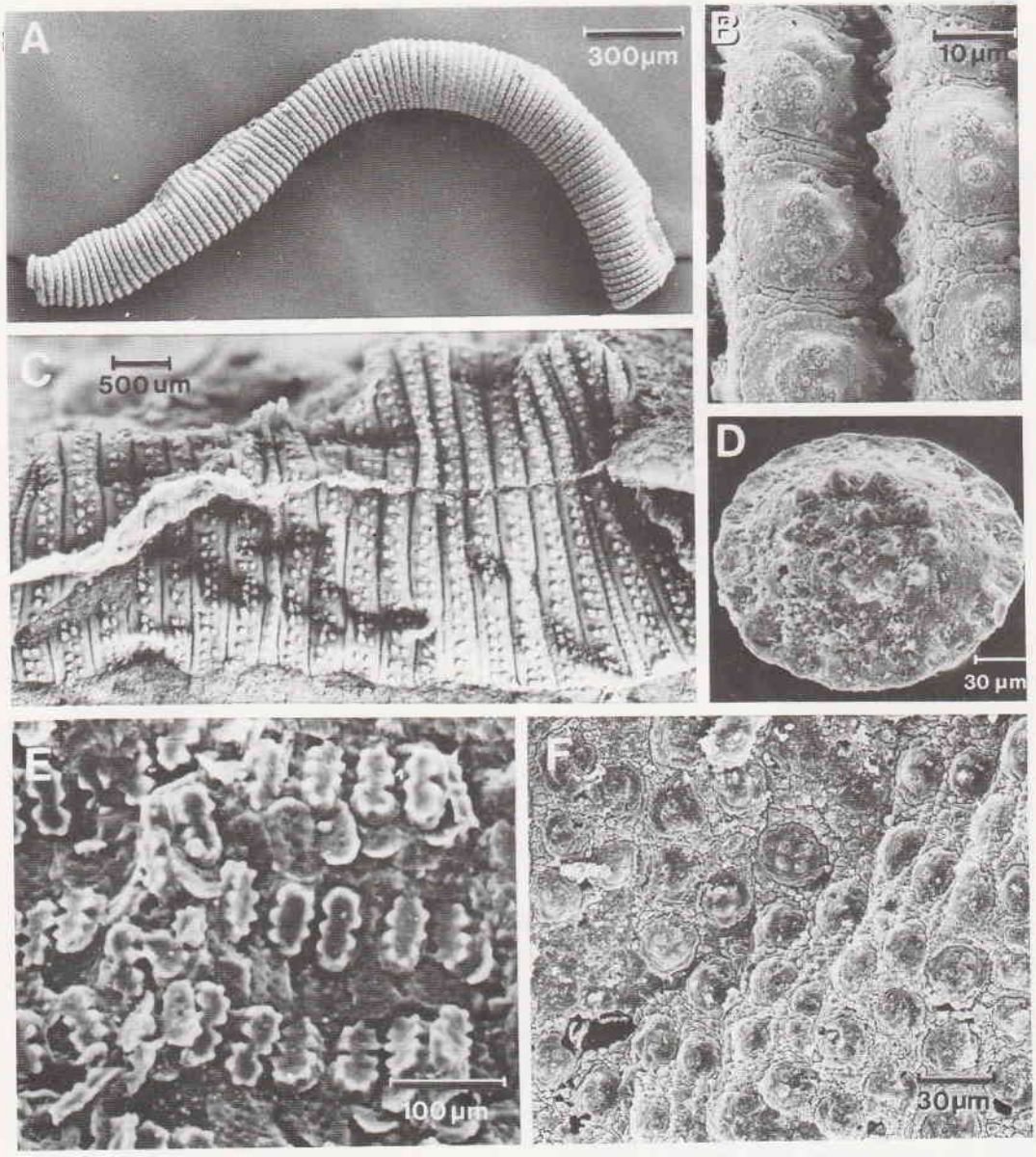


Fig. 1. □ A, B. Palaeoscolecida n. gen. Middle Cambrian, Monastery Creek Phosphate Member, Mt. Murray, Australia (CPC 28738). □ A. Secondarily phosphatized three-dimensional specimen. □ B. Detail showing two annuli, each of them ornamented with a single row of relatively large plates ('papillae'). Their position alternates between adjacent annuli. Between the latter and flanking the deeply incised margins, plates of much smaller size but with typical ornament arise between the surrounding polygonal platelets. □ C. *Gamascolex herodes* Kraft & Mergl, 1989. Lower Ordovician, Dobrotiva Formation, Male Prilepy locality (specimen NM–L24634). Outer surface of the cuticle close to the body axis at the ventral side. □ D. *Hadimopanella oezguli* Gedik, 1977; topotype. Upper Cambrian, Karakaya Tepe between Hadim and Konya, Middle Taurus, Turkey (UB 208). □ E: *'Palaeoscolex' tenesis* Kraft & Mergl, 1989. Lower Ordovician, Klabava Formation, Tene locality (specimen GS–MM 199). This specimen is preserved without its cuticle but with the plates remaining almost in their original position. Thus the sclerites from the lower side of the vermiform organism have their inner surface exposed. □ F. Detail of another palaeoscolecidan from Australia. Middle Cambrian, Monastery Creek Phosphate Member, Mt. Murray (CPC 28739). Cuticle with a double row of alternating plates on each annulus. Adjacent plates may vary considerably in size.

rare twin specimen but did not discuss its nature.

Utahphospha Müller & Miller, 1976 is a cone-like unit with numerous button-like sclerites covering the whole outer surface (Fig. 2A–C). *Utahphospha* and *Hadimopanella* have been united in a family Utahphosphidae Wrona 1987; order, class and phylum were incertae sedis. In our opinion, *Utahphospha* belongs to the Palaeoscolecidae; with its defined apical opening it possibly constitutes cysts.

Milaculum Müller, 1973 is somewhat less common than *Hadimopanella* but still widespread in the Early Palaeozoic. Van den Boogaard (1988) was the first to describe and illustrate jointed sclerites. The individual plates are slightly larger than *Hadimopanella* and of variably elongate outline. The upper surface is covered with rows of tiny cones that correspond to grooves or pores on the lower side (Fig. 2D–F).

Kaimenella Märss, 1988 is very close to *Milaculum*. It represents tiny plates of roughly ovoid outline. The ornamented surface carries tubercles arranged in two subparallel rows and the plain lower surface is dotted with pores.

New findings of Palaeoscolecida from the Middle Cambrian of Australia by Müller & Hinz (Fig. 1A, B), together with illustrated material of *Bohemoscolex*, *Gamascolex* and *Plasmuscolex* (Palaeoscolecida) from the Arenigian of Bohemia (Kraft & Mergl 1989), led to the identification of *Hadimopanella, Kaimenella* and *Milaculum* as exosclerites of this group (Figs. 1A, B, E, F; 2G, H). This is strengthened by the polygonal cuticular structure (Fig. 2D) and sets of horizontal canals which are perpendicular to each other in adjacent layers (Dzik 1986). Such a structure has been observed in both *Milaculum* sclerites and *Bohemoscolex* as well as *Gamascolex*. This coherence was independently recognized by both research groups in Bohemia and Bonn; thus it is reported here jointly. Based on a written communication by Mergl (June 1989), van den Boogaard also shares the opinion that *Hadimopanella* and *Milaculum* are palaeoscolecidans. The shell substance of these fossils in both the Australian and Bohemian occurrences is phosphatic despite an otherwise different preservation – three-dimensionally in limestones or flattened in shale. Whether the phosphate is a primary secretion or a secondary precipitation needs further study. However, the hyaline cap of *Hadimopanella* and a differently structured core give the impression of an unaltered preservation, as has been assumed by all previous workers. But in a number of occurrences with *Hadimopanella* and *Milaculum* secondary phosphatization can be observed on other fossil groups in the same samples.

Three-dimensional sclerites preserved in their natural context are rather rare. This might be due to the polygonal cuticular structure which favours breakage during the preparation process. On the other hand, the cuticle may be less sclerotized and accordingly may have a considerably reduced preservation potential (Fig. 1E).

Future investigation has to deal with terminology, synonymy and correlation of isolated sclerites with complex palaeoscolecidan structures concerning both morphology and locomotion.

Repositories: The material is housed in the collections of the Geological Survey, Prague (GS–MM), the National Museum, Prague (NM–L), the District Museum of Dr B. Horak, Rokycany (OMR), the Commonwealth Palaeontological Collections in the Bureau of Mineral Resources, Canberra (CPC) and the University of Bonn (UB).

Acknowledgement. – K.J.M. and I.H. thank the Deutsche Forschungsgemeinschaft for financial support of this paper.

References

Bather, A. 1920: *Protoscolex latus*, a new 'worm' from Lower Ludlow beds. *Annals and Magazine of Natural History, Series 9:5*, 124–132.

Bendix-Almgreen, S. E. & Peel, J. S. 1988: *Hadimopanella* from the Lower Cambrian of North Greenland: structure and affinities. *Bulletin of the Geological Society of Denmark 37*, 83–103.

Bengtson, S. 1977: Early Cambrian button-shaped phosphatic microfossils from the Siberian Platform. *Palaeontology 20(4)*, 751–762.

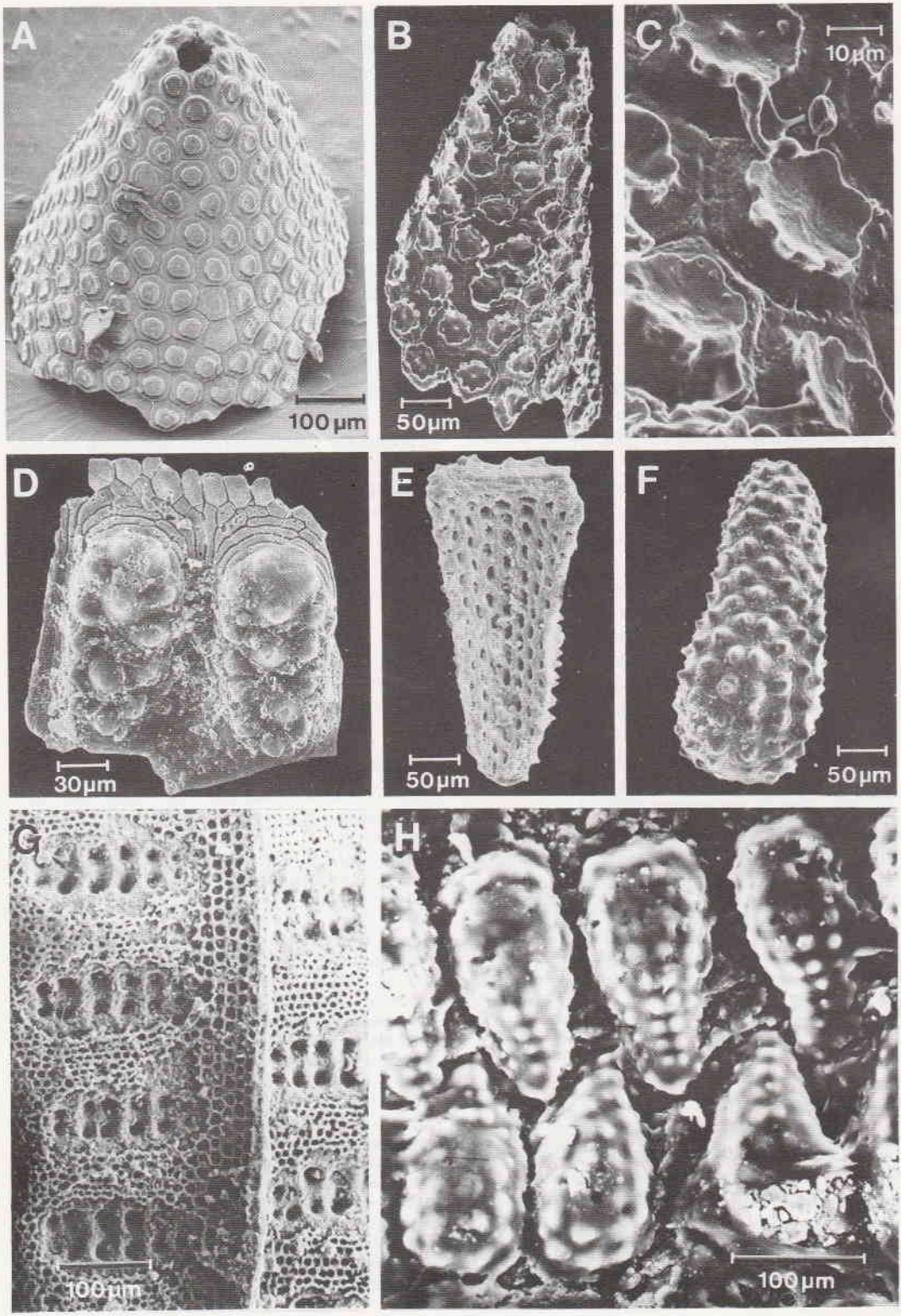
Berg-Madsen, V. 1985: Middle Cambrian biostratigraphy, fauna and facies in southern Balto-scandia. *Acta Universitatis Upsaliensis. Abstracts of Uppsala Dissertations from the Faculty of Science 781*, 1–37.

Boogaard, van den M. 1983: The occurrence of *Hadimopanella oezguli* Gedik in the Lancara Formation in NW Spain. *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschapen Series B86(4)*, 331–341.

Boogaard, van den M. 1988: Some data on *Milaculum* Müller, 1973. *Scripta Geologica 88*, 1–25.

Boogard, van den M. 1989: Isolated tubercles of some palaeoscolecida. *Scripta Geologica 90*, 1–12.

Conway Morris, S. & Robison, R. A. 1986: Middle Cambrian priapulids and other soft-bodied fossils from Utah and Spain. *The University of Kansas Paleontological Contributions 117*, 1–22.


A
100 µm
B
50µm
C
10µm
D
30µm
E
50µm
F
50µm
G
100µm
H
100µm

Dzik, J. 1986: Chordate affinities of the conodonts. *In* Hoffmann, A. & Nitecki, M. H. (eds.): Problematic fossil taxa. *Oxford Monographs on Geology and Geophysics 5*, 240–254.

Gadzicki, A. & Wrona, R. 1986: Polskie Badania Paleontologiczne W Antarktyace Zachodniej. *Przeglad Geologiczny Numer 11 (403)*, Listopad 1986, ROK XXXIV, 609–617.

Gedik, I. 1977: Conodont biostratigraphy in the Middle Taurus. *Bulletin of the Geological Society of Turkey 20*, 35–48.

Gedik, I. 1981: *Hadimopanella* Gedik 1977 nin stratigrafik dagilimi ve mikroyapisi konsunda bazi gözlemler. *Black Sea Technical University Earth Sciences Bulletin, Geology 1:2*, 159–163.

Gedik, I. 1989: Hadimopanellid biostratigraphy in the Cambrian of the Western Taurids: A new biostratigraphic tool in the subdivision of Cambrian System. *Geological Bulletin of Turkey 32*, 65–78.

Hinz, I. 1987: The Lower Cambrian microfauna of Comley and Rushton, Shropshire/England. *Paläontographica A 198*, 41–100.

Kraft, P. & Mergl, M. 1989: Worm-like fossils (Palaeoscolecida; ?Chaetognatha) from the Lower Ordovician of Bohemia. *Sbornik geologiceski věd. Paleontologie 30*, 9–36

Märss, T. 1988: Early Palaeozoic Hadimopanellids of Estonia and Kirgizia (USSR). *Proceedings of the Academy of Sciences of the Estonian SSR. Geology 37*, 10–17.

Müller, K. J. 1973: *Milaculum* n. gen., ein phosphatisches Mikrofossil aus dem Altpalaeozoikum. *Paläontologische Zeitschrift 47*, 217–228.

Müller, K. J. & Miller, J. F. 1976: The problematic microfossil *Utahphospha* from the Upper Cambrian of the western United States. *Lethaia 9*, 391–395.

Peel, J. S. & Larsen, N. H. 1984: *Hadimopanella apicata* from the Lower Cambrian of Western North Greenland. *Rapport Grønlands geologiske Undersøkning 121*, 89–96.

Ulrich, E. O. 1878: Observations on fossil annelids, and descriptions of some new forms. *Journal of the Cincinnati Society of Natural History 1*, 87–91.

Whittard, W. F. 1953: *Palaeoscolex piscatorum* gen. et sp. nov., a worm from the Tremadocian of Shropshire. *Quarterly Journal of the Geological Society of London 109*, 125–135.

Wrona, R. 1982: Early Cambrian phosphatic microfossils from Southern Spitsbergen (Hornsund Region). *Palaeontologica Polonica 43*, 9–16.

Wrona, R. 1987: Cambrian microfossil *Hadimopanella* Gedik from glacial erratics in West Antarctica. *Palaeontologica Polonica 49*, 37–48.

Fig. 2. □ A. *Utahphospha sequina* Müller & Miller, 1976. Upper Cambrian, Upper Franconian, *Elvinia* Zone, Orr Formation. N. side of Steamboat Pass, Southern House Range, Millard County, Utah. Holotype (UB 587). Coniform scleritome with apical opening. □ B, C. *Utahphospha sequina* Müller & Miller, 1976 with detail of plates. Locality and horizon as above (UB 592). □ D. Fragment of *Milaculum* sp. scleritome. Middle Cambrian, Monastery Creek Phosphate Member, Mt. Murray, Australia (CPC 28740). □ E. *Milaculum ruttneri* Müller, 1973. Upper Cambrian, transition zone between Derenjal and Shirgesht Formation, Derenjal Mountains at Shirgesht (UB 520). Lower, excavated side with pores. □ F. *Milaculum scandicum* Müller, 1973. Ordovician, *Orthoceras* Limestone, boulder, Berlin-Spandau (UB 525). Convex upper side with tubercle rows. □ G. *Gamascolex herodes* Kraft & Mergl, 1989. Lower Ordovician, Dobrotiva Formation, Male Prilepy locality (specimen GS–MM 118). External mould of the outer cuticular surface with elliptical sclerites surrounded by fine pits. □ H. *Plasmuscolex klabavensis* Kraft & Mergl, 1989. Lower Ordovician, Klabava Formation, Klabava (specimen OMR 18726). Latex cast, showing several sclerites in their natural position.