

New evidence for the synonymy of *Dilophaspis* and *Nahecaris* (Phyllocarida; Lower Devonian; Rhenish Massif)

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with 6 figures and 1 table

Kurzfassung: Kürzlich entdeckte Phyllocariden aus den Wiltz-Schichten (frühes Ober-Emsium) in der West-Eifel und im östlichen Luxemburg werden als *Dilophaspis frankel* n. sp. beschrieben. Die Art, die nach älteren Aufsammlungen auch schon im späten Unter-Emsium vorkommt, verbindet morphologische Merkmale von *Nahecaris* JAEKEL, 1921 und *Dilophaspis* TRAQUAIR in WALTHER, 1903 und zeigt damit, dass *Nahecaris* ein subjektives jüngeres Synonym von *Dilophaspis* ist, wie dies schon von HAHN (1990) vermutet wurde. *Dilophaspis* ist nunmehr aus vier unterschiedlichen stratigraphischen Einheiten bekannt: (1) frühes Emsium (Hunsrück-Schiefer; Datierung nach WEDDIGE 1996): *D. stuerzi* (JAEKEL, 1921) und *D. ? balssi* (BROILI, 1930); (2) spätes Unter-Emsium (Nellenköpfchen-Schichten, Vallendar-Gruppe): *D. frankel* n. sp.; (3) frühes Ober-Emsium (Wiltz-Schichten): *D. frankel* n. sp.; (4) spätes Ober-Emsium (Kieselgallen-Schiefer, Kondel-Gruppe): *D. lata* TRAQUAIR in WALTHER, 1903. Diese Abfolge deutet an, dass *Dilophaspis* für biostratigraphische Datierungen herangezogen werden kann.

Schlüsselwörter: Phyllocarida, *Dilophaspis*, *Nahecaris*, Synonymie, Unter-Devon, Emsium, Rheinisches Schiefergebirge

Abstract: Recently discovered phyllocarids from the early Upper Emsian Wiltz Beds in the Western Eifel Mountains and in eastern Luxemburg are described as *Dilophaspis frankel* n. sp. This species which – according to previous collections – already occurs in the late Lower Emsian, combines morphological characters of the two genera *Nahecaris* JAEKEL, 1921 and *Dilophaspis* TRAQUAIR in WALTHER, 1903 and, thus, shows that *Nahecaris* is a subjective junior synonym of *Dilophaspis* as already suggested by HAHN (1990). *Dilophaspis* is now known from at least four different stratigraphical units: (1) early Emsian (Hunsrück Slate; dating after WEDDIGE 1996): *D. stuerzi* (JAEKEL, 1921) and *D. ? balssi* (BROILI, 1930); (2) late Lower Emsian (Nellenköpfchen Beds, Vallendar Group): *D. frankel* n. sp.; (3) early Upper Emsian (Wiltz Beds): *D. frankel* n. sp.; (4) late Upper Emsian (“Kieselgallen-Schiefer”, Kondel Group): *D. lata* TRAQUAIR in WALTHER, 1903. This succession proves *Dilophaspis* applicable for biostratigraphical dating.

Keywords: Phyllocarida, *Dilophaspis*, *Nahecaris*, synonymy, Lower Devonian, Emsian, Rheinisches Schiefergebirge

Introduction

Phyllocarid crustaceans are well known from the Lower Devonian of the Rhenish Massif, in particular from the early Emsian Hunsrück Slate. By far the most common species from this unit was first described by JAEKEL (1921) as *Nahecaris stuerzi*. More detailed descriptions dealing with *Nahecaris* have been prepared by HENNIG (1922) and BROILI (1928, 1929, 1930). KUTSCHER (1971) contributed a compilation on the Hunsrück Slate specimens. These articles and, in particular, the careful and highly detailed study by BERGSTRÖM et al. (1987) made *Nahecaris stuerzi* one of the best known fossil phyllocarid species of all. In the earlier sense, *Nahecaris* was restricted to the Hunsrück Slate facies.

Just recently, the interest in the marine life of the Hunsrück slates has been revived and intensified by establishing the international “Project *Nahecaris*”. Its extent and aims are outlined in BRIGGS & BARTELS (2001: 301) and crustaceans and other arthropods will cover a large part of this project.

Prior to JAEKEL (1921), TRAQUAIR in WALTHER (1903) described a fossil from the late Upper Emsian “Kieselgallen-Schiefer” of Roßbach (SW of Marburg, Hesse) which he originally believed to be a dorsal shield of a cyathaspid. He named it *Dilophaspis lata* but did not add a figure. Since the description was rather extensive and included diagnostic morphological features (though under misleading systematic conditions), it was legal according to the International Code of Zoological Nomenclature. Subsequently, the presence of this specimen has been almost completely overlooked. Only SOLLE (1942: 125, footnote), in a comment about WALTHER’s (1903) modified list of fossils, mentioned *Dilophaspis lata* and added a brief oral communication by W. GROSS who supposed that it was not a piscimorph vertebrate but a large arthropod. SOLLE (1942) had already pointed out that the specific (and generic) name is legal.

The latter assumption was emphatically confirmed by HAHN (1990) who carefully revised the re-discovered

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holotype (and only specimen) and figured it for the first time. He concluded that *Dilophaspis* represents a phyllocarid crustacean of the family Rhinocarididae HALL & CLARKE, 1888 and which is closely related to (if not even synonymous with) *Nahecaris*. Due to the different preservation of both genera, HAHN (1990) postponed a definite decision of this question until additional material became available.

The recently discovered *Dilophaspis frankei* n. sp. clearly confirms HAHN's assumption and, furthermore, combines morphological characters of both genera. Therefore, we consider them as subjective synonyms. This means that, unfortunately, *Dilophaspis* has nomenclatural precedence, whereas the well known and better understood name *Nahecaris* as its younger subjective synonym has to be suppressed. According to current data, *Dilophaspis frankei* n. sp. is known from two different strata: (1) late Lower Emsian (Nellenköpfchen Beds, Vallendar Group) and (2) early Upper Emsian (Wiltz Beds). The specimens from the Nellenköpfchen Beds have already been mentioned by HEFTER (1973: 379) under open nomenclature as Phyllocarida and are included in the present article.

The new results show that the *Dilophaspis/Nahecaris* complex has a wider geographical and stratigraphical distribution than considered previously.

More recently, an additional single rhinocaridid (?) specimen has also been recorded from the Lower Devonian (Upper Emsian) of the Armorican Massif (NW France) by RACHEBOEUF (1994) under open nomenclature. As this specimen lacks a carina, it easily can be excluded from *Dilophaspis*.

Systematic Palaeontology

Infraclass Phyllocarida PACKARD, 1879

Order Archaeostraca CLAUS, 1888

Suborder Rhinocarina CLARKE in ZITTEL, 1900

Family Rhinocarididae HALL & CLARKE, 1888

Genus *Dilophaspis* TRAQUAIR in WALTHER, 1903

- * 1903 *Dilophaspis* TRAQUAIR in WALTHER: 30-31.
- 1921 *Nahecaris* JAEKEL: 290-292, fig. 1.
- 1922 *Nahecaris* JAEKEL. – HENNIG: 131-145, fig. 1, pls. 32-34.
- 1928 *Nahecaris* JAEKEL. – BROILÉ: 1-18, fig. 1, pl. 1.
- 1929 *Nahecaris* JAEKEL. – BROILÉ: 253-263.
- 1942 *Dilophaspis* TRAQUAIR. – SOLLE: 125.
- 1969 *Nahecaris* JAEKEL. – ROLFE: R322, fig. 146, 1.
- 1971 *Nahecaris* JAEKEL. – KUTSCHER: 30-42, figs. 1-4, pls. 1-4 (with additional synonymy).
- 1973 Ordnung Phyllocarida. – HEFTER: 379.
- 1987 *Nahecaris* JAEKEL. – BERGSTRÖM et al.: 273-298, figs. 1-14.
- 1990 *Dilophaspis* TRAQUAIR. – HAHN: 11-15, figs. 1, 4.

Type species: *Dilophaspis lata* TRAQUAIR in WALTHER, 1903.

Diagnosis: Because *Dilophaspis* is herewith treated as the older subjective synonym of *Nahecaris*, the diagnosis of both generic names can be largely used and com-

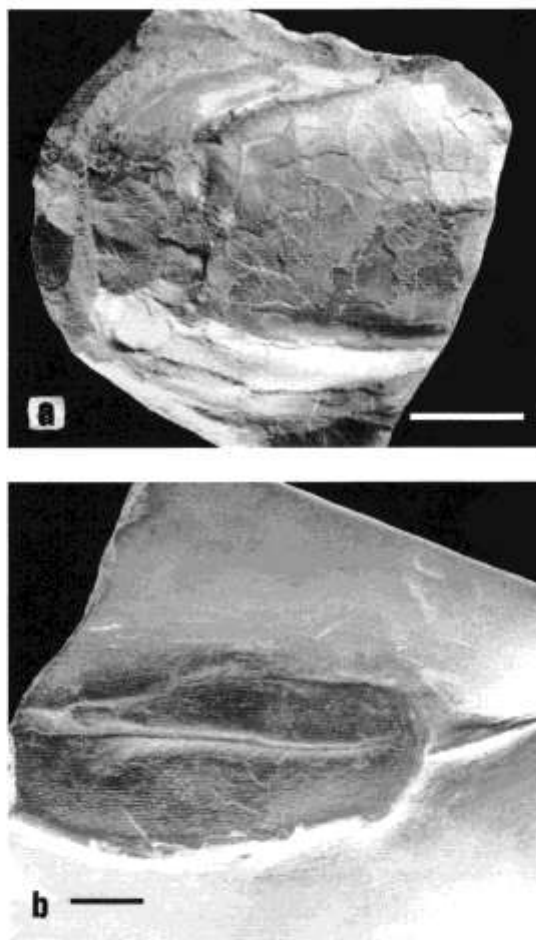


Fig. 1. – **a:** *Dilophaspis lata* TRAQUAIR in WALTHER, 1903 (holotype); dorsal view of a fragmentary carapace, shells preserved, showing the anterior and central part with dorsal plate, mesolateral carinae, and anterior tubercles; scale bar = 10 mm; Robbach near Gladenbach, Gladenbacher Bergland, Hesse; Kieselgallen-Schiefer, Kondel Group, late Upper Emsian (Lower Devonian); Mbg.3079 (Institut für Geologie und Paläontologie, Philipps-Universität Marburg). – **b:** *Dilophaspis stuerzi* (JAEKEL, 1921); lateral view of a fragmentary carapace, showing mesolateral carina, dorsal region not completely preserved; scale bar = 10 mm; Weisel/Taunus (Grube Kreuzberg); Hunsrück Slate, Early Emsian (Lower Devonian); DBM HS 211 (Deutsches Bergbau-Museum Bochum, BARTELS collection).

bined: Modified diagnosis after ROLFE (1969: R322), BERGSTRÖM et al. (1987: 275) (both for *Nahecaris*) and HAHN (1990; for *Dilophaspis*): Rhinocaridid phyllocarid with a single mesolateral carina on each carapace valve, mesolateral carinae extending from anterior to posterior margin; each valve with more or less prominent anterior tubercle, without furrows, posterodorsal spine lacking; median dorsal plate ending posterior to anterior tubercle; cross-section of carapace nearly trapezoidal; surface more or less largely covered by fine terrace lines.

Included taxa: (1) *Dilophaspis lata* TRAQUAIR in WALTHER, 1903, (2) *D. stuerzi* (JAEKEL, 1921), (3) *D.?* *balssi* (BROILA, 1930) [attribution to *Nahecaris* (and therefore to *Dilophaspis*, too) convincingly queried by BERGSTRÖM et al. (1989: 326)], (4) *D. frankei* n. sp.

Stratigraphical and geographical distribution: Lower Devonian (Lower Emsian, Upper Emsian); Rhenish Massif: Germany (Gladenbacher Bergland W of Marburg, Hesse; Hunsrück; Ösling/Western Eifel Mountains; central Rhine region near Koblenz), eastern Luxembourg (Ösling).

Dilophaspis lata TRAQUAIR in WALTHER, 1903

Fig. 1a

*v 1903 *Dilophaspis lata* TRAQUAIR in WALTHER: 30-31.

v 1942 *Dilophaspis lata* TRAQUAIR. – SOLLE: 125.

v 1990 *Dilophaspis lata* TRAQUAIR 1903. – HAHN: 11-14, figs. 1a-d, 4a-b.

Holotype (by monotypy): Specimen Mbg.3079, Geological Institute, Philipps-Universität Marburg (Fig. 1).

Type locality: Roßbach near Gladenbach, W of Marburg, Hesse.

Type horizon: "Kieselgallen-Schiefer", Kondel Group, late Upper Emsian, Lower Devonian.

Material: Only the holotype specimen.

Stratigraphical and geographical distribution: Known only from the late Upper Emsian (Lower Devonian) of the type locality.

Diagnosis (revised): Medium sized *Dilophaspis* with prominent anterior tubercle on each valve of carapace, narrow ventral marginal border and terrace lines spread over the whole carapace.

Description: See HAHN (1990: 12-14).

Discussion: With its late Upper Emsian age, *Dilophaspis lata* is the youngest species of the genus. Its size is similar to that of *D. frankei* n. sp., from which it mainly differs by (1) the more prominent anterior tubercle, (2) the narrower ventral marginal border and (3) the terrace lines being spread over the whole carapace. Adults of *D. stuerzi* are distinctly larger; the anterior tubercle is poorly developed or lacking.

Dilophaspis frankei n. sp.

Figs. 2-5

v 1973 Ordnung Phyllocarida. – HEFTER: 379.

Derivatio nominis: In honour of Dr. Christian FRANKE, D-54675 Wallendorf/Eifel.

Holotype: FRANKE collection, specimen no. 8 = Geological Institute, Technische Universität Clausthal, Clausthal-Zellerfeld TU Cl P Cr 87 (Fig. 4b).

Type locality: Krautscheid, Ösling, Western Eifel Mountains, Germany.

Type horizon: Wiltz Beds, early Upper Emsian, Lower Devonian.

Paratypes (Wiltz Beds, Ösling, Western Eifel and Luxembourg; FRANKE collection): specimens no. 1 (= TU Cl P Cr 88; Waxweiler), nos. 2 (= TU Cl P Cr 89) - 3 and 5 (= TU Cl P Cr 91) - 6 (Faulenpuhl), no. 4 (= TU Cl P Cr 90; Falkenauel), nos. 7-10 (10 = TU Cl P Cr 92; Krautscheid), no. 11 (Kohmenhaff, Luxembourg) and no. 12 (Marnach, im Lehmkaul, Luxembourg).

Additional paratypes from other localities: (1) Pfaffendorfer Höhe near Koblenz: Carapace MB.A 634 (FOLLMANN collection 1894); (2) Nellenköpfchen Beds, Nellenköpfchen; late Lower Emsian: Carapaces MB.A 635 and 637-639 (HEFTER collection 1933, 1935, 1939 and without year, respectively); each deposited in the Museum für Naturkunde der Humboldt-Universität, Berlin.

Stratigraphical and geographical distribution: Lower Devonian (late Lower Emsian to early Upper Emsian); Rhenish Massif: Germany (Ösling/Western Eifel Mountains and eastern Luxembourg, central Rhine region near Koblenz).

Diagnosis: Medium sized *Dilophaspis* with moderately prominent anterior tubercle on each valve of carapace, moderately broad ventral marginal border and terrace lines somewhat restricted to marginal and submarginal ventral regions.

Description (lateral view): Valves of carapace sub-semi-elliptical in shape, subdivided by a mesolateral carina into a dorsal (= adaxial) and a ventral (= abaxial) region. Mesolateral carina distinctly raised, slightly oblique, originating strongly concave close to the anterior-dorsal corner, then becoming nearly straight below anterior tubercle, finally again slightly concave in the posterior quarter of the carapace. Dorsal region slightly broader

Tab. 1. Measurements (valves) of selected specimens of *Dilophaspis* TRAQUAIR in WALTHER, 1903.

specimen	length (sag.) in mm	width (tr.) in mm	ratio length : width
<i>Dilophaspis lata</i> TRAQUAIR, 1903 (holotype), Mbg.3079	~ 50	~ 22	~ 2.27
<i>Dilophaspis stuerzi</i> (JAEKEL, 1921), from BERGSTRÖM et al. 1987: fig. 3	55	27	2.03
<i>Dilophaspis stuerzi</i> (JAEKEL, 1921), from BERGSTRÖM et al. 1987: fig. 2a	64	32	2.00
<i>Dilophaspis frankei</i> n. sp., coll. FRANKE, specimen no. 1	25	15	1.67
<i>Dilophaspis frankei</i> n. sp., coll. FRANKE, specimen no. 5	33	15	2.20
<i>Dilophaspis frankei</i> n. sp., coll. FRANKE, specimen no. 7	36	16	2.25
<i>Dilophaspis frankei</i> n. sp., (holotype), coll. FRANKE, specimen no. 8, TU Cl P Cr 87	36	16	2.25
<i>Dilophaspis frankei</i> n. sp., coll. FRANKE, specimen no. 9	26	14	1.86
<i>Dilophaspis frankei</i> n. sp., coll. FRANKE, specimen no. 12	44	18	2.44
<i>Dilophaspis frankei</i> n. sp., MB A.634	35	14	2.50

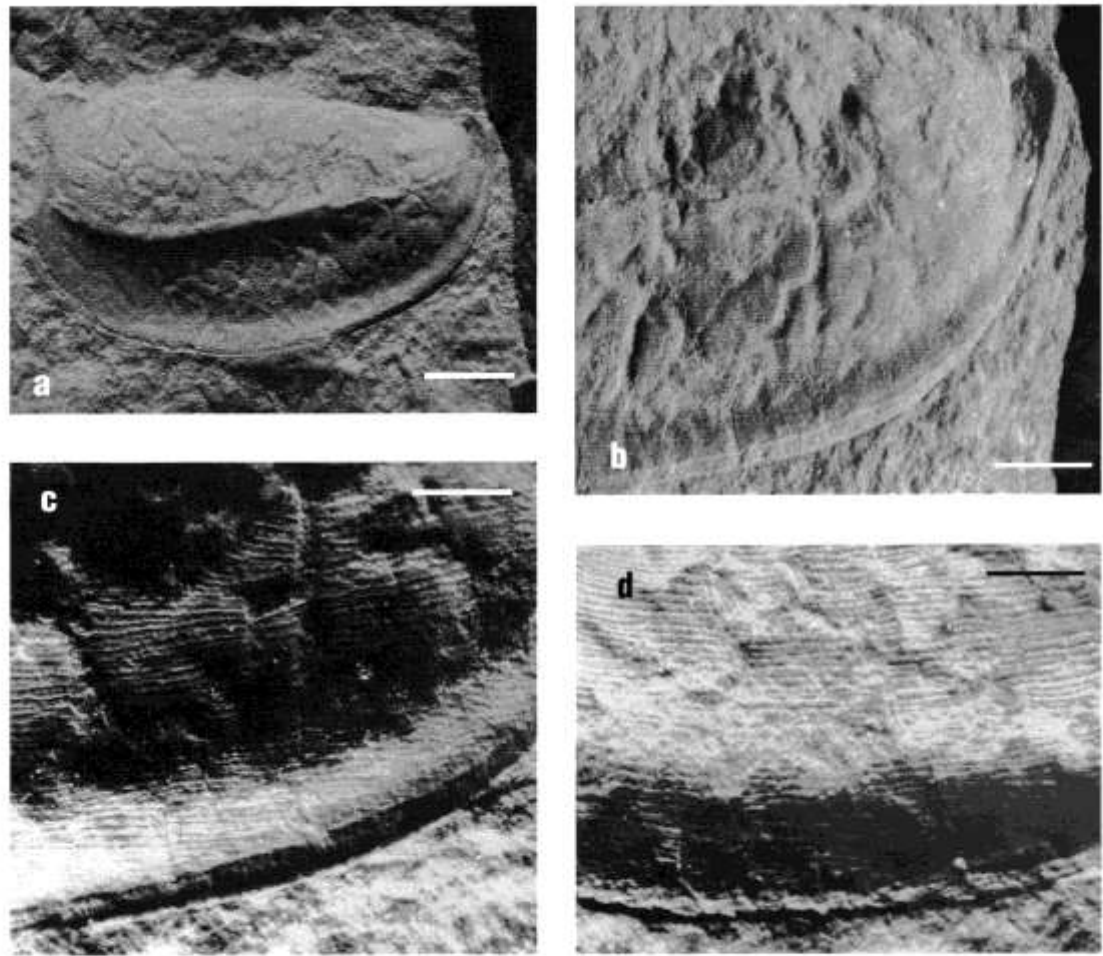


Fig. 2. *Dilophaspis frankei* n. sp.; Wiltz Beds, early Upper Emsian (Lower Devonian), Waxweiler (Ösling, Western Eifel Mountains); FRANKE collection (specimen no. 1 = TU C1 P Cr 88). – **a**: Lateral view of carapace, internal mould of the left valve, negative plate, positively shown by photographic reversal, outline clearly visible, mesolateral carina completely, anterior tubercles poorly, rostral plate not preserved; scale bar = 5 mm. – **b**: Detail of Fig. 2 a, showing the anterior part of the valve, doublure marked; scale bar = 3 mm. – **c-d**: Details of the doublure region of the same specimen, carapace ornament consisting of fine, sub-parallel raised terrace lines; scale bar = 1 mm.

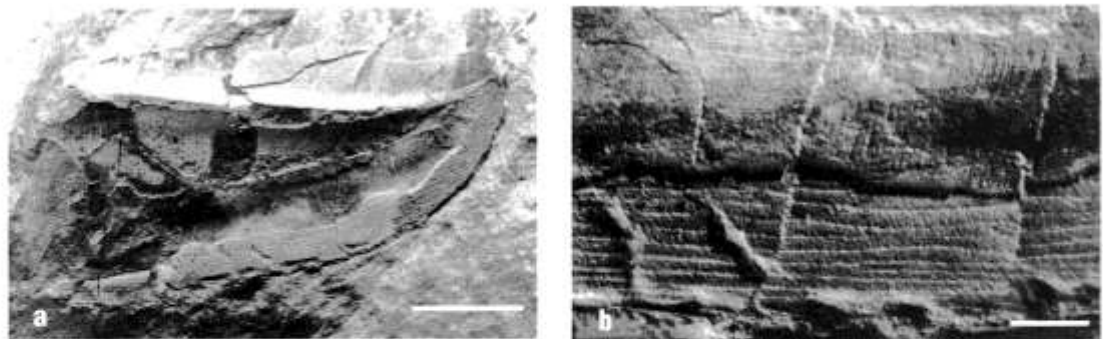


Fig. 3. *Dilophaspis frankei* n. sp.; Wiltz Beds, early Upper Emsian (Lower Devonian), Falkenauel (Ösling, Western Eifel Mountains); FRANKE collection (specimen no. 4 = TU C1 P Cr 90). – **a**: Fragmentary right valve with partially preserved shell; scale bar = 5 mm. – **b**: Detail of Fig. 3a., carapace ornament consisting of fine, sub-parallel raised terrace lines; scale bar = 1 mm.

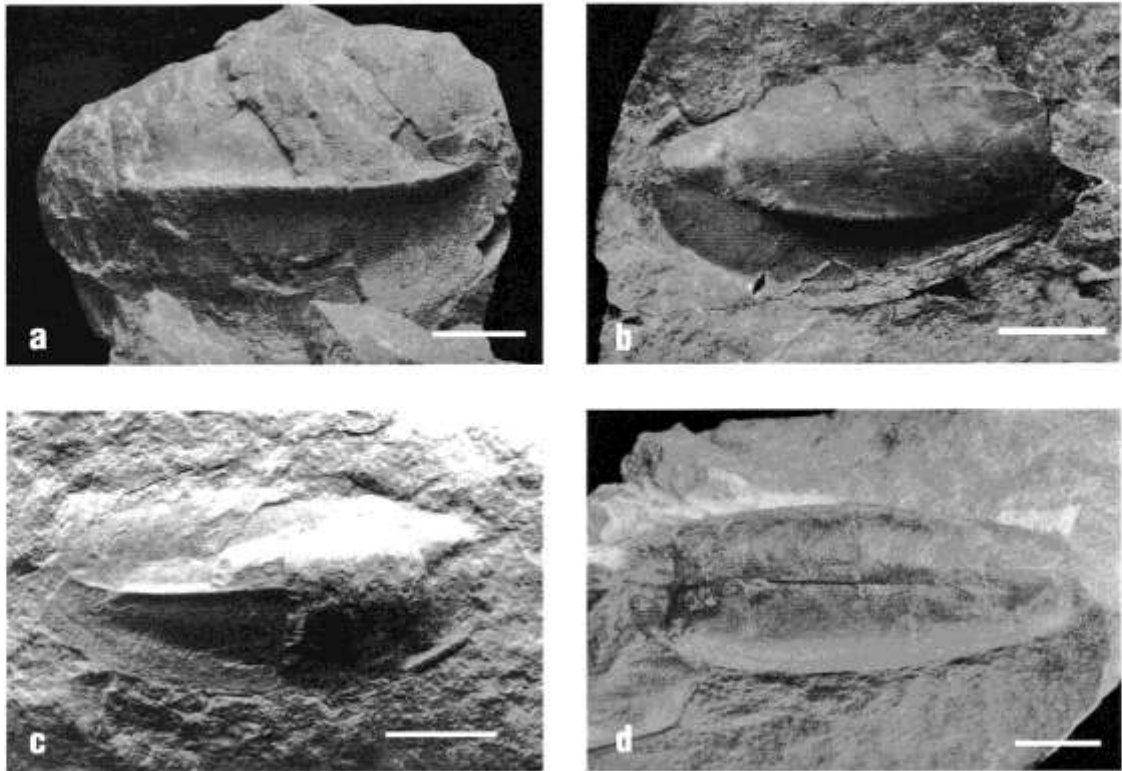


Fig. 4. *Dilophaspis frankei* n. sp.; Wiltz Beds, early Upper Emsian (Lower Devonian); Ösling, Western Eifel Mountains; localities: Faulenpuhl (a, c), Krautscheid (b, d). – a: Imperfectly preserved right valve, lateral view (internal mould) with well preserved mesolateral carina; scale bar = 5 mm; FRANKE collection (specimen no. 2 = TU CI P Cr 89). – b: Bivalved carapace (holotype), lateral view of right valve (internal mould, negative plate), positively shown by photographic reversal, mesolateral carina and dorsal plate preserved, anterior tubercles poorly visible; scale bar = 10 mm; FRANKE collection (specimen no. 8 = TU CI P Cr 87). – c: Left valve with partly well preserved mesolateral carina; scale bar = 10 mm; FRANKE collection (specimen no. 5 = TU CI P Cr 91). – d: Dorsal view of a bivalved carapace; scale bar = 5 mm; FRANKE collection (specimen no. 10 = TU CI P Cr 92).

than ventral region, broadened to the posterior area, then again narrowing close to posterior margin, with moderately prominent circular anterior tubercle close to anterior and dorsal margins; dorsal margin slightly convex to nearly straight (depending on degree of tectonic distortion). Posterior margin concave, dorsally and ventrally marked by pointed angles. Greatest width of ventral region close to the middle of the length of the carapace, ventral margin strongly convex, separated by a rather broad, shallow border furrow; ventral border nearly plain, moderately broad. Surface – mainly of ventral marginal area – broadly covered by fine, sub-parallel irregular terrace lines, strengthened on double.

Measurements: See Tab. 1.

Discussion: In the present definition, *Dilophaspis frankei* n. sp. occurs from the late Lower Emsian to the early Upper Emsian and is, thus, somewhat older than *D. lata* which is similar in size, but differs mainly by (1) the more prominent anterior tubercle, (2) narrower ventral marginal border and (3) the terrace lines being spread

over the whole carapace. Contrary to the presumption by HAHN (1990: 13) most of the adult specimens of the preceding *D. stuerzi* studied by us for comparison are distinctly larger; its anterior tubercle is usually even more orimontary to lacking and the ventral marginal border is broader.

Nomenclatural comment: As can be judged from the diagnoses, descriptions and discussions, the morphological differences of the three species included here in *Dilophaspis* are minor. *D. frankei* n. sp. can easily be considered as the intermediate species not only by its biostratigraphical position, but also by its morphology. It forms a link between the morphological characters of the preceding *D. stuerzi* and the succeeding *D. lata* and, therefore, combines the two genera *Nahecaris* JAEKEL, 1921 (type species *N. stuerzi* JAEKEL, 1921) and *Dilophaspis* TRAQUAIR in WALTHER, 1903. This leads to the following nomenclatorial situation:

(1) *Dilophaspis lata* was legally established by TRAQUAIR in WALTER (1903; i.e. later than 1899, in contrast to I.C.Z.N. article 23.9.1.1.).

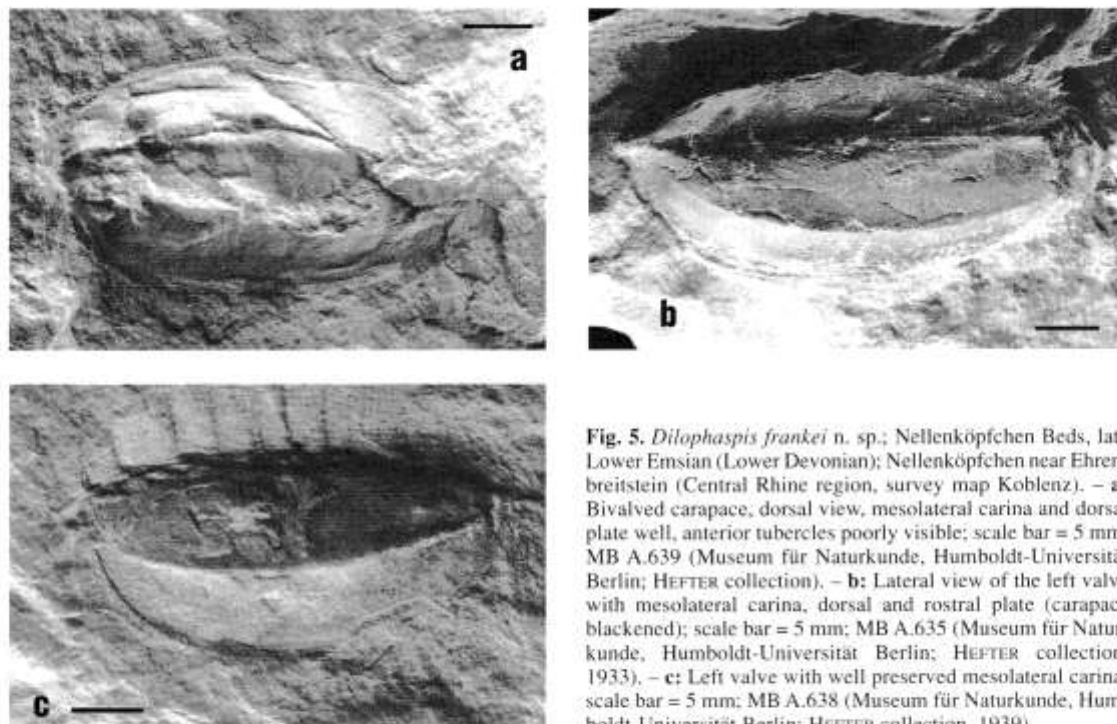


Fig. 5. *Dilophaspis frankei* n. sp.; Nellenköpfchen Beds, late Lower Emsian (Lower Devonian); Nellenköpfchen near Ehrenbreitstein (Central Rhine region, survey map Koblenz). – a: Bivalved carapace, dorsal view, mesolateral carina and dorsal plate well, anterior tubercles poorly visible; scale bar = 5 mm; MB A.639 (Museum für Naturkunde, Humboldt-Universität Berlin; HEFTER collection). – b: Lateral view of the left valve with mesolateral carina, dorsal and rostral plate (carapace blackened); scale bar = 5 mm; MB A.635 (Museum für Naturkunde, Humboldt-Universität Berlin; HEFTER collection, 1933). – c: Left valve with well preserved mesolateral carina; scale bar = 5 mm; MB A.638 (Museum für Naturkunde, Humboldt-Universität Berlin; HEFTER collection, 1939).

- (2) SOLLE (1942: 125, footnote), in a comment of WALTHER'S (1903) modified list of fossils, mentioned *Dilophaspis lata* and added a brief oral communication by W. GROSS who supposed that it was not a piscimorph vertebrate but a large arthropod; SOLLE (1942) already pointed out that the specific (and generic) name is legal.
- (3) HAHN (1990) presented a detailed revision of *Dilophaspis lata* and supposed that it might be congeneric with *Nahecaris*.
- (4) In spite of the fact that *Nahecaris* JAEKEL, 1921 has been used in scientific literature several times (and became one of the best known phyllocarid species of all), according to KUTSCHER'S (1971) and BERGSTRÖM et al. (1987) detailed bibliographies it cannot easily be shown that it fits in ICZN article 23.9.1.2. because it seems that it has not been dealt with in scientific literature more than 25 times by at least 10 authors during the last 50 years.

Therefore, in our opinion *Nahecaris* cannot be maintained through ICZN article 23.9.1 and is here regarded as the subjective junior synonym of *Dilophaspis* as already supposed by HAHN (1990).

Comments on the associated fauna

(Wiltz Beds; contributed by C. FRANKE, slightly modified; comp. FRANKE & GRAF 1996): The greenish to bluish grey shales of the Wiltz Beds within the eastern part of the Ösling in Luxemburg and the Western Eifel Mountains are characterized by a distinct silty compo-

nent; additionally, they contain a small quantity of irregularly distributed sand grains. Layers of more compact sandstone deposits are rare. Whereas the underlying Lower Emsian Klerf Beds show a strong terrestrial influence, partly with lagoonal brackish water conditions as documented by rapidly changing sedimentation as well as by their faunal components (Waxweiler, Willwerath, Consthum/Luxemburg), the relatively monotone appearance of the Wiltz Beds suggests a calm, more offshore zone in shallow water conditions no deeper than 70 m. Concerning the biofacies, the Lower Wiltz Beds correlate with the Hohenrhein and Lower Laubach Beds of the Middle Rhine and Moselle areas.

Typical for the faunal association within the group of Daleiden synclines are among others: *Digonus intermedius* (VIETOR, 1919), *Parahomalonotus mutabilis* (C. KOCH, 1880), *Treveropyge rotundifrons* (EMMRICH, 1839), *Rhenops lethaeae* (KAYSER, 1889), *Bembexia daleidensis* (C.F. ROEMER, 1844), *Tolmaia lineata lineata* (GOLDFUSS, 1836), *Palaeoneilo primaeva* (STEININGER, 1853), *Plebejochonetes plebejus* (SCHNUR, 1853), *Loreleiella dilatata* (C.F. ROEMER, 1844), *Oligoptycherhynchus daleidensis* (C.F. ROEMER, 1844), *Oligoptycherhynchus hexatomus* (SCHNUR, 1853), *Arduspirifer arduennensis arduennensis* (SCHNUR, 1853), *Euryspirifer paradoxus* (VON SCHLOTHEIM, 1813), *Brachyspirifer carinatus* (SCHNUR, 1853), *Cryptonella macrorhyncha* (SCHNUR, 1853), "*Atrypa reticularis* LINNÉ, 1758", *Uncinidus* cf. *orbignyianus* (de VERNEUIL, 1850).

The total number of documented species amounts to more than 150 (WERNER 1969). Fragmentary plant re-

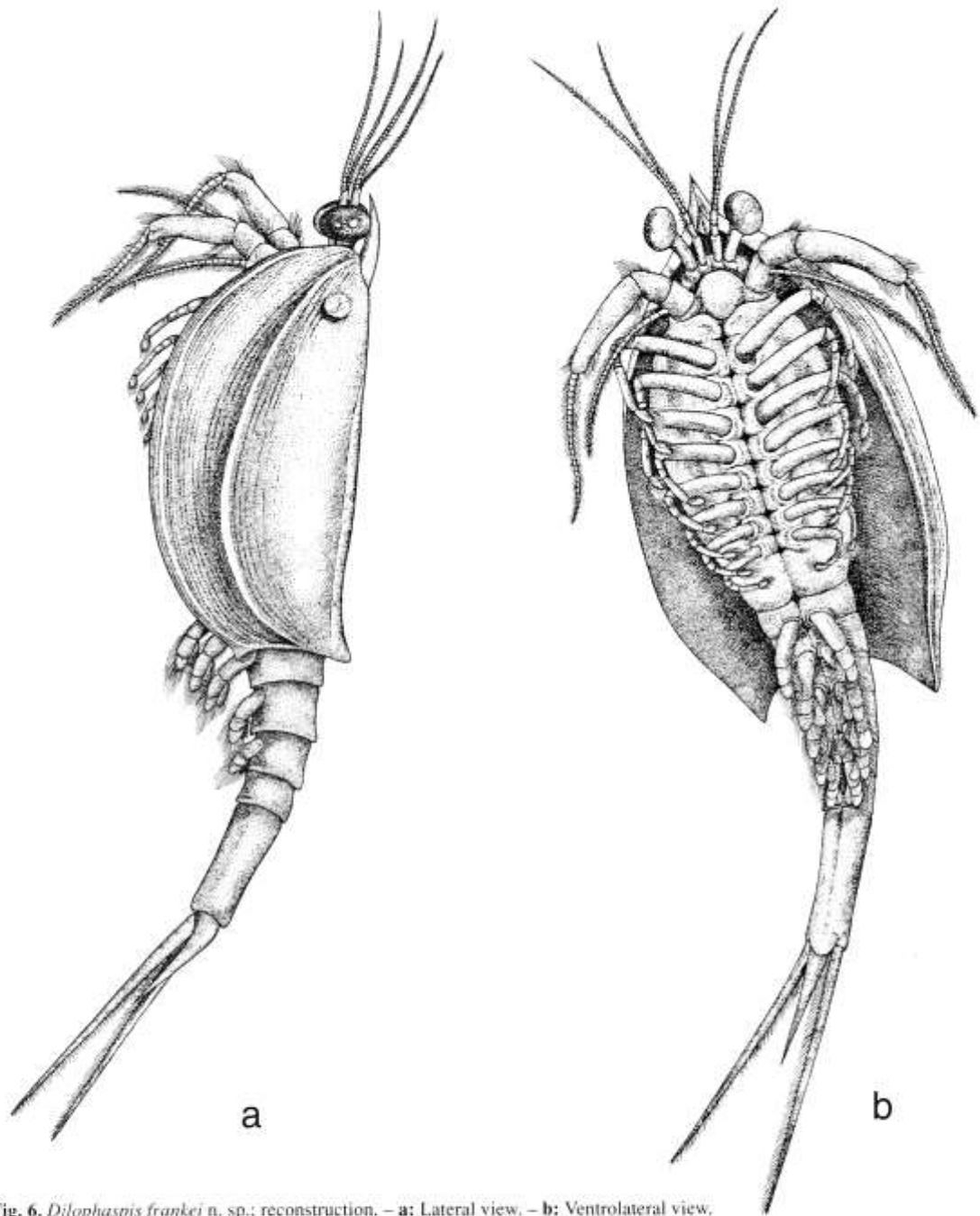


Fig. 6. *Dilophaspis frankei* n. sp.; reconstruction. – a: Lateral view. – b: Ventrolateral view.

mains are rare; as expected, the quantity decreases with an increasing distance from the coast. Brachiopods in life-position are abundant and large-eyed trilobites indicate a lighted, photic zone in a sublittoral area.

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