First Mid-Devonian Trilobites
from the Carnic Alps

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1 Text-Figure and 1 Plate

Austria
Carinthia
Devonian
Eifelian
Trilobites
Palaeogeography
Biofacies

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Blatt 197

Contents

Erste mitteldevonische Trilobiten
aus den Karnischen Alpen

Zusammenfassung

Erstmals in den Karnischen Alpen bekanntgewordene mitteldevonische Trilobiten stammen aus untereifelischen biomikritischen Kalken der Valentin-Formation vom Wolayer See. Die vielfältige Fauna enthält 8 Arten aus 7 Familien. *Tafilaltaspis tenuigena, Isoprusia convergens* und *Thysanopeltella* (*Septimopeltis*) *carinthiana* sind neu. Die Assoziation ist von typisch böhmischem Aspekt, wohingegen jegliche rheinische/avalonische Elemente fehlen. Der hohe Prozentsatz von mit der marokkanischen Meseta und dem Tafilalet gemeinsamen Taxa mag für nähere paläogeographische Beziehungen zwischen diesen Gebieten sprechen und/oder ähnliche Umweltbedingungen zu jener Zeit angeben.

Abstract

The first known Mid-Devonian trilobites from the Carnic Alps were recovered from Lower Eifelian biomicritic limestones of the Valentine Formation at Wolayer Lake. The diversified fauna is composed of 8 species from 7 genera. *Tafilaltaspis tenuigena, Isoprusia convergens* and *Thysanopeltella* (*Septimopeltis*) *carinthiana* are new. The association has a typical Bohemian aspect whereas no Rhenan/Avalonian elements are present. The high percentage of taxa that are common with both the Moroccan Central Meseta and Tafilalet might indicate nearer palaeogeographical relationships between these regions and/or similar environmental conditions at that time.

1. Introduction

Since the investigations of GORTANI (1907, 1915) essentially two trilobite associations are known from the Devonian carbonate sequences of the Central Carnic Alps: the Pragian fauna from the shallow biodetrital Hohe Warte Limestone, recently studied by ELLERMANN (1992) and the late Famennian fauna from the pelagic Pal Limestone (RICHTER, 1913; RICHTER & RICHTER, 1926), which awaits modern revision. Uppermost Famennian trilobites contributed to the definition of the Devonian/Carboniferous boundary in the local reference section at Grüne Schneid (FEIST, 1992). Only a few occurrences of trilobites were mentioned from other levels, such as the Lower Lochkovian (FLÜGEL et al., 1977, p. 133) and the late Frasnian (v. GAERTNER, 1931, p. 152). By contrast, no trilobites have yet been described from the Middle Devonian, though their presence in the Valentine Limestone was noticed in

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thin sections (BANDEL, 1972; GÖDDERTZ, 1982). During the IGCP 421 Field excursion in September 1997, a trilobite fauna from this Formation was collected along the shoreline of the Wolayer Lake. It constitutes the first known assemblage from the Mid-Devonian series of the Carnic Alps and is representative for the outer shelf biofacies of the Rauchkofel nappe. Preliminary results, that must be completed by further investigations, are presented here.
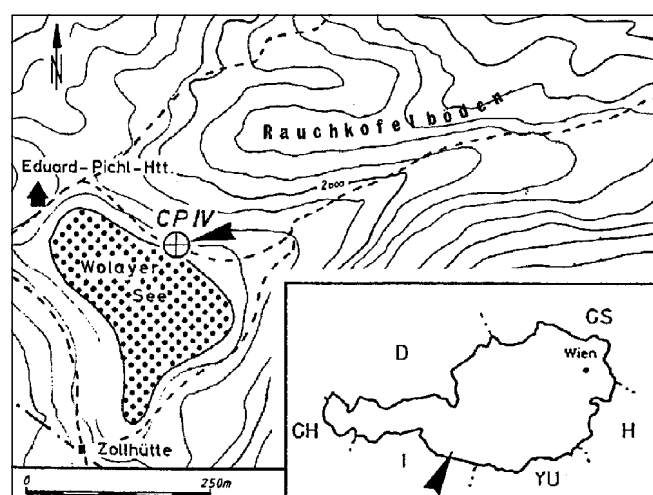
2. Locality, Facies and Age

The new fauna was recovered from the northeastern edge of Wolayer Lake within and adjacent to the footpath that runs along the edge, 200 m SE of Eduard Pichl hut (sheet 197, Kötschach 1 : 25000, x = 41465; y = 16368).

At this point a sequence of south dipping, well bedded, grey Flaser limestones of the Valentin Formation reaches the border of the lake. The section ("CP IV" of GÖDDERTZ [1982]) has been described and sampled for conodonts by SCHÖNLAUB (1980) and GÖDDERTZ (1982). BANDEL (1972) gave determinations of petro- and biofacies. According to these data, the Valentin Formation supersedes the pink nodular Findenig Limestone of Pragian age and comprises late Emsian, Middle Devonian and early Frasnian strata.

The sequence is condensed and reduced in thickness to about 15 m. A small number of isolated trilobite remains occur in stylioline-rich, grey-beige calcilutites that form the upper third of the section (sample "Wolayer See I"). Generally dispersed in the form of disconnected exosceleton pieces, these were more frequent in a loose block detached from the outcrop and displayed in immediate vicinity to it (sample "Wolayer See II"). Trilobites were accummulated there in thin biodebris layers that are intercalated, parallel to the bedding plane, within the micritic matrix. The concentration of exuvia might result from periods of extremely low sedimentation rates rather than from physical transport as the rock displays numerous crypto-hardgrounds that are coated, as well as the bioclasts, with Fe-Mg oxids and phyllitic matter.

Besides few crinoid ossicles, no shallow-water bioclasts such as hermatypic corals, brachiopods and bryozoan debris are associated. By contrast, pelagic biotas such as styliolines and a few cephalopods are present.

Text-Fig. 1.
Location of trilobite samples "Wolyer See I and II" from section CP IV (GÖDDERTZ, 1982).
Northeastern edge of Wolayer See near Eduard-Pichl hut, at 275 m N of the Italian border, Central Carnic Alps, Austria.

The conodont content of the trilobite bearing matrix is relatively high (100 platform elements per kg) and is nearly entirely composed of polygnathids, whereas shallow-water icriodontids are very rare.

The trilobite fauna is characterized by the minuteness of their adult morphotypes and their high taxonomic diversity on the family rank level, though specific diversity remains low and the two solely present proetid species outnumber by far all other taxa.

Several forms exhibit eyes with reduced sight, which generally is interpreted to be the result of adaptation to deeper bottom conditions at the limit of light penetration. This is emphazised by the absence of typical "rhenan" elements, such as asteropygines and dechenellines, adapted to shallow neritic environments influenced by clastic inputs, or peri-reefal biotas such as large-eyed phacopids and *Scutellum*. In addition, the unusual low diversity and frequence of phacopids might also be environmental controlled.

The Valentin Limestone trilobite association is one of the outer-shelf cephalopod-stylioline realm with lime-mud bottom conditions within the deeper photic zone (150–200 m). These palaeoecological data corroborate the interpretation of a deep off-shore environment for the Devonian of the Rauchkofel unit, and the Valentin Formation in particular (BANDEL, 1972; KREUTZER, 1992). However, and in contrast to the opinion of BANDEL (1974), water depth might not have exceeded 200 m. This is clear from the fact that many, if not all of the present, obliged bottom inhabiting trilobites have vision, although somewhat reduced in extent.

The trilobite association comprises typical early Eifelian taxa such as *Struveaspis*, *Thysanopeltella* and *Piriproetus amblyops*. Conodonts were recovered from the trilobite bearing limestone matrix in order to assign the fauna to the corresponding zonal standard based on conodonts. The following taxa were identified by H.P. SCHÖNLAUB:

Stylioline-rich sample "Wolayer See I" with *Tafilaltaspis tenuigena* n.sp. and *Piriproetus amblyops*: Pol. c. costatus, P. c. patulus, Pol. angustocostatus, Pol. l. linguiformis and Icriodus sp.

Sample "Wolayersee II" from loose block with the same proetids as in sample I and additional trilobites: Pol. c. patulus, Pol. c. partitus. Sample II might be slightly older than sample I.

According to these data an early Eifelian age is indicated for the new trilobite fauna. It is interesting to note that scutelluids provided with spines along the pygidial border such as *Thysanopeltella* and *Thysanopeltis* do not occur earlier than basal Eifelian; they constitute therefore an important index for the start of the Middle Devonian.

3. Palaeontological Notes

The trilobite association comprises 7 families: proetids, harpetids, odontopleurids, scutelluids, phacopids, aulacopleurids and lichids. The preservation of these faunas is generally poor due to frequent coating of the shell remains by Fe-Mg oxids, to fragmentation and tectonic deformation.

Only a few specimens can therefore be determined generically or specifically. For the remainder, more material is needed to complete the systematic analysis of the entire association. In the meantime, provisional data are given for 62 prepared specimens that are deposited in the collections of the Geologische Bundesanstalt Wien (GEOLBA 1998-1-1-62).

Proetidae Salter, 1864
Piriproetus Erben, 1952

Piriproetus amblyops Erben, 1952
(Pl. 1, Fig. 1–9)

Material:
   Figured: 4 cranidia (GEOLBA 1998-1-1-4); 1 librigena (GEOLBA 1998-1- 5); 4 pygidia (GEOLBA 1998-1-6-9). Supplementary: 7 cranidia, 7 librigenae, 4 pygidia (GEOLBA 1998-1-10-27).

Comments: The material from the Carnic Alps corresponds to the diagnosis of *P. amblyops* given by Erben (1952) and subsequently emended by G. Alberti (1969). However, due to the mediocre state of preservation of our material, subspecific attribution is difficult. The features of the cranidium seem to correspond best to the nominate subspecies especially with regards to the shape of the anterior border. The anterior fixigenae are apparently a little broader and ressemble more those of *P. amblyops patruelis* G. Alberti, 1967 from the Moroccan Hercynian Meseta. From these two taxa no free cheeks and pygidia are known and the comparison is limited to cranidial features alone. The Carnic material differs from *P. a. austromaurus* G. Albert, 1967 from Tafilalet by its continuous terrace lines on the cranidial border and the more elongated and long-spined librigenae that exhibit a much finer periocular groove. As in *austromaurus*, no occular lenses are observed on the gently swollen area adjacent to the palpebral suture; both taxa were probably blind. The pygidium of our material is nearly identical with that of *austromaurus* whereas it differs from *P. a. peregrinus* Clupáč & Vaněk, 1965 by its narrower axis exhibiting axial nodes.
The nominate and all other subspecies of *amblyops* are exclusively restricted to the Lower Eifelian and may thus be considered as contemporaneous geographical morphotypes. Their known distribution is: Harz, Bohemia, Morocco (Central Meseta and Tafilalet), Carnic Alps.

Tafilaltaspis G. Alberti, 1966

Tafilaltaspis tenuigena n.sp.
(Pl. 1, Fig. 10–17)

Derivatio nominis: After the narrow fixigenae.

Material:
   Figured: 3 cranidia (GEOLBA 1998-1-28-30), holotypus: GEOLBA 1998-1-28; 2 librigenae (GEOLBA 1998-1-31-32); 3 pygidia (GEOLBA 1998-1-33-35). Supplementary: 4 cranidia, 2 librigenae, 3 pygidia (GEOLBA 1998-1-36-44).

Diagnosis: Species of genus *Tafilaltaspis* with the following particular features: glabella large, subquadrangular; palpebral lobe and eye long and very narrow, situated anteriorly; straight portion of postpalpebral suture present. Pygidium with equally defined pleural and interpleural furrows.

Description: Prominent, tubelike anterior border regularly curved, sharply delimited by a narrow, deep border furrow. Narrow praefrontal field of constant sagittal length in front of glabella. Anterior border, border furrow and frontal glabella furrow of equal curvature. Glabella large, subquadrangular, a little larger (tr.) than long (sag.), largest at base. Glabella furrows very shallow but distinct. S1 nearly straight, obliquely backward

directed, defining unswollen L1 lobe that does not protrude onto the occipital furrow. Occipital furrow straight, narrow and deep. Occipital lobe as large as base of glabella (tr.), with central node; no lateral occipital lobes developed. Palpebral lobe long and very narrow; projection δ–δ (tr.) anteriorwards of S1; γ–γ at S3; straight portion of posterior suture between ε and ζ displayed parallel to the dorsal furrow. Eye lobe low with narrow visual field exhibiting numerous lenses. Rimlike eye-socle separates eye from genal field. Broad tubelike border runs continuously into long genal spine. Pygidium semicircular with sharp posterior and lateral borders; rachis narrower (tr.) than pleural area and as long (sag.) as postrachis field; postaxial ridge present not reaching posterior border. Pleural area with 3 shallow pleurae; pleural and interpleural furrows week, of equal depth and length, vanishing at the inner edge of the doublure; distal parts of the lateral and posterior pleural fields smooth. Sculpture: glabella and occipital ring with fine, dense granulation; pygidium smooth.

Comparison: The new species resembles the Moroccan Lower Eifelian *T. creber creber* and *T. creber tenuigranifer* in the general outline of the glabella and the prominent, tubelike anterior and lateral border of the cephalon. It differs by the broader glabella and the regularly curved anterior border furrow that has a more accentuated bent medially in the Moroccan forms. The most distinctive feature is the very narrow, anteriorly positioned palpebral lobe and the straight posterior portion of the postpalpebral suture. A similarly narrow palpebral lobe is developed in *T. velorex* Snajdr, 1980 from the topmost Emsian in Bohemia. However, in this taxon, there is no straight posterior portion of the suture as the palpebral lobe extends further backwards than in *tenuigena*.

Harpetidae Hawle & Corda, 1847
Reticuloharpes Vanek, 1963

? Reticuloharpes sp.
(Pl. 1, Fig. 18–19)

Material:
   Figured: 2 cephala (GEOLBA 1998-1-45-46). Supplementary: 1 cephalon (GEOLBA 1998-1-47).

Comments: The poor preservation of the material does not allow any definite generic attribution. However, the coarser, net-like and irregularly arranged brim perforation may indicate affinities with *Reticuloharpes* Vanek which is represented in Bohemia from late Emsian to Eifelian.

Odontopleuridae Burmeister, 1843
Isoprusia Bruton, 1966

Isoprusia convergens n.sp.
(Pl. 1, Fig. 20)

Derivatio nominis: After the convergence of pleural ridges.

Material: 1 pygidium, holotypus (GEOLBA 1998-1-48).

Diagnosis: Species of *Isoprusia* Bruton with the following characteristic features: pygidium semiellipitical with inflated borders; narrow, depressed post-rhachis-field; narrow, converging pleural ridges; no median and lateral border spines developed.

Description: Pygidium of semielliptical outline with narrow rachis, narrower than pleural field. Rachis strongly declining backwards, exhibiting two prominent rings, curved forward medially, the second narrower than the first (sag.) with axial depression. Terminal portion of rachis very small, triangular, poorly distinct, not reaching posterior border. Postrachis-field narrow (tr.) and large (sag.) with weak, pitted border depression. Dorsal furrow sharply delimiting axial rings, shallowing backwards. Pleural ridges narrow, straight, slightly converging, broadening on border and continuing into stout, upward directed border spines. No median border spine developed. Interspace between border spines narrower than first axial ring (tr.). Lateral and posterior border broadly inflated; lateral border without secondary spines. Anterior border formed by straight, prominent pleural ridge. Pleural area small with triangular, unpitted central depression.

Axial rings, borders and border spines provided with large tubercles.

Comparison: The new species resembles *Koneprusia subterarmata* (BARRANDE, 1846) in its general outline, the swollen posterior and lateral borders defining depressed pleural field. However, the tiny and narrow axis, the configuration of thin pleural ridges and the absence of the median border spine are distinct features that characterize the Bohemian *Isoprusia mydlakia* BRUTON, 1966 from the base of the Acanthopyge Limestone (basal Eifelian). Our species differs from *mydlakia* by the prominent, inflated borders, the converging pleural ridges and the much coarser sculpture. The erection of the new species on a single specimen is justified by these important diagnostic differences.

Comments: The minute size of the specimen may correspond to a juvenile morphotype. However, the presence of only two axial rings indicates the post-larval period. Further material, especially the still undiscovered cranidium, is needed to complete the diagnosis.

Scutelluidae RICHTER & RICHTER, 1925
Thysanopeltella KOBAYASHI, 1957
Thysanopeltella (Septimopeltis)
PŘIBYL & VANĚK, 1971

Thysanopeltella (*Septimopeltis*) carinthiana n.sp.
(Pl. 1, Fig. 21–23)

Derivatio nominis: After the region Carinthia.

Material:
Figured: 1 cranidium (GEOLBA-1998-1-49); 2 pygidia (GEOLBA 1998-1-50-51), Holotypus: GEOLBA 1998-1-50. Supplementary: 1 cranidium, 1 pygidium (GEOLBA 1998-1-52-53).

Diagnosis: Species of the subgenus *T.* (*Septimopeltis*) with the following particular features: cranidium with groove-like prefrontal depression and upturned sharp anterior border; large anterior fixigenae; deep combined S2–3 furrows; ovated, small isolated S3; stamplike posteror lobe of glabella; spine on posterior border of central occipital ring; pustular sculpture. Pygidium with middle rib bifurcating far behind in the distal third of pygidial length; bifurcating branches rapidly widening, with large posterior interspace; exoskeleton smooth.

Description: Prefrontal area depressed, with gently upturned sharp anterior border and broad, subtrian-gular fixigenal fields. Glabella narrow; anterior dorsal furrows parallel to axis, converging strongly posteriorly. Base of posterior glabella lobe, stamplike, enlarged; combined S1 and S2 deep grooves parallel to axis. S3 shallow, oval, without connection to dorsal furrow. L3 elongate subtriangular, not enflated. Occipital furrow shallow and large, anteriorly well delimited against glabella base, posteriorly continuously ascending to occipital lobe. Occipital lobe medially pointed posteriorly, central posterior border with spine; lateral occipital lobes weakly inflated. Posterior fixigenae strongly inflated between dorsal and palpebral furrow, elevated as high as posterior glabella lobe. Glabella inflated in its middle part adjacent to L3. Sculpture: granules with intermittant larger nodules. Pygidium with narrow ribs, semicircular in section; interrib depressions with flat bottom, three times larger than ribs; interspace adjacent to central rib larger than all other interspaces adjacent to the dorsal furrow of rachis. Middle lobe of rachis larger (tr.) than lateral lobes, reaching dorsal furrow (sag.). Bifurcation of central rib situated in the posterior third of its length (sag.). Bifurcating branches straight, widely straddled, interspace between them as large as neighboring interrib depressions (tr.). Posteriolateral border with narrow continuous rim. Ribs including bifurcating branches merge into border rim and continue distally into rather broad and long, straight, flat-topped spines. Surface of pygidial exoskeleton smooth.

Comments: The subgenus *T.* (*Septimopeltis*) was erected on pygidial features alone. This is the first time that the cranidium has been recovered. It shares with *Thysanopeltis* general features such as outline of glabella lobes and furrows and the praefrontal area. This emphazises the assumption of ERBEN (1967: 39) that both *Thysanopeltis* and *Thysanopeltella* have derived from a common late Early Devonian *Scabriscutellum* ancestor.

Phacopidae HAWLE & CORDA, 1847
Struveaspis G. ALBERTI, 1966

Struveaspis cf. fugitiva (BARRANDE, 1872)
(Pl. 1, Fig. 24–25)

Material:
Figured: 1 cephalon (GEOLBA 1998-1-54), 1 pygidium (GEOLBA 1998-1- 55). Supplementary: 4 cephala (GEOLBA 1998-1-56-59).

Comments: According to the large and flattened lateral preoccipital lobes, that are not sharply limited against the genae, and the comparably smaller eyes and palpebral lobes, the fragmental material seems to correspond to the Bohemian species *S. fugitiva* from the Chotec Limestone (Eifelian) rather than to the contemporaneous *S. marocanica* G. ALBERTI, 1970 (cf. CLUPÁČ, 1977, p. 112–113).

Aulacopleuridae ANGELIN, 1854
Otarion ZENKER, 1833

Otarion sp.
(Pl. 1, Fig. 26)

Material: librigena (GEOLBA 1998-1-60).

Comments: A single free cheek has been recovered that belongs to the genus *Otarion* rather than to *Cyphaspis*, based upon the short stout librigenal spine and the relatively small eye.

Lichidae Hawle & Corda, 1847
Acanthopyge Hawle & Corda, 1847

Acanthopyge sp.
(Pl. 1, Fig. 27)

Material:
  Figured: 1 cranidium (GEOLBA 1998-1-61).
  Supplementary: 1 cephalon (GEOLBA 1998-1-62).

Comments: The large lateral glabella lobes are typical of the genus *Acanthopyge*. The poor preservation of the material does not allow to determine wether it belongs to the nominate subgenus or to *A.* (*Lobopyge*) Přibyl & Erben, 1952.

4. Palaeobiogeographical Aspects

One of the outstanding particularities of Early Devonian trilobite faunas from the Carnic Alps is the presence of East Uralian, Altai-Tienshanian scutelluids, such as *Unicapeltis* and *Weberopeltis* that do not occur in N-Africa and elsewhere in Europe, the Montagne Noire excepted (Erben, 1969; Feist, 1974; Ellermann, 1992). Despite the close relationship of the associated taxa to those of Bohemia (all 20 genera and 10 species out of 30 are in commun) and to Morocco (all 20 genera and 5 species), the presence of "exotic" central Asian elements constitutes an important palaeobiogeographical argument in favor of an isolated Protoalpine terrain. This microplate was separated from N-Gondwana and Gondwana-derived terrains, including Armorica and Perunica, by wide oceanic interspace during the Devonian (Bachtadse et al., 1995; Schönlaub, 1997). This model contrasts with the hitherto widely accepted more compact plate configuration between N Europe and the N Gondwana margin (Scotese & McKerrow, 1990).

It is interesting to analyse the new fauna from the Middle Devonian, at a time when currently proposed models suggest that, after the Late Silurian/Early Devonian closure of the Rheic ocean, maximum continental separation of 4500 km occurred between Armorica, Perunica and the Proto-Alps on one side and N Gondwana on the other (Tait et al., 1997; Bachtadse et al., 1995; Schönlaub, 1997). Is such a large separation reflected by the biogeographic relationships of the trilobite fauna?
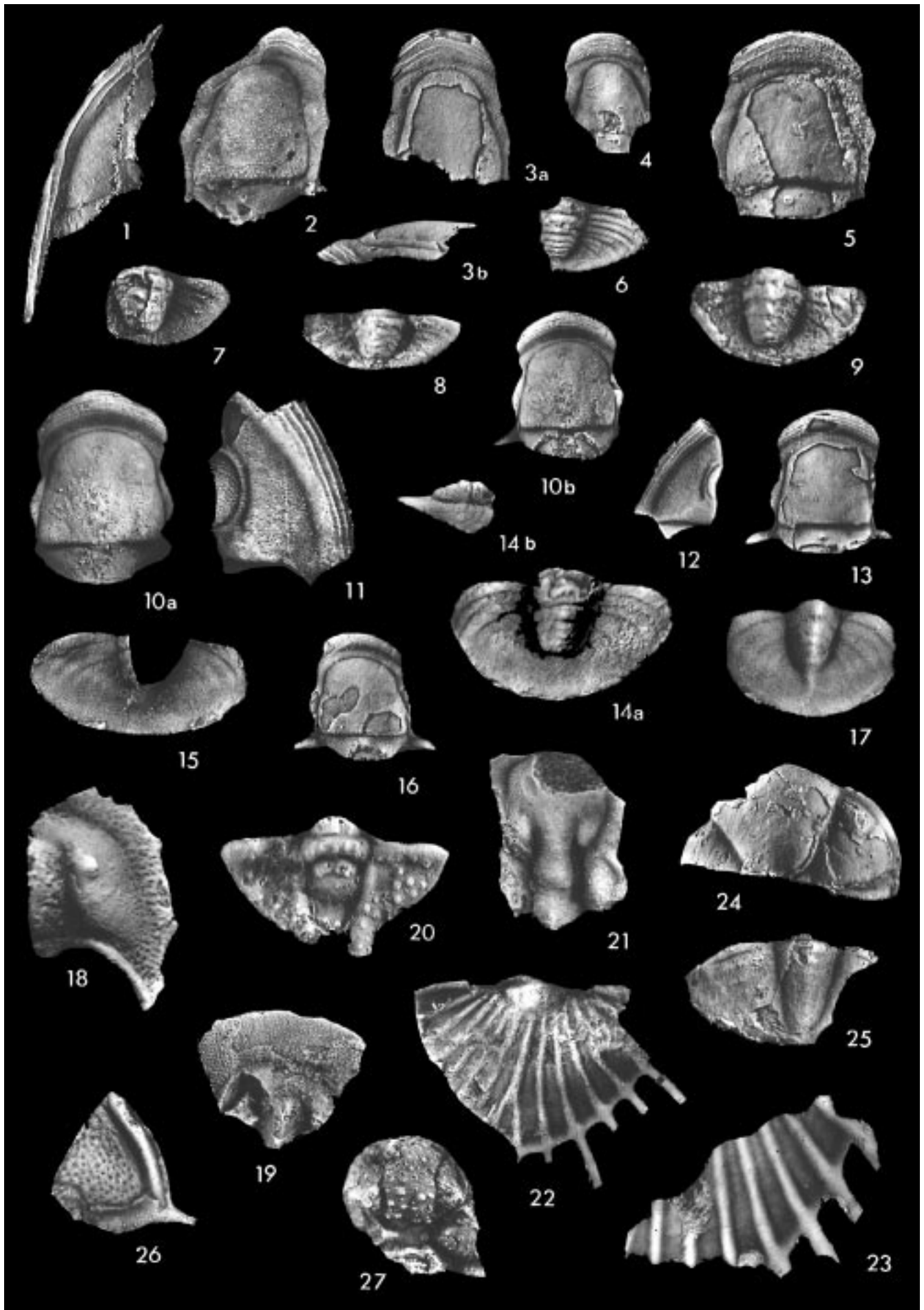
As far as the provisional data suggest, the fauna has a typical bohemian aspect: all taxa on the generic level and *Struveaspis* cf. *fugitiva* and *Piriproetus amblyops* occur in Bohemia. The latter has first been described from "hercynian" limestones in the Harz Mountains (Erben, 1952) where all other genera also occur with the exception of *Thysanopeltella* (*Septimopeltis*). This taxon is known, besides the present data from the Carnic Alps, only from Bohemia and the Montagne Noire (Feist, 1977). On the other hand, and similar to the relationships of the Pragian fauna, there are still taxa in common with Morocco such as *Tafilaltaspis* and *Piriproetus amblyops* (G. Alberti, 1969). These are not known from Avalonia and, inversely, "rhenan" faunas such as asteropygines and dechenellines do not occur in the Alps. It cannot be decided yet whether these data reflect true palaeobiogeographical constraints such as a reduced oceanic separation between the Protoalps, Perunica and the northern Gondwana margin or if the similarities of the faunistic associations are the result of equivalent palaeoecological and environmental conditions in widely separated terrains. Certainly both aspects must be evaluated.

Plate 1

Figs. 1–9:   *Piriproetus amblyops* ERBEN, 1952.
        Fig. 1: Librigena, GEOLBA 1998-1-5, ✕ 8.9.
        Fig. 2: Cranidium, GEOLBA 1998-1-1, ✕ 11.5.
        Fig. 3: Cranidium, GEOLBA 1998-1-2, fragmentary.
            a: dorsal view, ✕ 11.4.
            b: lateral view, showing slope of the anterior border, ✕ 13.
        Fig. 4: Cranidium, GEOLBA 1998-1-3, fragmentary, ✕ 7.4.
        Fig. 5: Cranidium, GEOLBA 1998-1-4, ✕ 11.3.
        Fig. 6: Pygidium, GEOLBA 1998-1-6, juvenile, fragmentary, ✕ 15.
        Fig. 7: Pygidium, GEOLBA 1998-1-7, fragmentary, ✕ 8.9.
        Fig. 8: Pygidium, GEOLBA 1998-1-8, ✕ 9.2.
        Fig. 9: Pygidium, GEOLBA 1998-1-9, ✕ 10.6.

Figs. 10–17: *Tafilaltaspis tenuigena* **n.sp.**
        Fig. 10: Cranidium, Holotypus, GEOLBA 1998-1-28.
            a: Rubber cast of external mould, ✕ 6.5.
            b: External mould, occipital ring damaged, ✕ 4.9.
        Fig. 11: Librigena showing eye with ocular lenses, occipital spine broken, GEOLBA 1998-1-31, ✕ 10.8.
        Fig. 12: Librigena, GEOLBA 1998-1-32, occipital spine broken, ✕ 10.
        Fig. 13: Cranidium, GEOLBA 1998-1-29, ✕ 8.
        Fig. 14: Pygidium, GEOLBA 1998-1-33.
            a: Dorsal view, ✕ 17.
            b: Lateral view, ✕ 12.7.
        Fig. 15: Pygidium, axis broken, GEOLBA 1998-1-34, ✕ 11.8.
        Fig. 16: Cranidium, GEOLBA 1998-1-30, ✕ 8.3.
        Fig. 17: Pygidium, rubber cast of external mould, GEOLBA 1998-1-35, ✕ 15.7.

Figs. 18–19: **?** *Reticuloharpes* **sp.**
        Fig. 18: Cranidium, fragmentary, GEOLBA 1998-1-45, ✕ 12.2.
        Fig. 19: Cranidium, fragment of the anterior portion showing the fringe, GEOLBA 1998-1-46, ✕ 6.1.

Fig. 20:   *Isoprusia convergens* **n.sp.**
        Fig. 20: Pygidium, Holotypus, external mould, left border spine incomplete, GEOLBA 1998-1-48, ✕ 12.9.

Figs. 21–23: *Thysanopeltella* (*Septimopeltis*) *carinthiana* **n.sp.**
        Fig. 21: Cranidium, fragmentary, GEOLBA 1998-1-49, ✕ 6.1.
        Fig. 22: Pygidium, Holotypus, rubber cast of the external mould, fragmentary, GEOLBA 1998-1-50, ✕ 2.4.
        Fig. 23: Pygidium, rubber cast of the external mould, fragmentary, GEOLBA 1998-1-51, ✕ 2.3.

Figs. 24–25: *Struveaspis* **cf.** *fugitiva* (BARRANDE, 1872).
        Fig. 24: Cephalon, fragmentary, GEOLBA 1998-1-54, ✕ 3.1.
        Fig. 25: Pygidium, fragmentary, GEOLBA 1998-1-55, ✕ 5.8.

Fig. 26:   *Otarion* **sp.**
        Librigena, GEOLBA 1998-1-60, ✕ 5.5.

Fig. 27:   *Acanthopyge* **sp.**
        Cranidium, fragmentary, GEOLBA 1998-1-61, ✕ 7.3.

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