GEOLOGICA CARPATHICA, 45, 4, BRATISLAVA, AUGUST 1994
195 - 202

REMARKS ON THE STRATIGRAPHY AND BRACHIOPOD PALAEOBIOGEOGRAPHY IN THE LOWER JURASSIC HIERLATZ TYPE LIMESTONE FACIES; THE CHOČ UNIT, CENTRAL WESTERN CARPATHIANS

ALFRED UCHMAN[1] and PLATON TCHOUMATCHENCO[2]

[1]Institute of Geological Sciences, Jagiellonian University, Oleandry 2a; 30-063 Kraków, Poland
[2]Geological Institute of the Bulgarian Academy of Sciences, Acad. G. Bončev Str. 24, 1113 Sofia, Bulgaria

(Manuscript received March 1, 1993; accepted June 30, 1993)

Abstract: Bioclastic grainstones and packstones occur in three small thrust sheets of the Choč Unit in the Tatra Mts., called the Konczysta, Uplaz and Brama Kantaka scales. They are similar to the Alpine Hierlatz facies. The bioclast faunas are dominated by crinoid ossicles and brachiopods and pelecypod shells. Their sedimentation is related to tilting blocks originated during the opening of the Western Tethys. Numerous brachiopods enable the age of the limestones to be determined. The limestones from the Brama Kantaka scale may be assigned to the Domerian, while the limestones of the Konczysta scale may be ascribed to the Upper Sinemurian-Domerian. The limestones of the Uplaz scale contain Hettangian-Sinemurian brachiopods which are mixed together with Domerian brachiopods. The Domerian brachiopods belong to the NW European biogeographical province. The Hettangian-Sinemurian brachiopods are probably allochthonous and belong to the Alpine biogeographical province. Thus, the age of the Hierlatz type limestones of the Uplaz scale is Domerian.

Key words: Tatra Mts., Lower Jurassic, carbonates, stratigraphy, brachiopods, palaeobioprovinces.

Introduction

The Choč (Middle Sub-Tatric) Unit in the Tatra Mts. contains mainly Middle-Upper Triassic carbonate deposits. Jurassic deposits are very scarce. Only three small thrust-sheets, called the Uplaz, Konczysta, and Brama Kantaka scales (Fig. 1), comprise tectonically intensively deformed Lower Jurassic limestones assigned to the Mietusia Limestone Formation (cf. Lefeld 1985) and to the ?Middle Jurassic red limestones (Uchman 1988). Only a small outcrop of the Lower Jurassic siliciclastics (Gresten facies?) occurs in the Siwa Woda Unit in the Dolina Lejowa Valley (cf. Kotanski 1985).

The age of the informal lithostratigraphic units of the Mietusia Formation is still not well documented. Generally, the units lack good index fossils. Only the organodetritic limestones, which may be compared to the Hierlatz limestones of the Northern Calcareous Alps, contain numerous brachiopods. Age determination of the brachiopods, as presented herein, enables precise stratigraphic positioning of the limestones.

The field and the laboratory works were performed by Uchman, while Tchoumatchenco determined the brachiopod taxa and their age, and gave bioprovincial interpretations as well.

The Jurassic deposits of the Choč Unit

The Jurassic deposits of the Uplaz, Konczysta, and Brama Kantaka scales consist of Lower-?Middle Jurassic limestones which are approximately 60 - 180 m thick. They exhibit typical Alpine facies showing mosaic changes (Fig. 2). The facies types are: peloidal, partially dolomitized limestones with ooids, organodetritic Hierlatz type limestones, crinoidal and cherty limestones (Sokolowski 1924; Kotanski 1965; Grabowski 1967 with references; Uchman 1988, 1989, 1992, 1993) and ?Middle Jurassic red pelagic limestones (Uchman 1988). The Hierlatz type limestones consist of crinoidal limestones containing shallow-water brachiopod and bivalve shells. The cherty limestones consist of siliceous crinoidal limestones interbedded with spongiol-

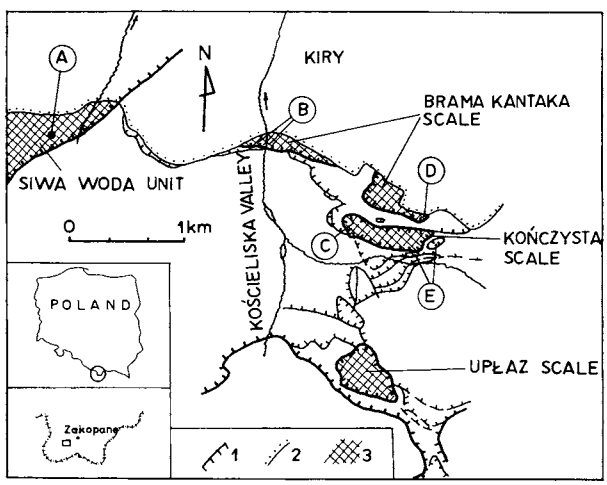


Fig. 1. Locality map of the Konczysta, Brama Kantaka, and Uplaz scales. **1** - main overthrusts; **2** - minor overthrusts; **3** - Choč Unit. **A** - outcrop of the Lower Jurassic siliciclastics in the Siwa Woda Unit; **B** - Brama Kantaka gate; **C** - Konczysta Turnia Mt.; **D** - Jaworzynka Mietusia Mt.; **E** - problematic section "Nad morena".

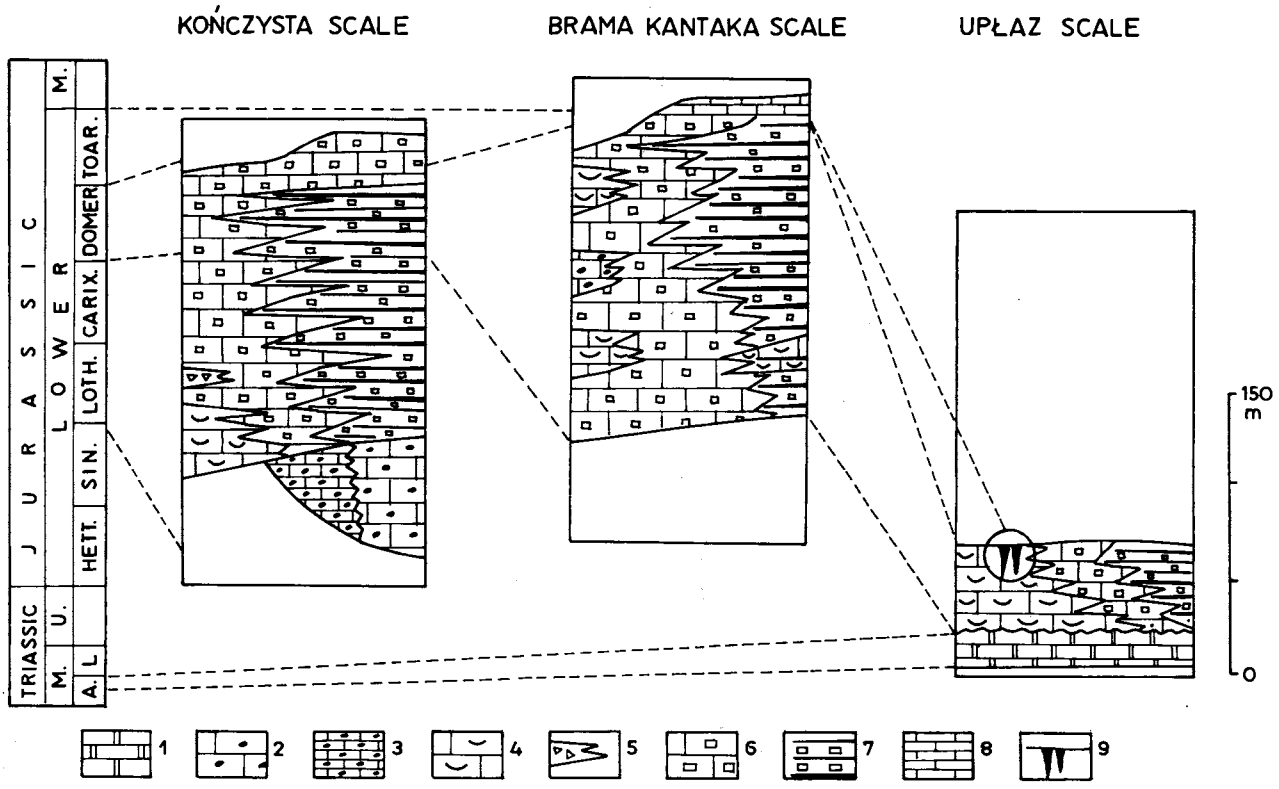


Fig. 2. Stratigraphic columns of the Konczysta, Brama Kantaka, and Uplaz scales. **1** - dolomites; **2** - bedded peloidal limestones with ooids; **3** - massive peloidal limestones; **4** - Hierlatz type limestones; **5** - sedimentary breccias; **6** - crinoidal limestones; **7** - cherty limestones; **8** - red pelagic limestones; **9** - neptunian dykes filled with red pelagic limestones.

ites. Gradation of the Hierlatz type limestones into crinoidal and cherty limestones can be observed in one and the same horizon. The red limestones occupy the highest position and consist of biomicrites containing ?planktonic foraminifers and locally filaments. They also fill neptunian dykes penetrating the Hierlatz type limestones (Uchman 1988).

The problematic section "Nad morena" (Fig. 1), located in the vicinity of the Konczysta scale, is related to the Choč Unit in literature (e.g. Grabowski 1967). Among others, it contains the Lower Jurassic siliciclastics and spotty marls ("Fleckenmergel" facies) (Grabowski 1967 with references). This section most likely belongs to the Krížna (Lower Sub-Tatric) Unit and occupies the position of the tectonically strongly deformed Czarna Turnia scale.

Hierlatz type limestones in the Choč Unit

The Hierlatz type limestones of the Choč Unit have been named "zoogenic limestones" (e.g. Kotanski 1965) or "zoogenic limestones from Konczysta" (Grabowski 1967). In the Uplaz scale, the limestones were compared to the Hierlatz limestones of the Northern Calcareous Alps by Stache (1868), and this comparison seems to be still valid.

The limestones are pink or grey biosparites and rare biomicrites (grainstones and packstones, respectively) (Fig. 3). Yellowish weathered pebbles of Triassic dolomites, up to 5 cm in diameter, are commonly found. The pebbles most likely derive from the eroded substratum of the Jurassic sediments. The bioclasts are dominated by crinoid ossicles and predominantly by fragmented shells of brachiopods and bivalves. The crinoid ossicles are generally only a few millimetres in diameter; however they occasionally reach up to 10 mm in the Konczysta scale. The bivalves are dominated by small pectinids. Thick-shelled forms are rare. Tests of foraminifers of the *Textulariidae* and *Nodosariidae* families are common. Echinoid spines, belemnite guards, and calcitized sponge spicules are rare. Unidentified problematic ?calcareous sponges or ?hydrozoans are locally present in the Konczysta Turnia Mt. and are common in the Brama Kantaka rocky gate. Microborings, 100 - 200 μm in diameter, occur in the crinoid ossicles and shells. The crushed shells are typically oriented parallel, probably by bottom currents. The uncrushed shells seem to be randomly distributed, although the brachiopod shells of terebratulids and zeilleriids are occasionally found in concentrated clusters (Uplaz scale).

The limestones are generally massive, however they are weakly bedded in the Konczysta scale.

Locally (Uplaz scale), the Triassic pebbles exhibit borings (cf. Kotanski 1965; Grabowski 1967) filled with the Hierlatz type limestones. Two types of borings may be distinguished: **1** - those circular in cross section, 1.5 - 2.3 mm in diameter, up to 20 mm long, straight or slightly curved, and resembling *Trypanites,* and **2** - bigger forms, up to 5.2 mm in diameter, up to 13 mm long, exhibiting an elongated oval shape, and resembling the bivalve borings of *Gastrochaenolithes* (cf. Bromley 1992, and references therein).

The Hierlatz type limestones of the Uplaz scale (Fig. 2), which are up to 50 m thick, overlie the Upper Anisian dolomites (Kotanski 1965; Grabowski 1967). Although their contact with the dolomites does not crop out, the expected gap allowed Kotanski

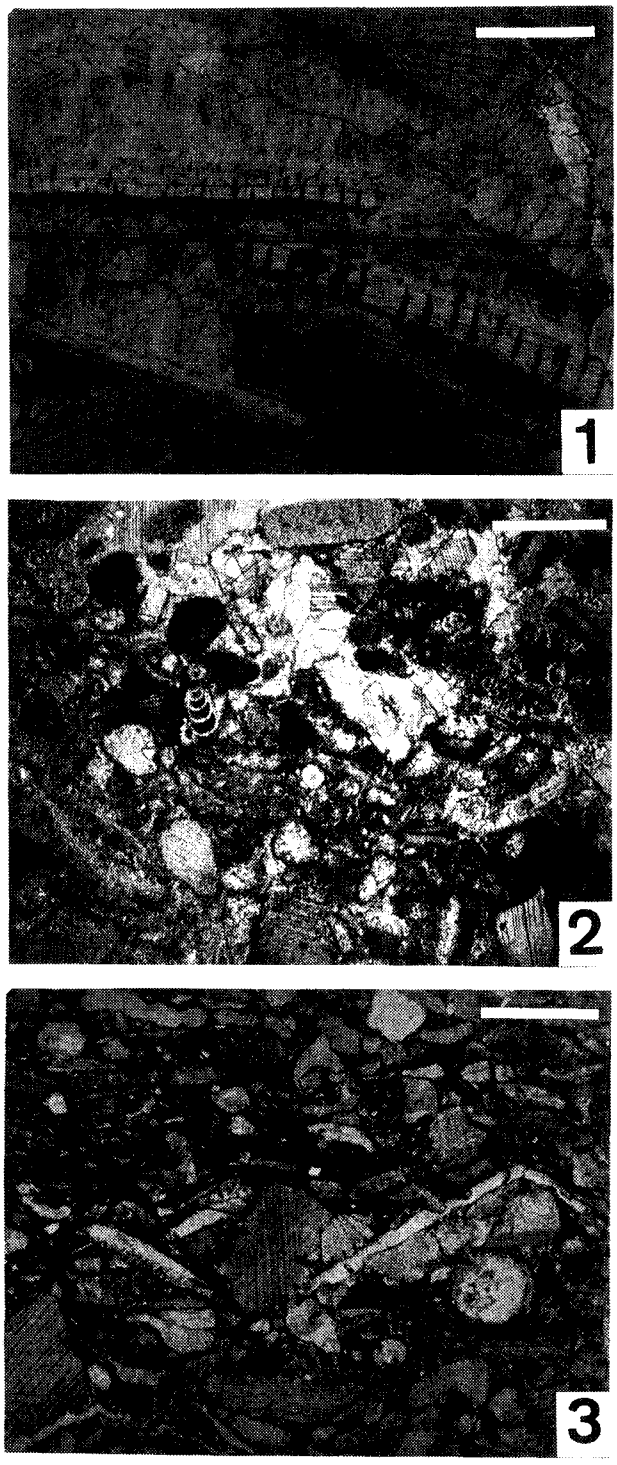


Fig. 3. Hierlatz type limestones of the Uplaz scale. **1** - bioclastic grainstones with crinoid ossicles and punctated shells of brachiopods; **2** - bioclastic packstones with crinoid ossicles and foraminifers. Some grains have micritized envelopes; **3** - bioclastic packstones with crinoids, crushed brachiopod and bivalve shells, and spines of echinoids. Scale bar = 300 m.

(1965) to ascribe the scale to the Vepor series which occurs in the Slovak Western Carpathians. Laterally, the limestones pass into crinoidal and cherty limestones. They comprise neptunian dykes filled with ?Middle Jurassic red pelagic limestones. The outcrops are strongly karstified and covered with huge boulders. Nevertheless, the boulders are not significantly displaced and keep their original stratigraphic position.

The Hierlatz type limestones of the Konczysta scale (Fig. 2), (only grey in colour) are 50 m thick. They crop out in an overturned position (see Grabowski 1967) at and below the summit of the Konczysta Turnia Mt. and pass upward and horizontally into crinoidal limestones. Underlying deposits, probably peloidal limestones, are not preserved, but they crop out nearby.

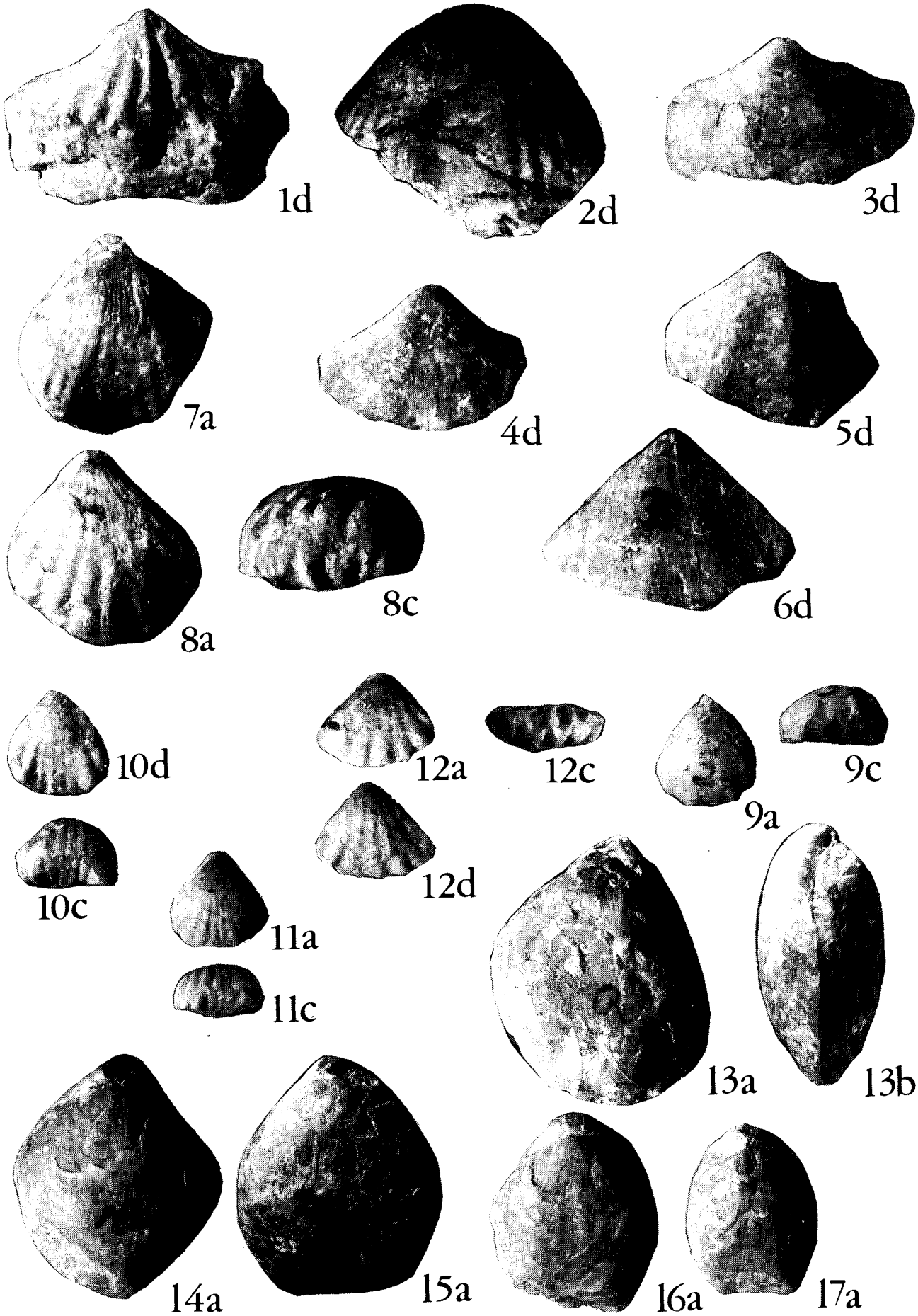
The Hierlatz type limestones of the Brama Kantaka scale (Fig. 2), occur in overturned positions as intercalations, up to a dozen metres thick, in the crinoidal and cherty limestones (Uchman 1988). In the Jaworzynka Mietusia Mt., they pass into the cherty limestones and are interbedded with spongiolithic cherts. In this locality, they are silicified and contain sponge spicules, mainly monaxones. The spicules are oriented parallel.

Hierlatz limestones as a facies

The Hierlatz facies is one of the most characteristic Early Jurassic facies of the shallow-water carbonate deposits in the Western Tethys realm. Its name derives from the Hierlatz Mt. near Salzburg in the Northern Calcareous Alps, where it was previously described by Simony (1850) and Lipold (1852). Usually, the Hierlatz limestones overlie the eroded Triassic platform carbonates and commonly occur as fillings of neptunian dykes (Geyer 1889; del Negro 1983; Galácz et al. 1985). Their horizontal interfingering with crinoidal and cherty limestones and upward transition to the pelagic limestones are typical of this facies (Štúr 1871; Arkell 1956; Bernoulli & Jenkyns 1974; Thenius 1974; Bujnovský & Polák 1979; Géczy 1973; Plöchinger 1980; with references). The Hierlatz type limestones are interpreted as sediments produced on tilted blocks ("seamounts") which originated as a result of the disintegration of the Triassic carbonate platform during the opening of the Western Tethys since the beginning of the Jurassic. The limestones were deposited during the first phase of sinking of the blocks. Their sedimentation was affected by sinking and tilting following further opening of the Tethys (Jenkyns 1971; Vörös 1974; Plöchinger 1980; Lemoine & Trümpy 1987; Eberli 1988, with references therein). The sediments originally formed on the tops of the "seamounts" and then were redeposited into deeper environments in the "inter-seamount" basins (Galácz & Vörös 1972; Vörös 1973, 1982a).

The profound analysis of the limestone palaeoenvironment is beyond the scope of this paper. Nevertheless, with respect to the Tatra Mts., the character of deposits and faunas suggest that the limestones were previously formed in shallow but relatively quiet water and were transported into a deeper-marine environment. The analysis of the brachiopod fauna (see next section) confirms this belief. The representatives of *Spiriferidina* dominate all outcrops studied. The relative abundance of the brachiopod representatives is as follow: *Spiriferidina*, *Rhynchonellida*, *Terebratellidina*, *Terebratulidina*. The predominance of *Spiriferidina* indicates the existence of a quiet biotope (deeps in the bottom?), colonized by representatives of this group (cf. Tchoumatchenco 1992). However, the specimens of *Spiriferidina* are only with one valve, which indicates their disarticulation and resedimentation by bottom currents after their death. Then, they were "mixed" with the rhynchonellids. The biodetrital character of the limestones, in which the subsequent colonizers (terebratulids and

PLATE I


1d
2d
3d
7a
4d
5d
8a
8c
6d
10d
12a
12c
9a
9c
10c
12d
11a
11c
13a
13b
14a
15a
16a
17a

zeilleriids) are occasionally concentrated in clusters, also supports this view.

The suggested shallow-marine environments may be related to elevated blocks ("seamounts"). Sediments accumulated on the tops of the "seamounts" were redeposited into deeper environments, filling "intra-seamount" basins where the cherty limestones were formed. The increasing amount of cherts and the occurrence of red pelagic limestones up section, suggest the sinking of these "seamounts" (Uchman 1989, 1992, 1993) following a widely known trend of development of the Tethys (cf. Bernoulli 1967; Galácz & Vörös 1972; Böhm 1986, with references).

The typical localities of the Hierlatz limestones occur in the Northern Calcareous Alps (Simony 1850; Lipold 1852; Štúr 1871; Geyer 1889; Ganss et al. 1954; Ganss 1956; Jurgan 1969; Plöchinger 1980, 1983; Schott 1984; Tollmann 1985; Böhm 1986; Lackschewitz et al. 1991). Furthemore, Hierlatz type limestones occur in the Lombard Alps (Wiedenmayer 1963; Hallam 1971), Karawanken Mts. (Bauer 1970) Croatia (Gušic & Babic 1972), and in the Southern Tirol (Kraus 1951). They are also found in the Slovak Western Carpathians in the autochthonous units of the Žiar Ridge (Maheľ 1967), Malá Fatra Mts. (Bujnovský & Polák 1979), in the Hron synclinorium in the Vysoká facies of the Krížna (Lower Sub-Tatric) series (Kollárová 1957; Andrusov 1959), in the Gemeric units in the Slovenský Kras Mts. (Bystrický 1960, 1964). In Hungary they occur in the Bakony Mts. (Lóczy 1916; Fülöp 1971; Galácz & Vörös 1972; Vörös 1973, 1974; 1982a, b, 1983). The most south-easterly outcrop of the Hierlatz type limestones is located in the eastern Stará Planina Mts. in Bulgaria, where they occur in olistholites within the Mid-Jurassic Kotel olistostrome Formation (Tchoumatchenco 1988).

Age of the Hierlatz type limestones in the Tatra Mts.

In contrast to the Alpine outcrops (Hauer 1856; Stoliczka 1861), the Tatras Hierlatz type limestones contain no ammonites. Belemnites are present, but poorly preserved and rare. Thus only the brachiopods (Pl. I) may be used successfully as a stratigraphic tool. However profound palaeontological investigations are not possible because of poorly preserved internal structure.

The age of the brachiopod collections is generally determined by the comparison with the ammonites found together with them. In these cases, the range of the ammonites is accepted *a priori* as isochronous throughout the area of their distribution. This generalisation enables one to deduce that the age of many brachiopods from the eastern parts of the Tethys (Bulgaria) is different from those recorded in Western Europe. For example, the well known and widely distributed *Lobothyris subpunctata* (Davidson) has a range in Bulgaria from the upper part of the Carixian (Davoei Zone) to the lower part of the Domerian (Stokesi Zone). In Western Europe, its range coincides with the Domerian (Alméras 1964, p. 104), but in Britain (Ager 1991, p. 19) - only with the upper part of Domerian (Spinatum Zone). This phenomenon may be explained by a migration of *Lobothyris subpunctata* from East to West. Similar results can be obtained for other Liassic brachiopods. The lack of ammonites in the Tatras Hierlatz type limestones prohibits us from determining the age of the examined brachiopods. Thus, we generally accept here their ranges, given by Alméras (1964) for the Western European brachiopods, which are the closest geographically to the Tatra Mts.

The following brachiopods have been determined by Sokolowski (1924) from the Konczysta Turnia Mt.:

Terebratula punctata Sowerby - present *Lobothyris punctata* (Sowerby)

Terebratula punctata Sowerby var. *walfordi* Davidson - present *Lobothyris walfordi* (Davidson)

Rhynchonella polyptycha Oppel - present *Prionorhynchia polyptycha* (Oppel)

Rhynchonella plicatissima Quenstedt - present *Calcirhynchia plicatissima* (Quenstedt)

Rhynchonella cf. *tetraedra* Quenstedt - present *Tetrarhynchia tetraedra* (Sowerby)

We may add two more taxa in this locality:

Spiriferina alpina alpina Oppel

Spiriferina cf. *oxyptera* Buvignier

According to Sokolowski (1924) and Rabowski (1954), the Hierlatz type limestones in the Konczysta Mt. may be assigned to the Upper Sinemurian-Domerian. In general we support this view, because *Spiriferina alpina alpina* has a range Sinemurian-Pliensbachian, and *Spiriferina* cf. *oxyptera* - Upper Sinemurian-Pliensbachian (cf. Alméras 1964).

In the Uplaz scale, the age of the Hierlatz type limestones was ascribed to the "upper divisions of the Liassic" (Stache 1868; Kotanski 1965) or to the "Middle Liassic" (Stache 1868; Kotanski 1965; Grabowski 1967), but without any direct proof. Numerous brachiopods were found in the Uplaz scale. The following is a list of the taxa which may be presented:

Spiriferina haueri Suess (erroneously described as *S.* cf. *obtusa* Oppel (Uchman 1988))
Spiriferina cf. *haueri* Suess
Spiriferina alpina alpina Oppel
Spiriferina cf. *alpina alpina* Oppel
Spiriferina cf. *oxyptera* Buvignier
Homoeorhynchia ?prona (Oppel)
Cirpa cf. *langi* Ager
Cuneirhynchia retusifrons (Oppel)
Furcirhynchia rimata (Oppel)
Lobothyris cf. *subpunctata* (Sowerby)
Lobothyris subpunctata (Sowerby)
Zeilleria cf. *subnumismalis* (Davidson)
Zeilleria subnumismalis (Davidson)
Zeilleria aff. *subnumismalis* (Davidson)
Zeilleria indentata (Sowerby)

Plate I: Selected brachiopods from the Hierlatz type limestones of the Choč Unit. **Fig. 1d.** *Spiriferina* cf. *oxyptera* Buvignier. BU 8428. Konczysta Turnia scale. **Fig. 2d.** *Spiriferina haueri* Suess. BU 8401. Uplaz scale. **Fig. 3d.** *Spiriferina alpina alpina* Oppel. BU 8425. Brama Kantaka scale. **Fig. 4d.** *Spiriferina alpina alpina* Oppel. BU 8425. Brama Kantaka scale. **Fig. 5d.** *Spiriferina alpina alpina* Oppel. BU 8402C. Uplaz scale. **Fig. 6d.** *Spiriferina alpina alpina* Oppel. BU 8436. Konczysta scale. **Fig. 7a.** *Furcirhynchia rimata* (Oppel). BU 8410. Uplaz scale. **Fig. 8a, c.** *Cirpa* cf. *langi* Ager. BU8406. Uplaz scale. **Fig. 9a, c.** *Homeorhynchia prona* (Oppel). BU8405. Uplaz scale. **Fig. 10c, d.** *Cuneirhynchia retusifrons* (Oppel). BU8423. Brama Kantaka scale. Uplaz scale. **Fig. 11a, c.** *Cuneirhynchia retusifrons* Oppel. BU8407. Uplaz scale. **Fig. 12a, c, d.** *Cirpa* cf. *langi* Ager. BU8411. Uplaz scale. **Fig. 13a, b.** *Lobothyris subpunctata* (Sowerby). BU 8440A, BU 8440B. Uplaz scale. **Fig. 14a.** *Lobothyris subpunctata* (Sowerby). BU 8412. Uplaz scale. **Fig. 15a.** *Zeilleria* cf. *subnumismalis* (Davidson). BU 8414. Uplaz scale. **Fig. 16a.** *Zeilleria indentata* (Sowerby). BU 8440C, D, E. Uplaz scale. **Fig. 17a.** *Zeilleria indentata* (Sowerby). BU 8440. Uplaz scale. All the specimens 2x. In each case, **a** - is the dorsal view, **b** - is the lateral view, **c** - is the anterior view (brachial valve uppermost), and **d** - is the ventral view.

The crinoidal limestones of the Uplaz scale, which interfinger with the Hierlatz type limestones, contain Lower Domerian *Spiriferina* cf. *haueri* Suess. In this locality, the different brachiopods have a different range. We have found together brachiopods, with ranges coinciding only with the Hettangian (*Spiriferina* cf. *haueri*), Lower-Upper Sinemurian (*Homoeorhynchia ?prona* and *Furcirhynchia rimata*), Domerian (*Lobothyris subpunctata, Zeilleria subnumismalis, Z. indentata*), or the upper part of the Domerian (*Cirpa langi*), as well as brachiopods with ranges coinciding with the Lower and Middle Liassic (*Spiriferina alpina alpina, S. oxyptera*) (cf. Alméras 1964). The age of the Hierlatz type limestones of the Uplaz scale is thought to coincide with the youngest age shown by the brachiopods, namely with the Domerian. In addition the rhynchonellids coinciding with the Lower-Upper Sinemurian, are perceived to be resedimented.

The intercalations of the Hierlatz type limestones in the Brama Kantaka scale (Brama Kantaka gate locality) contain the following taxa:

Spiriferina alpina alpina Oppel
Spiriferina cf. *alpina alpina* Oppel
Cuneirhynchia retusifrons (Oppel)
Zeilleria aff. *subnumismalis* (Davidson)

These taxa, especially *Zeilleria* aff. *subnumismalis* (Davidson), enable us to assign a Domerian age.

The silicified Hierlatz type limestone of the Jaworzynka Mietusia Mt. contain Hettangian *Spiriferina* cf. *haueri* Suess. Its specimens are very rare and probably are resedimented.

We conclude, therefore that the age of the Hierlatz type limestones in the Choč Unit in the Tatra Mts. may be assigned to the Domerian, while the limestones from the Konczysta scale may be ascribed to the Upper Sinemurian-Domerian. Furthermore, the occurrence of the Domerian brachiopods in the crinoidal and cherty limestones confirms the viewpoint (Uchman 1989, 1992) that the facies interfinger horizontally with the Hierlatz type limestones.

Remarks on the palaeobiogeography of brachiopods

Two palaeobiogeographic brachiopod provinces are distinguished in the Pliensbachian (Ager 1967, 1971, 1973; Vörös 1982b, with references therein), namely the Mediterranean or Alpine province and the NW European province. According to Vörös (1982b), the North Alpine brachiopods, especially those from Hierlatz near Salzburg, belong to the Mediterranean province. The following Pliensbachian taxa typify this province: *Pisirhynchia retroplicata, P. inversa, Prionorhynchia ?flabellum, P. ?scherina, Apringia piccininii, A. mariottii, A. ?stoppanii, Gibbirhynchia ?sordelli, Linguithyris aspasia, Phymatothyris rheumatica, Viallithyris gozzanensis, V. ?delorenzoi, Securithyris adnethensis, Aulacothyris ?furlana, A. ?apenninica,* and *A. ?pedemontana.* The characteristic NW European species are: *Gibbirhynchia curviceps, Tetrarhynchia tetraedra, Prionorhynchia quinqueplicata, Lobothyris edwardsi, L.punctata, L. subpunctata, Zeilleria subnumismalis, Z. mariae, Z. indentata, Z. quadrifida,* and *Aulacothyris resupinata.*

The brachiopod fauna collected from the Hierlatz type limestones of the Choč Unit belongs to two taphonomic types: autochthonous (Domerian) and resedimented (Hettangian-Sinemurian). The Domerian brachiopods such as *Lobothyris subpunctata, Zeilleria subnumismalis,* and *Z. indentata* are typical of the NW European province. The allochthonous Hettangian-Sinemurian brachiopods, such as *Spiriferina* cf. *haueri, Homeorhynchia ?prona, Furcirhynchia rimata*, belong to the Alpine biogeographical province. The last form, being an Alpine representative, was resedimented and included in the typical NW European brachiopod biocoenosis. Finally, a mixed Alpine-NW European thanathocoenosis was formed during the Domerian.

According to (Siblík 1992), the brachiopod content is highly diversified in particular outcrops of the Hierlatz limestones in the region of Hierlatz. In some outcrops, the brachiopods are typically Mediterranean (*Nucleata aspasia* and other taxa), while in other zones these distinctly Mediterranean species are missing (in the Marmorea Zone of Steinplatte, for example). Most probably, the situation is almost the same in the Choč Unit. Thus, the diversity of the brachiopods is related to the difference in the physical conditions in the biotope. In calmer, deeper waters, the brachiopod fauna is of Mediterranean type, and in the shallower, more energetic biotope, they are of NW European type. Similar relations are observed among the Lower Jurassic brachiopod fauna of the eastern part of the Stara Planina Mts. in Eastern Bulgaria (Tchoumatchenco 1988). In this area, the Lower Jurassic brachiopods occur in different olistolithes which are included in a Middle Jurassic fine-grained matrix. The so called Bilka type olistolithes consist of micritic and crinoidal red and pink limestones, which are very similar to the Hierlatz type limestones. They bear brachiopods, especially *Lobothyris subpunctata* and others, and ammonites (for example *Amaltheus subnodosus* (Young & Bird)) of the NW European type. The same relations are also proved for the Turkish Liassic brachiopods from Antalya which are also of NW European type (Ager 1991).

Conclusions

1 - The Hierlatz type limestones of the Choč Unit in the Tatra Mts. were originally sedimented in shalow-marine environment on tilted blocks of disintegrated Triassic carbonate platform, which were formed during opening of the Western Tethys. Their sediments were resedimented into deeper environment.

2 - The age of the Hierlatz type limestones of the Brama Kantaka and Uplaz scales is Domerian, while the limestones of the Konczysta scale may be ascribed to the Upper Sinemurian-Domerian.

3 - The Hierlatz type limestones of the Uplaz scale contain Hettangian-Sinemurian Alpine allochthonous brachiopods which are mixed together with Domerian NW European autochthonous brachiopods.

Acknowledgements: We are grateful to Dr. J. Michalík (Slovak Academy of Sciences, Bratislava) and Dr. A. Vörös (Hungarian Natural History Museum, Budapest) for critically reviewing the manuscript. The first co-author would like to thank Dr. J. Wieczorek (Polish Academy of Sciences, Kraków) for introducting him to the studied area. P. Radzicki prepared a part of the photographic work.

References

Ager D.V., 1967: Some Mesozoic brachiopods in the Tethys region. *Syst. Assoc. Publ.* (Aspects of Tethyan biogeography). 7, 135 - 151.

Ager D.V., 1971: Space and time in brachiopod history. In: Middlemiss F.A., Rawson P.F. & Newall G. (Eds.): Faunal provinces in space and time. *Geol. J.*, 4, 95 - 110.

Ager D.V., 1973: Mesozoic Brachiopoda. In: Hallam A. (Ed.): Atlas of paleobiogeography. *Elsevier*, 431 - 436.

Ager D.V., 1990: British Liassic Terebratulida (Brachiopoda). Part 1. *Monograph of the Palaeontological Society,* London, 1 - 39.

Ager D.V., 1991: Mesozoic brachiopod fauna from Western Pontides, Turkey; their stratigraphical palaeogeographical and palaeoecological significance. *Geol. Romana*, 27, 237 - 243.

Alméras Y., 1964: Brachiopodes du Lias et du Dogger. *Doc. d. Lab. d. Geol. d. l. Fac. d. Sci d. Lyon,* Lyon, 5, 1 - 160.

Andrusov D., 1959: Geologie der Tchechoslowakischen Karpaten, *Slov. Akad. Vied.*, Bratislava, 1 - 375 (in Slovak).

Arkell W.J., 1956: Jurassic Geology of the World. *Oliver & Boyd Ltd. Hafner Pub. Company,* New York, 1 - 681.

Bauer F.K., 1970: Zur Facies und Tectonic des Nordstammes des Ostkarawanken von der Petien bis zum Obir. *Jb. Geol. Bundesanst.*, 113, 189 - 245.

Bernoulli D., 1967: Probleme der Sedimentation im Jura Westgriechenlands und des zentral Apennin. *Verh. Naturforsch. Gesell.*, 78, 35 - 54.

Bernoulli D., & Jenkyns H.C., 1974: Alpine, Mediterranean, and Central Atlantic Mesozoic Facies in Relation to the early Evolution of the Tethys. *Spec. Publ, Soc. Econ. Paleontologists Mineralogists,* Tulsa, Okla., 19, 129 - 160.

Böhm F., 1986: Der Grimming: Geschichte einer Karbonatplatform von der Obertrias bis zum Dogger (Nördliche Kalkalpen, Steiermark). *Facies,* 15, 195 - 232.

Bromley R., 1992: Bioerosion: Eating Rocks for Fun and Profit. *Short Courses in Paleontology*, 5, 121 - 129.

Bujnovský A. & Polák M., 1979: Correlation of Mesozoic lithostratigraphic units of the Malá Fatra, Veľká Fatra and NW part of the Low Tatras. *Geol. Práce, Spr.*, 7, 77 - 96 (in Slovak, English summary).

Bystrický J., 1960: Einige Bemerkungen zum Jura des Gebirges Slovenský Kras. *Geol. Práce, Spr.*, 18, 39 - 48 (in Slovak).

Bystrický J., 1964: Stratigraphgie und Dasycladacean des Gebirges Slovenský kras. *Ústr. ústav geol. Press.*, Bratislava, 1 - 203.

Del Negro W., 1983: Geologie des Landes Salzburg. *Sch. d. Landespress,* Salzburg, 1 - 125.

Eberli G.P., 1988: The evolution of the southern continental margin of the Jurassic Tethyan Ocean as recorded in the Algäu Formation in the Austroalpine nappes of Graubünden. *Eclogae Geol. Helv.*, 81, 1, 175 - 214.

Fülöp J., 1971: Les Formations Jurassiques de la Hongrie. *Ann. Inst. Geol. Publ. Hung.*, 54, 31 - 46.

Galácz A. & Vörös. A., 1972: Jurassic history of the Bakony Mountains, and interpretation of principal lithologoical phenomena. *Földt. Közl.*, 102, 122 - 135.

Gálacz A., Horváth F. & Vörös A., 1985: Sedimentary and Structural Evolution of the Bakony Mountains (Transdanubian Central Range, Hungary): paleogeographic implications. *Acta Geol. Hungarica*, 28, 85 - 100.

Ganss O., 1956: Geologie des Blattes Bergen. *Geol. Bavarica*, 26, 1 - 64.

Ganss O., Kümel F. & Spengler E., 1954: Erläuterung zur geologischen Karte der Dachsteingruppe. *Universiätverlag Wagner*, Innsbruck, 1 - 86.

Géczy B., 1973: The origin of the Jurassic faunal provinces and the Mediterranean plate tectonics. *Ann. Univ. Sci. Budapest., Sect. Geol.*, 14, 20 - 52.

Geyer G., 1886: Über die Lagerungsverhältnisse der Hierlatz -Schichten in der südlichen Schottirol-Zone der Nordalpen vom Pass Pyhrn bis zum Achensee. *Jb. K.-kön. Geol. Reichsanst.*, 33, 215 - 294.

Geyer G., 1889: Über die liasischen Brachiopoden des Hierlatz bei Hallstadt. *Abh. K.-kön. Geol. Reichsanst.*, 15, 1, 1 - 88.

Grabowski P., 1967: Geology of the Chocz scales of Uplaz, Konczysta and Brama Kantaka east of Koscieliska Valley). *Acta Geol. Pol.*, 17, 672 - 696 (in Polish, English summary).

Gušic I. & Babic L., 1972: Die Mikrofazies und Mikrofauna der Obertrias und des Lias des Medvednica Gebirges (Nordkroatien). *Mitt. Gesell. Geol. Bergbaustud. Wien*, 21, 327 - 340.

Hallam A., 1971: Evolution of bathymetric criteria for the Mediterranean Jurassic. *Ann. Inst. Geol. Publ. Hung.*, 54, 2, 63 - 70.

Hauer F., 1856: Ueber die Cephalopoden aus dem Lias der Nordöstlichen Alpen. *Denkschr. der K. Akad. Wiss.*, 11, 1 - 86.

Jenkyns H.C., 1971: Speculations on the genesis of crinoidal limestones in the Tethyan Jurassic. *Geol. Rdsch.*, 60, 471 - 488.

Jenkyns H.C., 1972: Pelagic "oolites" from the Tethyan Jurassic. *J. Geol.*, 80, 21 - 33.

Jürgan H., 1969: Sedimentologie des Lias der Berchtesgarden Kalkalpen. *Geol. Rdsch.*, 58, 464 - 501.

Kollárova V., 1957: Le Lias a Faciés de Hierlatz dans les environs du village Slovenská Ľupča. *Geol. Sbor. Slov. Akad. Vied,* 8, 1, 128 - 134 (in Slovak, French summary).

Kotanski Z., 1965: La structure geologique de la chaine subtatrique entre la vallée de Mala Laka et la vallée Koscieliska dans les Tatras Occidentales. *Acta Geol. Pol.*, 11, 178 - 480 (In Polish, French summary).

Kotanski Z., 1985: Once more about the Stražov nappe in the Tatra Mts; part II. *Przegl. Geol.*, 11, 621 - 628 (in Polish).

Kraus E., 1951: Die Baugeschichte der Alpen. *Akademie Verlag,* Berlin, 1 - 552.

Lackschewitz K.S., Grützmacher U. & Henrich R., 1991: Paleooceanography and relation block faulting in the Jurassic carbonate series of the Chiemgau Alps (Bavaria). *Facies*, 24, 1 - 24.

Lefeld J., 1985: Jurassic and Cretaceous lithostratigraphic units of the Tatra Mountains. Part C. Middle Sub-Tatric Succession. *Stud. Geol. Pol.*, 84, 82 - 93.

Lemoine M. & Trümpy R., 1987: Pre-oceanic rifting in the Alps. *Tectonophysics*, 133, 305 - 320.

Lipold M.V., 1852: Geologische Stellung der Alpenkalksteine welche die Dachstein bivalve enthalten. *Jb. K.-kön. Geol. Reichsanst.*, 3, 4, 90 - 98.

Lóczy L., 1916: Die eologischen Formation der Balatongegend und ihre regionale Tektonik. *Druck V. Hornyanszky*, Budapest.

Maheľ M., 1967: Regional Geology of ČSSR. Western Carpathians, part I. *Akad. Vied.*, Bratislava, 1 - 486.

Plöchinger B., 1980: Die Nördlichen Kalkalpen. Der Geologische Aufbau Österreichs. *Springer Verlag*, Wien-New York, 228 - 229.

Plöchinger B., 1983: Sammlung Geologischer Führer. B. 73. Salzburger Kalkalpen. *Gebruder Borntraeger Press.*, Berlin-Stuttgart, 1 - 146.

Rabowski F., 1954: Les repports structuraux entre les nappes subtatriques de la Tatra sur le versant drait de la vallée Koscieliska aux environs de l'Uplaz Mietusi et leur significations. *Biul. Inst. Geol.*, 86, 17 - 27 (in Polish, French summary).

Schott M., 1976: Microfaziell, multivariale Analyse einer rhätoliassischen Karbonateplatform in den Nördlichen Kalkalpen. *Facies*, 9, 1 - 59.

Siblík M., 1992: Review of the Lower Liassic brachiopod faunas of the Northern Alps. In: Vörös A. & Pálfy J. (Eds.): Program, Abstracts and Field guide on Mesozoic brachiopods. Vörösbereny, Hungary, September 6-11, 1992. *Hungarian Natural History Museum*, Budapest, 28 - 28.

Simony F., 1850: Bericht über die Arbeiten der Section 5. *Jb. K.-kön. Geol. Reichsanst.*, 4, 651 - 657.

Sokolowski S., 1924: Die Beobachtung über das Alter und Entwicklung des subtatrischwen Lias in Tatragebirges. *Rocz. Pol. Tow. Geol.*, 2, 78 - 84 (in Polish, German summary).

Stache G., 1868: Die Sedimentäschichten der Nordseite der hohen Tatra. *Verh. K.-kön. Geol. Reichsanst.*, 13, 322 - 324.

Stoliczka F., 1861: Ueber die Gastropoden und Acephalen der Hierlatz-Schichten. *Sitzungsber. K. Akad. Wiss.*, 43, 1 - 157.

Štúr D., 1871: Geologie der Steiermark. *Verl. geogn.-mont.*, Graz, 1 - 665.

Tchoumatchenco P., 1988: Reconstruction stratigraphique et paleogeographique du Jurassique inferieur et moyen a partir des olistolithes includes dans la Formation de Kotel (Stara Planina orientale, Bulgarie). *Geol. Balcanica*, 18, 6, 3 - 28.

Tchoumatchenco P., 1992: The horizontal distribution of the brachiopods during the Zeilleria quadrifida zone (late Carixian-early Domerian, Early Jurassic) in Bulgaria. In: Vörös A. and Pálfy J. (Eds.): Program, Abstracts and Field guide on Mesozoic brachiopods. Vörösbereny, Hungary, September 6-11, 1992. *Hungarian Natural History Museum*, Budapest, 30 - 30.

Thenius E., 1974: Niederösterreich Verhandlungen. Die Nördlichen Kalkalpen. *Geol. Bundes.*, Wien, 1 - 125.

Tollmann A., 1985: Geologie von Österreich. Band 2. *Franz Deuticke Press.*, Wien, 1 - 710.

Uchman A., 1988: Red limestones - the youngest lithological unit of the Choč Nappe, Tatra Mts. *Ann. Soc. Geol. Pol.*, 58, 277 - 286.

Uchman A., 1989: Development of Jurassic carbonate sedimentation in the Choč Unit, the Tatra Mts., Poland. In: Kázmér M. (Ed.): International Association of Sedimentology. Abstracts. *Hungarian Geological Institute*, Budapest, 1 - 243.

Uchman A., 1992: Jurassic carbonate sedimentation in the Choč Unit in the Tatra Mts., Poland. International Symposium "Platform Margins", Chichilianne, France, 6-8 May, 105 - 105.

Uchman A., 1993: Lower Jurassic carbonate sedimentation controlled by tilted blocks in the Choč Unit in the Tatra Mountains, Poland. In: Amler M.R.E. & Tietze K.-W. (Eds.): Sediment 93. 8. Sedimentologen-Trefen, 3. - 5 Juni 1993 an der Philipps-Universität Marburg. Kurzfassungen von Vorträgen und Postern. *Geologica et Palaeontologica*, Marburg, 94 - 94.

Wiedenmayer F., 1963: Obere Trias bis mittleren Lias zwischen Saltrio und Tremona (Lombardische Alpen). Die Wechselberichungen zwischen Stratigraphie, Sedimentologie und syngenetischer Tektonik. *Eclogae Geol. Helv.*, 56, 529 - 640.

Vörös A., 1973: Speculations on food supply and bathymetry in the Mediterranean Jurassic Sea. *Ann. Univ. Sci. Budapest., Sect. Geol.*, 16, 213 - 220.

Vörös A., 1974: Bathymetric distribution of some Mediterranean Lower Jurassic brachiopods (Bakony Mountains, Hungary). *Ann. Univ. Sci. Budapest., Sect. Geol.*, 17, 279 - 286.

Vörös A., 1982a: Stratigraphic evolution of the Pleisbachian brachiopod fauna of the Bakony Mts. (Hungary). *Földt. Közl.*, 112, 351 - 361 (in Hungary, English summary).

Vörös A., 1982b: Lower and Middle Jurassic brachiopod provinces in Western Tethys. *Ann. Univ. Sci. Budapest., Sect. Geol.*, 24, 208 - 233.

Vörös A., 1983: The Pliensbachian brachiopods of the Bakony Mts. (Hungary): a stratigraphical study. *Fragm. Mineral. Paleont.*, 11, 23 - 39.

Vörös A. & Pálfy J. (Eds.), 1992: Program, Abstracts and Field guide on Mesozoic brachiopods. Vörösberény, Hungary, September 6 - 11, 1992. *Hungarian Natural History Museum*, Budapest, 91 - 91.