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THE KÖSSEN BEDS IN THE WEST CARPATHIANS AND THE PROBLEM OF THEIR STRATIGRAPHIC DIVISION

Abstract: The Kössen Beds on the West Carpathians contain the same fauna of brachiopods and bivalvs as the Kössen Beds of the Eastern Alps. Because of the absence of cephalopods, however, they cannot be divided more in detail. According to the isolated occurrence of *Rhaetites cf. rhaeticus* (Clark) (locality of Hybe) they begin in the Choč nappe in the zone with *Rhabdoceras suessi* (Sevastian), according to megalodonts of the genera *Conchodon* and *Rhaetomegalodon* nearly as late as the zone with *Choristoceras marshi* (Rhaetian) in the Krížna nappe („Upper Rhaetian“ of the Southern and Northern Alps, Hungarian Midmountains). Zonal division of the „Rhaetian“ (i. e. Kössen Beds) by means of foraminifers has so far not been possible; zonal division by means of conodonts is not proved by macrofauna. The „Conodontenfreier Bereich“ (H. Kozur 1972, 1973, 1974) is not possible to consider as a stratigraphic horizon equivalent to the biozone.

Резюме: Кёссенские слои в Западных Карпатах содержат согласную фауну плеченогих и пластиножаберных с кёссенскими слоями Восточных Альп. Из-за отсутствия головоногих нельзя было слои подробнее расчленить. На основании единичной находки *Rhaetites cf. rhaeticus* (Clark) (местонахождение Гибе) начинают появляться в хочском покрове в зоне с *Rhabdoceras suessi* (Sevastian), на основании мегалодонтов рода *Conchodon* и *Rhaetomegalodon* а в крижнском покрове только в зоне с *Choristoceras marshi* (пет) (верхний пет южных и северных Альп, венгерского Среднегорья). Зонарное распределение „рета“ (т. е. кёссенских слоев) на основании фораминифер пока невозможно, зонарное разделение на основании конодонт не подложено макрофауной. „Conodontenfreier Bereich“ (H. Kozur 1972, 1973, 1974) нельзя считать за стратиграфический горизонт равноценный биозоне.

The Kössen Beds are the only lithostratigraphic unit of the Upper Triassic in the West Carpathians, the age of which was considered as completely and unambiguously solved although the stage of Rhaetian itself, in which they were included, was not always equally interpreted (Triassic, Infratrias, Triassic). The complex of dark-coloured banded limestones and dark to black shales, in its lithological character and dark colouring of rocks so conspicuously contrasting to the variegated (red, green, yellow-spotted) shales found in its underlier (Carpathian Keuper) and also so rich in fossils as no other one in the Triassic of the West Carpathians, was already established in the first years of general geological investigation of Slovakia. D. Stur (1859 a, b; 1860), F. Foersterle (1859) and F. Hauer (1859) established it at the same time in the Váh river valley, Tatras and the Humenské pohorie Mts. in the same development and the same position within the bed sequence, and immediately recognized in it an equivalent of the Kössen Beds of the Eastern Alps. D. Stur (1859 b) devoted to the Kössen Beds of the West Carpathians even a particular paper and E. Suess (in E. Suess — E. Mojsisowics 1868) choose them as the type of a faunistic — lithological unit, called the „Carpathian facies of the Rhaetian stage“ by him.

A paradoxon is that just this lithostratigraphic unit, about which V. Uhlig (1897, p. 653) stated: „Keine andere Schichtgruppe der Karpathen ist so leicht zu erkennen

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und zeigt eine so beständige Beschaffenheit und solchen Fossilreichtum wie die rhätische..." and further on, "...erheben diese Stufe sozusagen zum Leitstern des Feldgeologen in den Karpathen..." is for the stratigraphy still at present a puzzle and that the views on its or stratigraphic range are changing so quickly mainly in the last years. The question of the age of the Kössen Beds attributed to the Rhaetian formation in the Alps (C. W. Gumbel 1861) as well as in the West Carpathians (G. Stache 1864), understood later as the Rhaetian stage (F. Hauer 1862, p. 41, C. W. Gumbel 1864) was set again because it directly concerns placing of the boundary between the Norian and Rhaetian stage and especially the redefinition of the Rhaetian stage.

The Rhaetian stage in the definition of C. W. Gumbel (1864) and later authors (E. Mojsisowics 1872, 1895; G. Arthaber 1905) as "Beds with *Rhaetavicula contorta*" or "zone with *Rhaetavicula contorta*" includes, as established in the last years (M. Ulrichs 1972, L. Krystin 1974), two ammonite zones: the Zone with *Rhabdoceras suessi* (Upper Norian, substage Sevatian) and the Zone with *Choristoceras marshi* (Rhaetian stage). In correlation with the orthostratigraphic division of the Upper Triassic of E. T. Tozer (E. T. Tozer 1967, N. J. Silberling — E. T. Tozer 1968) thus only the uppermost part of the Kössen Beds, represented by the so called Salzburg facies (E. Suess in E. Suess — E. Mojsisowics 1868) or — as it is just the case in the type profile of Weissloferbach — by the Kössen facies (M. Ulrichs 1972) correspond to the Rhaetian stage. The more lower part of the Kössen Beds (Swabian, Carpathian and Kössen facies) in which a "typical Rhaetian" fauna of brachiopods, lamellibranchs — including the species *Rhaetavicula contorta* (Portl), which in the last time still also D. A. B. Pearson (1970) considered as an index species of the Rhaetian stage (sensu the Zone with *Choristoceras marshi*), is found — is lying in the Zone with *Rhabdoceras suessi* and consequently belongs to the substage Sevatian (M. Ulrichs 1972).

In correlation of the mentioned ammonite zones with the scale of conodont zones, the Zone with *Choristoceras marshi* and the uppermost part of the Zone with *Rhabdoceras suessi* should correspond to the so called "Conodontenfreier Bereich" (H. Kozur 1971 c, p. 5; 1972 d; H. Kozur — H. Mostler 1972 a, b; H. Kozur — B. Mock 1973 a, 1974 c, p. 142). The more lower part of the Kössen Beds containing conodonts is attributed to the uppermost part of the Norian stage (L. C. Mosher 1968). Such a parallelization of ammonite zones with conodont zones (sensu H. Kozur — H. Mostler 1972 b) should also agree with the ostracode fauna as "...selbst in der Typus — Localität der Kössener Schichten (Weissloferbach bei Kössen) kommt im unteren Teil noch die typische obernorische Ostracodenfauna vor" (H. Kozur 1972 b, p. 388).

With the division of the "Zone with *Rhaetavicula contorta*" into two ammonite zones, of which only the higher one — Zone with *Choristoceras marshi* — should represent the Rhaetian stage, the Kössen Beds in the West Carpathians would remain without a possibility of direct correlation and parallelization. From the Kössen Beds of the West Carpathians, with the exception of the Kössen Beds near the community of Hybe, we have known no ammonites so far. The parallelization of the Kössen Beds of the West Carpathians with the Zone with *Choristoceras marshi* by means of the so called "Conodontenfreier Bereich" (H. Kozur 1971 c, p. 5; 1972 b, p. 388) is so uncommon in the method of stratigraphic correlation that the doubt of its correctness is quite justified (usually one fauna with another present fauna, not with an absent fauna is correlated). This was otherwise confirmed by the find of the conodont species

Spathognathus hernsteini Mostler in the Kössen Beds near the community of Hybe (J. Michalík 1973 a, b; H. Kozur — R. Moek 1973 a, p. 10), which formerly also were ranged to the "Conodontenfreier Bereich" and parallelized with the Zone with *Choristoceras marshi* (H. Kozur 1971 c, 1972 b).

At the present-day state of knowledge on the fauna of the Kössen Beds of the West Carpathians determination of their age or stratigraphic range is a very difficult task. Above all the question arises, whether also in the West Carpathians both the mentioned ammonite zones are represented in them. Further on, whether in all tectonic units their base is found at an equal or at different stratigraphic level. To solve this problem means mainly to obtain a survey of the total situation, to collect in detail the fauna from complete profiles, including also the beds in their direct underlier, to revise up to present fauna collections in the sense of modern taxonomy and to select the most suitable group of fossils for a correlation with ammonite zones distinguished in the Kössen Beds of the Eastern Alps. The existing information on the fauna of the Kössen Beds of the West Carpathians is modest in this regard — as we shall see in the next — but, after all, it outlines certain possibilities how to solve this problem.

Terminology

Before I approach the West Carpathian Kössen Beds problem proper, I take it for necessary to mention that the term Kössen Beds has not been used in the Carpathian literature for almost sixty years. W. Goetel (1916, 1917), considering the problem of their age as unambiguously solved, substituted the term Kössen Beds used by his predecessors simply by the term Rhaetian. W. Goetel (1917, p. 214) writes: "Die subtatrische Schichtfolge des Rhäts lässt sich in keine Unterabteilungen zergliedern, sie bildet eine geschlossene stratigraphische Einheit (Stufe) . . . Diese Einheit (Stufe) ist in der Tatra von dem Keuper gut abgesondert und mit Unterlias innig verbunden . . ." The term Rhaetian for designation of a lithostratigraphic unit was later generally accepted and since then we meet in literature only the expressions: Rhaetian, Rhaetian limestones, Rhaetian beds, Rhaetian in marine development or "lithological" Rhaetian, etc. The term Kössen Beds was used only seldom (J. Bystrický — A. Biely 1966, J. Bystrický 1972), but only for the so called Kössen facies present in the West Carpathians only near the community of Hybe (G. Stache 1868, W. Goetel 1916, 1917). With the term "Rhaetian", however, also beds are designated, the development of which does not correspond to the Kössen Beds (e. g. Dachstein limestones with megalodonts in the Malé Karpaty Mts.) or beds, competence to the Rhaetian stage of which is questionable, as it follows from the conception of the so called "High Tatric Rhaetian": "For petrographic and sedimentological purposes, however, a certain compromising starting point is necessary, making a general solution of certain groups possible, which are concluded to include the Rhaetian at least partly" (A. Radwański (1968), p. 12, translation from Polish by the author).

This approach is specific not only for the Carpathian literature; we meet it, although more rarely, also in the Alpine literature. Therefore it is sometimes really very difficult to judge, in which case e. g. the "Lower Rhaetian" is only the lower part of the lithostratigraphic unit, and in which case the lower part of the Rhaetian stage is thought with this designation. In order to avoid whatever misunderstanding, I propose to distinguish both categories of stratigraphic classification by nomenclature. For the lithostratigraphic unit described and designated by D. Stur (1859 b) as "a dark-grey

to black facies of the Kössen Beds I propose the designation Kössen Beds. This facies, as already found by D. Stur (l. c.) and also confirmed by W. Goetel (1917), agrees with the Kössen Beds of the Eastern Alps not only lithologically but also in the paleontological content. With repeated application of the original term a better correlation with Kössen Beds of the Alps will be possible, misunderstandings gathered with time, hindering this correlation, will be removed and tautonomic or controversial statements will disappear from literature as, for instance, "das bisherige Rhät in der Slowakei... bleibt rhätisch (H. Kozur — R. Moek 1974 b, p. 246). "Thus the lowermost part of "lithological" Rhaetian is placed in the Norian. It should be noted that these underlying Norian strata are developed in the Rhaetian facies" (A. Gaździcki 1974, p. 76).

The problem of the "stratigraphic hiatus in the Rhaetian" (D. Andrusov 1959, p. 71, 101; 1965, p. 70) will appear to us otherwise when instead of the statement that "In der Tatridentzone fehlt hingegen das Rhät zumeist" (D. Andrusov 1965, p. 68) we shall be only restricted to the statement that in some areas of the Tatric and Gemeric the Kössen Beds are not represented and we shall examine whether their time equivalent is not present in other lithostratigraphic unit (e. g. in the Tatric in the uppermost part of the Carpathian Keuper, a possible equivalent of the Tomanová Beds). In the Gemeric, where also a stratigraphic hiatus in the Rhaetian was mentioned, in the meantime the Rhaetian stage has been established (sensu the Zone with *Rhaetavicula concorta*) at the Murán plateau (M. Kochanová 1964, p. 75) and in the Slovak Karst in the facies of the Zlambach Beds (J. Bystrický 1964, p. 79, 173). Finally, our knowledge on the stratigraphic level of the uppermost parts of the Furmanec limestones, Hauptdolomit and other lithostratigraphic units of the highest part of the Upper Triassic has not yet been in such a stage of investigation, so that we could responsibly state that they do not reach the Rhaetian stage whether defined as the "Zone with *Rhaetavicula contorta*" (C. W. Guembel 1864, G. Arthaber 1905) or as the Zone with *Choristoceras marshi* (E. T. Tozer 1967).

Distinguishing of the lithostratigraphic unit from the chronostratigraphic one by nomenclature I take for especially necessary now, when suggestions to the definition of the Rhaetian stage are being presented for discussion in several variants (E. Kittl 1903, T. Fuchs 1904, D. A. B. Pearson 1970, E. T. Tozer 1970, J. Wiedmann 1972).

Kössen Beds of the Alps and the problem of their stratigraphic division

As the problem of the stratigraphic division of the Kössen Beds of the Alps and the West Carpathians is a common one, I take it for convenient, at least quite briefly, first to refer to the history and the present-day suggestions to solve the Kössen Beds stratigraphy of the Alps.

The Kössen Beds had been distinguished and given a name in the Alps before the Rhaetian formation was established — the later representative of the Rhaetian stage. E. Suess (1852, p. 180) introduced this term with the words „Kalkstein von Kössen" for a complex of strata formerly termed „Gervilienschichten" (E. Emmerich 1849) or also „Unterer Oolith" (F. Hauer 1850). He himself, however, did not submit their definition. F. Hauer (1853) described them as... „meist dunkel gefärbte, dünn geschichtete, oft mergelige Kalksteine...". containing the same fossils as are present in the Starhenberg Beds (Starhenberg-Schichten), i. e. „in the Dachstein limestone proper". All these three lithostratigraphic units according to F. Hauer (l. c., p. 734) „...gehören entschieden ein und derselben Formation". C. W. Guembel (1859, p. 84; 1861, p. 214) suggested to term this formation as *raetische Formation*. C. W. Guembel (1861, p. 214) writes: „Es wäre nach den in den Alpen herrschenden Verhältnissen nicht unnatürlich, aus den oberen Schichten des Alpenkeupers, den Kössener Schichten und dem

Dachsteine eine eigene zwischen Keuper und Lias stehende, selbständiges Schichtgruppe oder Formation zu bilden, welche man den Namen rhaetische Formation von dem Hauptgebiete ihrer Entwicklung in den rhaetischen Alpen beilegen könnte". In this Rhaetian formation C. W. Guembel (l. c., p. 214) distinguished: 1. Oberes Glied, Dachsteinkalk and 2. Unteres Glied, Schichten der *Avicula contorta* — Kössener Schichten. In the same publication, however C. W. Guembel (l. c., p. 536) relates the term „Schichten der *Avicula contorta*“ to the whole Rhaetian formation, not only to the Kössen Beds. In every case, the Kössen Beds in the conception of C. W. Guembel (l. c.) are only a lithostratigraphic unit of a lower order than the Rhaetian formation although in places they may be its only representative. Identification of the Kössen Beds with the Rhaetian stage („Zone with *Avicula contorta*“) has caused so many difficulties in Upper Triassic stratigraphy¹ that justly at present a revision of the Rhaetian stage is required (E. T. Tozer 1967, M. Ulrichs 1972, J. Wiedman 1972, 1974) or it is suggested to abolish the Rhaetian stage and to use the term „Rhät“ only in the facial sense (F. Fabricius 1974), thus to give it such a meaning as „...was er immer war, nämlich eine informal lithostratigraphic unit“ (L. Krystyn 1974, p. 142).

It is evident from the above mentioned that E. Mojsisowics, considering the „Zone with *Rhaetavicula contorta*“ — Rhaetian stage as certain taboo, was not able to correlate the ammonite fauna of the Kössen Beds with that of the Zlambach Beds and therefore he assigned the latter en bloc to the Sevatian, to the Subzone with *Choristoceras haueri* (E. Mojsisowics 1902).

Division of the Kössen Beds

The Kössen beds were considered as one unit with one fauna, which was not possible to divide more in detail stratigraphically. As a representative of the Rhaetian stage in the Kössen Beds were considered younger than the Zone with *Pinacoceras metternichi* found in the Hallstatt limestones (E. Mojsisowics in E. Mojsisowics — W. Waagen — C. Diener 1895). Since the ammonite fauna of the Kössen Beds was poorly known (E. Mojsisowics — E. Suess 1868, J. F. Pompeckj 1895), it was not possible to correlate it well with the ammonite fauna of the Zlambach Beds, which enabled to divide the Zlambach Beds into the *Cochloceras* marls, belonging to the Norian stage, and the *Choristoceras* marls, belonging to the Rhaetian stage (E. Kittl 1903, p. 16, T. Fuchs 1904). In the last time also D. A. B. Pearson (1970) was of the opinion that the Kössen Beds as one unit correspond to the Zone with *Choristoceras marshi*, consequently to the Rhaetian stage in the sense of E. T. Tozer (1967). D. A. B. Pearson (l. c.), considering the *Cochloceras* marls of the Zlambach Beds as the final unit of the Zone with *Rhabdoceras suessi* (Norian stage), thought that the base of the Kössen Beds is the base of the Rhaetian stage as he writes (l. c., p. 141): „The top of the *Rh. suessi* Zone may therefore be within the Plattenkalk or even the Hauptdolomit, but is is not higher than the lowest brachiopod horizon of the Kössen Beds.“ On the contrary, E. Kittl (1903, p. 22—23) observed that the ammonite fauna which J. F. Pompeckj described from the Kössen Beds as Rhaetian (J. F. Pompeckj 1895) shows certain marks of an impoverished Norian fauna and concluded that the Kössen Beds could be

¹ E. Mojsisowics 1869, p. 99; Seitdem aber die Bezeichnung „rhätische Stufe“ durch die allgemeine Aufnahme, welche sie ausserhalb der Alpen allenthalben fand, eine ganz scharf umgrenzte Bedeutung erhalten hat, werden wir auch in den Alpen nur diejenigen Bildungen als „rhätische“ bezeichnen dürfen, welche sich nach ihrer Fossilführung oder nach der Lagerung tatsächlich als solche erweisen.“ E. Mojsisowics 1874, p. 87; „Wäre für die rhätische Stufe durch die ganz bestimmte Beschränkung dieser Bezeichnung auf die Zone der *Avicula contorta* nicht ein Präjudiz geschaffen, so würde ich den Hauptdolomit gerne als untere Abtheilung in die rhätische Stufe setzen...“

only a particular facies of the Norian stage as also fauna from the limestones of Bleskový prameň (Dnava — Dernö) would testify ... "in welcher Norische Hallstätter Cephalopoden mit Brachiopoden vom Typus jener der Kössener Schichten gemengt erscheinen".²

From the above mentioned no detailed division of the Kössen Beds was evident. The Kössen Beds of the Alps could be divided more in detail in the last years only. At the type profile (Weissloferbach bei Kössen) in their lower part the species *Rhabdoceras suessi*, in the higher part the species *Choristoceras marshi* and other as *Choristoceras ammonitiforme*, *Choristoceras rhaeticum*, *Trachyphyllites?* sp. were found (M. Ulrichs 1972, J. Wiedmann 1972). On the basis of these finds as well as of other finds at other localities (L. Krystyn 1974, p. 142) the lower part of the Kössen Beds was assigned to the substage Sevatian and only their upper part to the Rhaetian stage in the definition of E. T. Tozer (1967). It is also judged whether the Kössen Beds — regarding to the occurrence of the species *Rhabdoceras suessi* only in the higher part of the bed sequence — do not begin even earlier, already in the Middle Norian (L. Krystyn 1974, p. 142).

By aid of microfauna, mainly conodonts, H. Kozur (1971—1973) tried to divide the Kössen Beds. According to him, between the Zone with *Rhabdoceras suessi* (Sevatian) and the Zone with *Choristoceras marshi* (Rhaetian) there is a "very sharp faunistic and floristic cut", which should be mainly shown (H. Kozur 1971 c, p. 5—6):

1. In the ammonite fauna: "Bei einigen Makrofossilgruppen (z. B. Cephalopoda) lässt sich schon jetzt mit Sicherheit sagen, dass der Schnitt ebenso gross war wie an der Perm-Trias — Grenze".

2. In the extinction of conodonts: "Die Conodonten sterben an der Nor Rhät — Grenze bzw. unmittelbar darunter völlig aus".

3. In the fauna of holothurian sclerites: "Besonders auffällig ist der Schnitt bei den gut untersuchten Holothuriern — Skleriten ...".

4. In the ostracode fauna: "... bei Flachwasserostrocoden ist ebenfalls ein sehr scharfer Schnitt zu erkennen ...".

This distinct boundary between the mentioned ammonite zones would have been much welcomed in division of the Kössen Beds if also other authors have confirmed it. Unfortunately, many literary data contradict it: ostracodes — M. Ulrichs (1972), conodonts — L. C. Mosher (1968), W. C. Sweete et al. (1972), brachiopods — D. A. B. Pearson (1970), A. S. Dagys (1974) (see also F. Fabricius 1974, p. 88).

The mentioned criteria which had to confirm that placing of the boundary between the Norian and Rhaetian stage in the sense of E. T. Tozer (1967) is also for the region of the Alps and West Carpathians the "best solution" and that the "Lower Rhaetian" of the Eastern Alps and the "Rhaetian" in the West Carpathian are nothing else than a "facial equivalent of the Upper Norian Zone with *Pinaoceras metternichi* (= Zone with *Rhabdoceras suessi*)" (H. Kozur 1971 c, H. Kozur — R. Mock 1973 a) soon lost the importance originally ascribed to them. If the "sharp faunistic

² In the stratigraphic table E. Kittl (1903, p. 16) parallelizes the Kössen Beds (Zone with *Avicula contorta*) with the *Choristoceras* marls, but then on p. 23 he writes: „Es würde heute schon die strikte Parallelisierung der oberen Zlambach-Schichten (*Choristoceras*-Mergel) mit den Kössener Schichten nicht gewagt erscheinen, wenn nicht die faunistischen Differenzen namentlich in Bezug auf die Brachiopoden heute noch als bedeutend genug zugegeben werden müssen, um die weitere Annahme von der Existenz der Zone der *Avicula contorta* neben, respektive über der norischen Stufe zu rechtfertigen“.

cut" had been found at the base of the Kössen Beds ("Zone with *Rhaetavicula contorta*"), where it is recently placed as a consequence of parallelization of the highest part of the Zone with *Rhabdoceras suessi* with the lower part of the *Choristoceras* marls ("Zone with *Choristoceras haueri*", H. Kozur 1973 b), then through this "very sharp faunistic cut" not only the index species of the Zone with *Rhabdoceras suessi* (so far its representation in the *Choristoceras* marls has not been cleared up sufficiently³ but also the "typical Upper Norian ostracode fauna" (H. Kozur 1972 b, p. 388), the well investigated holothurian sclerites" (H. Kozur 1971 c, p. 6), conodonts which should have been extinct prior to the termination of the zone with *Rhabdoceras suessi* (H. Kozur 1971 c, H. Kozur — H. Mostler 1972 b, H. Kozur — R. Moock 1973 a), also the "Conodonten Holothurien — Assoziation, wie sie für die -hernsteini-Assemblage-Zone charakteristisch ist" (H. Kozur — R. Moock 1973 a, p. 10, see Kössen Beds from the community of Hybe) had passed into the Rhaetian stage.

The sudden change in the view of the content of the Rhaetian stage and the return to its conception in the sense of E. Kili (1903) is substantiated by H. Kozur (1973 b) as due to parallelization of the lower part of the Kössen Beds (Zone with *Rhaetavicula contorta*) with the lower part of the *Choristoceras* marls through the conodont Zone with *Misikella posthernsteini* (the definition of this zone see in H. Kozur — R. Moock 1974 b, p. 249), formerly designated simpler as "posthernsteini-Fauna" (H. Kozur 1972 d, p. 38—39, strat. tab., H. Kozur — R. Moock 1972 a, p. 7). This conodont zone characterized by a very poor conodont fauna is found above the Assemblage-Zone with *Spathognathus hernsteini* (= *Misikella hernsteini* in H. Kozur — R. Moock 1974 a) and represents the youngest so far known Triassic conodont horizon. Above it should be only the "Conodontenfreier Bereich". Although the cono-

³ H. Kozur 1971 c, p. 5: „Es findet sich jedoch nirgends der Hinweis, dass *Choristoceras marshi* und die norischen Faunenelemente aus der gleichen Schicht stammen." Neither J. Wiedmann (1972), nor M. Ulrichs (1972) mentioned the common occurrence of *Rhabdoceras suessi* with *Choristoceras marshi*. Only J. Wiedmann (1974, p. 230) mentioned it: „Der... oberste Profil-Abschnitt (3 ist durch *Ch. marshi* gekennzeichnet, das am Weissloferbach in Probe A 85 (also neben *Rh. suessi*) einzusetzen scheint". From this sample, however, M. Ulrichs (1972, p. 670, Abb. 3) mentions *Rhabdoceras suessi* only. H. Kozur 1973 b, p. 17: „Die *Choristoceras haueri* — Zone entspricht der oberen *Rhabdoceras suessi* — Zone (Bereich des gemeinsamen Vorkommens von *Rh. suessi* und *Choristoceras*) but does not mention the concrete profile, where these species have been proved together.

P. 14: „Es ist nicht völlig auszuschliessen, dass sich *Rhabdoceras suessi* und *Choristoceras marshi* in ihren stratigraphischen Reichweite etwas überschneiden. Dies könnte im Niveau des Ammonitenhorizontes von Bleskový prameň (Dnava-Dernö) der Fall sein, wo in einer reichen sevatischen Ammonitenfauna ganz vereinzelt *Rh. suessi* vorkommt und nach weiteren Angaben auch *Choristoceras marshi* auftreten soll. *Rhaetavicula contorta* kommt ebenfalls ganz vereinzelt vor". As to the fauna from Bleskový prameň, the species *Choristoceras marshi* was mentioned only by J. Sturzenbaum (1879), who also quoted *Rhaetina gegaria* (Suess) from there and so was convinced that the Salzburg facies of the Kössen Beds was concerned. Both the named species were neither confirmed by E. Mojsisowics (1896), nor by A. Bittner (1890), nor by any later author (V. Kollárová — Anrušová — M. Kočanová 1973, M. Šiblík 1967). Beside H. Kozur (1972 b, 1973 b) none of the collectors has found the species *Rhabdoceras suessi* and *Rhaetavicula contorta* at this locality. In spite of that a find of such a great stratigraphic value is concerned, there is nothing to document the mentioned species. In this regard the locality of Bleskový prameň was of a particular importance as it might be the only locality in the world, where the species *Halorella amplitoma* (Bronn), a typical species for the Norian stage (A. S. Dagys 1974, E. Kili 1903) would have reached as late as the „upper part of the Lower Rhaetian" or, according to H. Kozur (l. c.) even the Zone with *Ch. marshi*.

dont fauna of this zone (formerly placed to the nearly uppermost Sevatian) had been established already earlier in the Kössen Beds (L. C. Mosher 1968), however, such a great importance, as it is ascribed to in the definition of the Rhaetian stage, it acquired only when it was found also in the Kössen Beds of the type profile (Weissloferbach bei Kössen), in that part of the bed sequence, which M. Ulrichs (1972) included in the Zone with *Rhabdoceras suessi*, thus in the Sevatian. It is supposed that the Zone with *Misikella posthernsteini* is also represented in the *Choristoceras* marls of the Zlambach Beds and therefore it is suggested to assign to this conodont zone an equivalent ammonite zone — the Zone with *Choristoceras haueri* (H. Kozur 1973 b). The lack of this parallelization is, as the author himself writes, that in the Zone with *Choristoceras haueri* "Conodonten fehlen oder kommen nur noch im bassalen Teil ganz vereinzelt vor (-posthernsteini-Fauna)" (H. Kozur 1973 b, p. 17). This indication about the modest occurrence of conodonts, however, relates in fact only to the lower part of the Kössen Beds (considered as a time equivalent of the Zone with *Choristoceras haueri*) as it follows from the further text: "Lediglich an der Basis der *Rhaetavicula contorta* — Zone kommt eine sehr arme Conodontenfauna mit *Misikella posthernsteini* vor... in den *Choristoceras*-Mergel fehlen Conodonten" (H. Kozur l. c., p. 14).

The only indication about the presence of the Zone with *Misikella posthernsteini* in the "*Choristoceras* marls of the Zlambach Beds", which I know, concerns the Zlambach Beds of the Slovak Karst (Malý Mlynský vrah), from which *Choristoceras* sp. is mentioned (H. Kozur — R. Moock 1974 b, p. 249). The specimen which should prove the *Choristoceras* marls and so also their Rhaetian age here, however, has neither been figured nor described. In the statement about the Zone with *Misikella posthernsteini* in these beds it is not mentioned that from the same beds at the same locality an assemblage of conodonts pointing at the uppermost part of the zone with *Metapolygnathus bidentatus* has been found: *Epigondolella bidentata* Mosher (= *Metapolygnathus bidentatus* (Mosher), in H. Kozur 1972 d), *Spathognathodus hernsteini* Mostler (= *Misikella hernsteini* (Mostler), in H. Kozur — R. Moock 1974 a), *Oncodella paucidentata* (Mostler) and *Gondolella navicula* Hückriede (R. Moock 1973), and that their basal beds were also assigned to the Zone with *Misikella hernsteini* (H. Kozur — R. Moock 1974 c, p. 139). From the given data as mentioned: "Malý Mlynský vrah: Unteres Untererhät" (H. Kozur — R. Moock 1974 b, p. 248) it is not so clear, mainly when it is not indicated whether these three conodont zones are found above one another also in the bed sequence. Without explaining the succession of strata and conodont zones it is not possible to find out whether also in the case of the Zlambach Beds of the Malý Mlynský vrah the same situation as in the Kössen Beds near the community of Hybe is not repeated (see p. 189).

To divide the Kössen Beds or to establish the stratigraphic level of their base by aid of conodonts or generally by aid of a "very sharp faunistic and floristic cut" is not reliable. In the latest publication dealing with this problem (H. Kozur 1974) the text is in contradiction to the conclusions: contradictions are between the German wording of the conclusions and the wording in other languages; the text and conclusions do not agree with the correlation table. So, for instance, in the conclusions in German wording (p. 187) the Zone with *Rhabdoceras suessi* is assigned to the Sevatian but the "sharp cut" is placed "at the base of, or inside the Rhaetian" (i. e. the Zone with *Ch. marshi*) in the French and Russian wording of the conclusion the "faunistic cut" is only at the base of the Rhaetian stage.

The Kössen Beds in the West Carpathians and the problem of their stratigraphic division

The Kössen Beds in the West Carpathians as the only representative of the Rhaetian formation (G. Stache 1864) formerly assigned to the Liassic (G. Stache l. c.), afterwards considered as an independent formation between the Triassic and Liassic (D. Stur 1868, F. Hauer 1878) and at last, in the sense of C. W. Gumbel (1861), ranged to the Triassic (D. Stur 1871) as the only representative of the Rhaetian stage (V. Uhlig 1897), were always considered as one stratigraphically indivisible complex with a uniform fauna corresponding to the definition of the Rhaetian formation as "Beds with *Rhaetavicula contorta*", W. Goetel (1916, 1917) was of the same opinion, considering the Rhaetian stage (and so also the Kössen Beds termed Rhaetian by him) as the lowermost Liassic stage — the Infralias he declared: "Das Rhät lässt sich in der Tatra, wie überall, in keine Unterabteilungen zergliedern" (W. Goetel 1916, p. 187). Likewise also in the interpretation of the Kössen Beds as a representative of the Zone with *Choristoceras marshi* (= Rhaetian stage sensu E. T. Tozer 1967) as considered by H. Kozur (1971 c, p. 5; 1972 b, p. 388), they could not be divided more in detail by aid of conodonts. That is to say, they might just have assumed that stratigraphic interval, which was free of conodonts — the so called "Conodontenfreier Bereich" (H. Kozur 1972 a, b; H. Kozur — H. Mostler 1972 b, p. 795, H. Kozur — R. Moek 1972 a, p. 7). The opinion of W. Goetel (l. c.), similarly as that of his predecessors and followers can be understood quite well. To divide the Kössen Beds according to brachiopods and bivalvs is really very difficult if not imposible. *Rhaetavicula contorta* Portl., similarly also the bivalvs and brachiopods associated with this species, are found in the whole complex from the base to the top and beside that the assemblage of faunas is largely dependent on the facies (the most abundant occurrence of the species *Rhaetavicula contorta* (Portl.) is in the "Swabian facies", in the "Carpathian" and Kössen facies it is found only sporadically or totally missing (M. Kochanová 1967, p. 10, 33)). The view that conodonts are not found in the Kössen Beds of the West Carpathians is debatable on the other hand. This view has not resulted from the state of investigation of this complex but from uncritical accepting of the North American scale of conodont zones, the validity of which for the region of the Alps and West Carpathians should have been confirmed by the absence of conodonts in the Kössen Beds of the Krížna nappe near Valaská Belá (H. Kozur 1971 c, p. 5).⁴

All the data about conodonts from the Kössen Beds of the Alps (L. C. Mosher 1968) and West Carpathians (K. Budurov — J. Pevný 1970) contradicting to the North American conodont scale were categorically rejected, giving reasons that in the Alps an "incorrect stratigraphic assignment"⁵, in the West Carpathians "mistaken

⁴ „Aus... sehr „conodontenhöffigen“ rhätischen Kalken von Valaská Belá (Strážovská hornatina (Slowakei), die durch nichtmarinen „Karpätenkeuper“ unterlagert werden, konnten keinerlei Conodonten gefunden werden... Insgesamt wurden ca 50 kg „conodontenhöffige“ rhätische Kalke von verschiedenen Lokalitäten untersucht, ohne dass ein einziger Conodont gefunden wurde. Es ist daher kaum anzunehmen, dass die Conodonten die Nor/Rhät-Grenze überschritten haben...“ (H. Kozur 1971 c, p. 5).

⁵ H. Kozur 1971 c, p. 5: „Die rhätischen Conodonten, die L. C. Mosher (1968) aus den Alpen angibt, beruhen auf einer stratigraphischen Fehlenstufung der oberrhätischen Schichten... Dadurch erklärt sich auch die Tatsache, dass die weltweite einheitliche norische Conodontenfauna in Nordamerika an der Nor/Rhät-Grenze ausstirbt, während sie in den Alpen noch bis ins Unterhät reicht“.

samples"⁶ (H. Kozur 1971 c, p. 5; H. Kozur — H. Mostler 1972 b, p. 795) are concerned.

The occurrence of conodonts in the Kössen Beds was later confirmed by the find of the species *Spathognathus hernsteini* Mostler (J. Michalík 1973 a, b) but in spite of that the views of their presence are still differing.⁷ Therefore we have to mention the conodonts in the Kössen Beds a little more in detail.

The first to describe conodonts from the Kössen Beds of the Alps was L. C. Mosher (1968). He collected samples from the profile of Kendellbachgraben, described much in detail by E. Suess and E. Mojsisowics (1868) about hundred years ago. The samples were taken by him precisely according to feet indicated in the detailed profile of E. Suess and E. Mojsisowics (l. c., tab. 7) as follows:

- Fuss 140: Lower part of the Swabian facies with *Mytilus minutus*; *Cypriodella conflexa* n. sp., *Hindeodella suevica* (Fatio),
- Fuss 295: Higher part of the Swabian facies with *Gervillia inflata*, *Rhaeticicula contorta*; *Neospathognathus lanceolatus* n. sp.,
- Fuss 445: Carpathian facies with *Rhaetina gregaria*; *Neospathognathus lanceolatus* n. sp.,
- Fuss 653: Kössen facies with *Orycolpella orycolpos*; *Cypriodella delicatula* n. sp.,
- Fuss 708: Salzburg facies with *Choristoceras marshi* (above the "Hauptlager der *Choristoceras marshi*"), *Cypriodella delicatula* n. sp., *Neospathognathus lanceolatus* n. sp.

Beside that in the description of individual species L. C. Mosher (l. c.) mentioned on p. 920: "*Cypriodella delicatula* n. sp. — Specimens were encountered only in upper Noric and Rhaetic strata in Europe. *Cypriodella conflexa* n. sp. — This species was encountered in upper Scythic to Noric strata in both Europe and North America: On p. 930: "*Neospathognathus lanceolatus* n. sp. — This form is characteristic of upper Noric strata in Europe: "On the occurrence of conodonts in the Rhaetic stage (zone with *Choristoceras marshi*)" he writes on p. 905: "Conodonts are exceedingly rare but present in the Rhaetic sequence at Kendellbachgraben: only two formspecies, however, were encountered in the upper portion, *Cypriodella delicatula* n. sp. and *Neospathognathus lanceolatus* n. sp.:

It is evident from the above mentioned (similarly also from the stratigraphy in p. 906) that the lower part of the Kössen Beds (Swabian, Carpathian and Kössen facies) he assigned to the Norian stage and only the Salzburg facies he included in the Rhaetic stage and also proved the presence of conodonts in this facies. He also pointed at the difference between the Rhaetic stage of North America in which conodonts are missing and the Rhaetic stage of the Alps with still rare conodonts present.

⁶ H. Kozur 1971 c, p. 5: „*Gondolella navicula*, um die es sich hierbei offenbar handelt, nicht einmal im obersten Nor vorkommt („rhätische Fauna“ nach L. C. Mosher (1968), or still more convincing... „Dabei handelt es sich aber offensichtlich um Verunreinigungen, denn *Gondolella navicula* kommt weder in der -hernsteini-Assemblage-Zone noch in der darüber liegenden sehr armen Conodontenfauna des obersten Nor vor“ (H. Kozur — H. Mostler 1972 b, p. 795).

⁷ H. Kozur — R. Möck 1974 b, p. 247: „...die von Mosher (1968) angegebenen Conodonten könnten aus der *Choristoceras marshi*-Zone stammen, doch ist der genaue Fundpunkt nicht bekannt. Nach eigenen Untersuchungen treten die stratigraphisch jüngsten Conodonten in dem untersten Unterrhät auf“, but further on p. 248 they write: „Vorkommen: ... Oberrhät, ?Oberrhät Slowakei und Österreich“.

Somewhat different is the situation in the West Carpathians. K. Budurov and J. Pevný (1970) found the species ?*Gondolella navicula* Huckriede in the Kössen Beds near the community of Hybe but did neither figure it nor mention the precise site of the find. Doubts about occurrence of this species have followed in the first place — as I already mentioned — from the circumstance that the Kössen Beds in the West Carpathians were considered en bloc as sediment of the Zone with *Choristoceras marshi* (H. Kozur 1971 c, 1972 b) and in zone not only this species (referring to L. C. Mosher 1968 and his Rhaetian fauna) but any conodonts are not expected since still before the beginning of this zone they should have become extinct. In that time the possibility was not taken into consideration yet that the Kössen Beds could have started earlier than in the Rhaetian stage in some West Carpathian areas although indications for such a possibility were known already just at the locality of Hybe (*Rhaetites cf. rhaeticus* (Clark), D. Andrusov 1934). The occurrence of conodonts of the Kössen Beds was confirmed (H. Kozur — R. Moock 1973 a, J. Michalík 1973 a, b) but the doubts about the occurrence of the species *Gondolella navicula* remained, the more when it has turned out that in these beds the species *Misikella posthernsteini* Kozur et Moock is present, which is the only one to represent the assemblage-zone with *Misikella posthernsteini* (= Lower Rhaetian, H. Kozur — R. Moock 1974 b) here. The precise position of the beds corresponding to this zone is not known; nor the relation of this find to the beds with *Spathognathus hernsteini* is mentioned. Regardless of these unclarified questions (however, so important for stratigraphy) we may only state that in the Kössen Beds of the West Carpathians conodonts are present. In this regard the quotation is very remarkable that “*Misikella posthernsteini* Kozur et Moock has so far been found at numerous localities from Slovakia... also in the uppermost Sevatian” and even the possibility of the occurrence of this species in the “Upper Rhaetian of Slovakia” (H. Kozur — R. Moock 1974 b, p. 248)⁸ is being admitted. Whether these data are promising also for solution of the Kössen Beds problem is not known as neither localities, nor lithological units, nor on the basis of what the boundary between the “lower and upper” Rhaetian was established and which lithostratigraphical units or part of them are designated with the term Rhaetian are mentioned.

Establishing of the stratigraphic level of the Kössen Beds base is of an extraordinary importance in the West Carpathians. The Kössen Beds are present in several tectonic units and are lying on facially largely different beds. In the Choč nappe they are underlain by the Dachstein limestones or Hauptdolomit, in the Šturec nappe by the Hauptdolomit and in the Krížna nappe and in some Tatric areas (Štrážovská hornatina Mts.) by variegated beds of the Carpathian Keuper. Therefore the question is well-chosen whether in the given tectonic units the Kössen Beds base are lying at an equal or different stratigraphic level. As for the time being there are still very little paleontological data for its solution, we can so far mutually correlate, only the Kössen Beds from the most investigated areas, especially of the Choč nappe (locality of Hybe) and of the Krížna nappe (Tatras, Ružbachy Mesozoic).

⁸ „*Misikella posthernsteini* n. sp. wurde bisher in mehreren unterrhätischen Lokalitäten der Slowakei und der Alpen sowie vereinzelt auch im obersten Sevat gefunden“ (H. Kozur — R. Moock 1974 b, p. 248).

Kössen Beds of the Choč nappe, Hybe.

The Kössen Beds exposed at the right bank of the Biely Váh river south of the community of Hybe belong among these localities, which are mentioned nearly in every textbook or compilatory works as the only example of the so called Kössen facies of the Rhaetian stage in the West Carpathian region. The Kössen Beds are formed by a complex of dark banked limestones with layers of dark marly shales and marls about 40—50 cm thick, which is found in the overlier of typical Dachstein limestones with megalodonts. We do not know the original overlier of the Kössen Beds from this locality. They are intensely folded and their uppermost part (at the outcrop) is in tectonic contact with the dolomite considered as Hauptdolomit. To reconstruct the original bed sequence of tectonically so strongly affected beds is very difficult and unprecise. According to detailed lithological and paleontological investigations (not finished yet) the bed sequence is from bottom to top as follows (J. Michalík 1973 a, b):

1. Hauptdolomit.
2. Dachstein limestone: light-grey, compact, in places with gastropods and megalodonts.
3. Red marly limestone, grey organodetrital limestone, limestone breccias.
4. Light-coloured oolitic limestone with intercalations of light-grey limestone.
5. Dark oolitic limestone.
6. Dark crinoidal and grey lamachelle limestones.
7. Dark-grey fine-crinoidal biosparitic limestones.
8. Grey coral limestone.
9. Banks of grey organodetrital biosparitic to biomicritic limestone.
10. Rhythmically alternating dark marls and banked organodetrital limestones.

As Kössen Beds we designate here the beds no. 5 to 10. The fauna "typical for the Kössen facies" (W. Goetel 1917, M. Kochanová 1957) is mainly found in beds no. 6 to 10. The species *Rhaetavícula contorta* (Portl.) and *Austrihynchia cornigera* (Zugm.) present in it are quite rare and found from the base of beds no. 6 to the top of beds no. 10. The species *Oxycolpella oxycolpos* (Emm.) is mainly present in the higher part of beds no. 10 (J. Michalík 1973 b). Beside the fauna of brachiopods and lamellibranchs also Cephalopoda — *Rhaetites cf. rhaeticus* (Clark) (D. Andrusov 1934) and so far unidentified nautiloids (J. Michalík 1973 a, b) were found. From the microfauna of beds no. 10 foraminifers and ostracodes washed out from dark marls (J. Salaj — O. Jendrejáková 1967) and from conodonts *Spathognathus hirsteini* Mostler (J. Michalík 1973 a, p. 201, 241) are mentioned. Holothurian sclerites (without determination of species (J. Michalík 1973 b, H. Kozur — R. Moek 1973 a)) are also quoted. The conodonts *Gondolella navicula* Huckriede (K. Budurov — J. Pevný 1970, p. 170) and *Misikella posthernsteini* Kozur et Moek (H. Kozur — R. Moek 1974 b) are mentioned from "the Kössen Beds" but it is not known which part of the beds no. 5 to 10 is concerned.

The views on the age of the Kössen Beds of this locality have agreed so far. Already their discoverer G. Stache (1868) considered them as Kössen Beds with a Kössen facies and as such ones they have been accepted till now. A. Rhaetian age was generally ascribed to them and beginning with W. Goetel (1916, 1917) they were also designated as "Rhaetian in Kössen facies". To the Rhaetian stage they were also assigned when this stage was defined by the Zone with *Choristoceras marshi*

(H. Kozur 1971 c, 1972 b) only. The first change in their stratigraphic assignment appeared only after conodonts had been found, which in the sense of parallelization of the Zone with *Choristoceras marshi* with the "Conodontenfreier Bereich" were not expected in them (H. Kozur 1971 c, H. Kozur — H. Mostler 1972 b). Therefore the first find of conodonts, originally restricted only to the species *Gondolella navicula* Huckriede, was rejected (R. Moock 1971, p. 234; H. Kozur 1971 c, p. 5; H. Kozur — H. Mostler 1972 b, p. 795) and practically has been rejected till now (H. Kozur — R. Moock 1974 b), also in spite of that the age of the Kössen Beds near the community of Hybe is older than the Zone with *Choristoceras marshi*. The later find of the species *Spathognathus hernsteyni* Mostler (= *Neospathodus hernsteyni* (Mostler) in W. C. Sweet et al. (1972), (= *Misikella hernsteyni* Mostler) in H. Kozur — R. Moock (1974 a)) not only confirmed assignment of the Kössen Beds from this locality to the Sevatian (Zone with *Rhabdoceras suessi*, V. Kollárová — Andrusovová — J. Bystrický (1974) but defined their position within this substage with more precision to the "Assemblage zone with *Spathognathus hernsteyni* = middle part of the Upper Sevatian (H. Kozur — R. Moock 1973, p. 10). Recently the Kössen Beds near the community of Hybe are placed to the Rhactian again (sensu the Zone with *Rhaetavicula contorta*) and the age: "Unteres Unterrhät" is ascribed to them, giving reasons that the species *Misikella posthernsteyni* Kozur et Moock, an index species of the Zone with *Misikella posthernsteyni* present also in the basal layers of the Kössen Beds of the Alps, is found in them (H. Kozur — R. Moock 1974 b, p. 248).

As it is to be seen the views on the age of the Kössen Beds deduced from the conodont fauna are very contradictory. There are many obscurities, mainly because so far only the position of the beds containing *Spathognathus hernsteyni* (J. Michálik 1973 a, b) has been known, consequently of beds, in which according to H. Kozur and R. Moock (1973 a, p. 10 "...kommt eine Conodonten-Holothurien-Assoziation vor, wie sie für die -hernsteyni-Assemblage-Zone charakteristisch ist, die sich in ammonitenreichen Schichten mit dem höheren Sevat korrelieren lässt, aber niemals zur Obergrenze des nach Ammoniten eingestuften Sevat reicht (dazwischen liegt noch die post-hernsteyni-Fauna und ein conodontenfreier Bereich)".

The position of the beds with *Gondolella navicula* Huckriede as well as the position of the beds with *Misikella posthernsteyni* Kozur et Moock is not mentioned. The relation of the beds with the "Conodonten-Holothurien-Assoziation-hernsteyni-Assemblage-Zone" to the beds containing *Misikella posthernsteyni* Kozur et Moock also remained unclarified. In the latest work in which the definition of the Assemblage-zone with *Misikella posthernsteyni* is presented (H. Kozur — R. Moock 1974 b, p. 249) and its representation in the Kössen Beds near the community of Hybe stated the Assemblage-zone-hernsteyni is not mentioned any more. According to the statement of the named authors "...bisherige Rhät in der Slowakei... bleibt rhätisch" (H. Kozur — R. Moock 1974 b, p. 246) it might be concluded that the Assemblage-zone-hernsteyni, considered as a conodont zone of the uppermost Sevatian (equivalent of the ammonite zone of the *Cochloceras suessi*, H. Kozur 1973 b, p. 16) in the latest interpretation, is not present in the Kössen Beds near the community of Hybe. In this case the "Conodonten-Holothurien-Assoziation, wie sie für die -hernsteyni-Assemblage-Zone charakteristisch ist" must necessarily be identified with the Assemblage-zone with *Misikella posthernsteyni*.

From among the whole conodont assemblage characterizing the Assemblage-zone with *Misikella posthernsteyni* the index species of this zone is mentioned only. This

species, however, may be found already in the uppermost Sevatian, in the Assemblage-zone with *Misikella herustei* (H. Kozur — R. Moock 1974 b, p. 248). Without precise data on the occurrence of the fauna, which are unconditionally necessary in stratigraphy, consequently also the indication of the occurrence of *Misikella postherustei* Kozur et Moock is not more valuable than the rejected presence of the species ?*Gondolella navicula* Huckriede. Only theoretically, if we take account of the stratigraphic range of the conodont species mentioned from the Kössen Beds near Hybe, neither of them can be excluded. *Spathognathus herustei* Mostler (= *Misikella herustei* (Mostler) in H. Kozur — R. Moock 1974 a, for instance, is mentioned together with *Gondolella navicula* Huckriede from the Zlambach Beds of the Slovak Karst (R. Moock 1973). In the case of the Kössen Beds from the community of Hybe, however, a common occurrence of both these species has not been found in any combination. It is, however, a question, to what an extent one or a few samples may be considered as a suitable representative of the whole association of microorganisms of a certain layer (bank) or even of a whole complex. Generalization of isolated data, just applied here, may result in relevant errors in stratigraphic valuation of beds. An example of it can just the Kössen Beds of the West Carpathians, which were generally included in the Zone with *Choristoceras marshi* only because at one locality (Valaská Belá) or at a few localities conodonts were not found in them and even this fact was considered as a direct evidence that the conodonts had become extinct still before the Zone with *Choristoceras marshi* (H. Kozur 1971 c, p. 5—6).

As to conodonts, there are still always too little reliable data, which could enable us to divide or range stratigraphically the Kössen Beds "precisely, finely and unambiguously". The less when the species *Misikella postherustei* Kozur et Moock is not an evidence of their assignment to the "Unteres Unterhät" yet, it is namely also found in the Zone with *Choristoceras marshi* (L. Mosher 1968 sub *Neospathodus lanceolatus*, see H. Kozur — R. Moock 1974 b, p. 247).

On the basis of foraminifers the Kössen Beds near Hybe were assigned to the "Lower Rhaetian" (A. Gaździcki — K. Zawadzka 1973, p. 487, A. Gaździcki 1974, p. 77). In the given case it is better, however, to understand the term Rhaetian in a facial and not a stratigraphic sense. The authors of the division of the "Rhaetian" according to foraminifers keep to the terminology so far currently used in Carpathian literature. Assignment of the Kössen Beds near the community of Hybe to the "Lower Rhaetian" is justified by the absence of the zone with *Triasina hantkeni*, considered by J. Salaj (1969) and then also by A. Gaździcki (1974) as a "range zone" of the "Upper Rhaetian". It has not been considered whether this absence was caused by the facies. The foraminifers described so far come from a washing from dark marly shales (J. Salaj — O. Jendrejáková 1967). On the other hand, we have found out (J. Bystrický — O. Jendrejáková, in press) that the assemblage of foraminifers characterizing the "Zone with *Triasina hantkeni*", i. e. the common occurrence of the species *Glomospirella friedli*, *Glomospirella pokornyi* and *Triasina hantkeni* is present already in the basal banks of the Kössen Beds (i. e. in beds no. 5, on p. 188) and even also in the banks of the Dachstein limestone with megalodonts underlying them. In the sense of the foraminifer division of the "Rhaetian" near Hybe the "Lower Rhaetian Kössen Beds" are the direct overlier of the "Upper Rhaetian zone with *Triasina hantkeni*".

So as the first occurrence of the species *Triasina hantkeni* does not signify the beginning of the "Upper Rhaetian", so also the first occurrence of the species *Glomospirella friedli* and *Glomospirella pokornyi* cannot be considered as the beginning of the

"Lower Rhaetian". The onset of the mentioned species in the Kössen Beds of the Tatras is caused by a sudden change of facies (in the underlier of the Kössen Beds the Carpathian Keuper is present), whilst in the case of the Kössen Beds near Hybe, they start to appear already in the Dachstein limestones. Even the locus typicus of the species *Glomospirella pokornyi* (Sala j) is found in the Dachstein limestones in the railway-cut, thus at the left bank of the Biely Váh river (J. Sala j 1967, p. 128, in J. Sala j — A. Biely — J. Bystriek ý 1967).

The foraminifera are thus (at least according to the present-day state of knowledge) unsuitable not only for a more detailed division of the Kössen Beds but also for the division of the Rhaetian stage (*sensu* the Zone with *Rhaetavicula contorta*). Parallelization of the conodont zone with *Misikella postherustei* and of the foraminifer zone with *Glomospirella friedli* — *Glomospirella pokornyi* (H. Kozur — R. Moek 1974 b, p. 249) is not fitting according to the mentioned condition in the bed sequence.

Cephalopods are only seldom present in the Kössen Beds. The specimen of the *Rhaetites cf. rhaeticus* (Clark) found a longer time ago (D. Andrusov 1934), originally considered as a species of the Rhaetian stage, has turned out as a species characteristic for the Zone with *Rhabdoceras suessi* ("Bereich III—IV, Zone", J. Wiedmann 1972, p. 604) after a revision of the stratigraphic division of the Zlambach Beds, thus of a zone, which corresponds to the substage Sevatian in the sense of the orthostratigraphic scale of E. T. Tozer (1967) and according to the proposal of the definition of the Rhaetian stage of J. Wiedmann (l. c.) it should correspond to the middle part of the Rhaetian stage. This was also the reason why the Kössen Beds of this locality have been assigned to the Zone with *Rhabdoceras suessi* corresponding to the Sevatian substage (V. Kollárová — Andrusovová — J. Bystriek ý 1974).

As it was already mentioned, the underlier of the Kössen Beds near the community of Hybe are the Dachstein limestones with banks containing megalodonts in mass occurrence in places. The stratigraphic level of these limestones has not been sufficiently cleared up so far. R. Kettner (1927, p. 11) and J. Koutek (1927, p. 4) considering the Kössen Beds only as an intercalation in the Dachstein limestones, ascribed a Rhaetian age to them. M. Mahel (1964) and A. Biely (1960, p. 129) held the same opinion. In order to confirm the Rhaetian age of the Dachstein limestones, a fauna with *Zeilleria elliptica* (Zugm.), *Austrihyuchia cornigera* (Zugm.), *Placunopsis alpina* (Winkl.), *Placunopsis intusstriata* (Emmer) is mentioned (M. Mahel 1964, p. 89, M. Mahel — M. Kochanová 1964, p. 651), thus species present in the Zone with *Rhabdoceras suessi* (M. Ulrichs 1972). The relation of the Dachstein limestones to the Kössen Beds, however, is not so clear that the Kössen Beds could be considered as a larger lenticle within the Dachstein limestone only. Everywhere, as far as visible at the outcrops, the Kössen Beds are always overlying the Dachstein limestones and we could not confirm a lateral transition or wedging of these beds into the Dachstein limestones. Unfortunately, also in this case the place of the first find of the mentioned fauna is not indicated with more precision. If it comes from light-coloured and light-grey brecciated (pink spotted) limestones near the eastern border of the Kössen Beds, what is most probable, then the Dachstein limestones are concerned, which are separated from the Kössen Beds by a transversal fault.

From the microfauna of the Dachstein limestones we know mainly foraminifera so far. These, as already mentioned, are represented by an assemblage characteristic for the "Zone with *Triasina hantkeni*" (*sensu* J. Sala j 1969, A. Gažd z i c k i 1974).

The Kössen Beds of the Choč nappe near the community of Hybe can be unambiguously

assigned stratigraphically to the "Lower Rhaetian" neither by aid of foraminifers, nor by aid of conodonts from the Zone with *Misikella posthernsteini*. So far one can be based only on the species *Rhaetites cf. rhaeticus* (Clark), indicating the possibility of their competence to the Zone with *Rhabdoceras suessi*.

Kössen Beds of the Križna nappe

Unlike the Kössen Beds of the Choč nappe are those of the Križna nappe always the direct overlier of variegated shales and sandstones of the Carpathian Keuper. In the most area of the extension of this tectonic unit, beside common "typical Rhaetian" fossils (as such mainly *Rhaetina gregaria* (Suess), *Rhaetavicula contorta* (Portl) are considered), no other fossils have been found in them. The stratigraphic orientation is therefore mostly very difficult and as I have already mentioned, the absence of conodonts cannot be considered as an evidence that en bloc they are equivalent to the Zone with *Choristoceras marshi*, thus to the Rhaetian stage (sensu E. T. Tozer 1967).

In the Križna nappe of the Tatras and the so called Ružbachy Mesozoic (or also in the mountains of Humenské pohorie), however, banks of limestones with megalodonts are found in the Kössen Beds, not taken into consideration in their up to present stratigraphic valuation or their stratigraphic value was subordinate to the "foraminifer zones" (A. Gaździcki 1974). In the Tatry and the Ružbachy Mesozoic the Kössen Beds were considered as the only representative of the Rhaetian stage (sensu the Zone with *Rhaetavicula contorta*) and in this sense also their division into the "Lower" and "Upper" Rhaetian was understood (A. Gaździcki 1974). As I already mentioned, the division of the "Rhaetian" into the foraminifer "zones": "Zone with *Glomospirella friedli* and *Glomospirella pokornyi*", which has to correspond to the "Lower Rhaetian", and the "Zone with *Triasina hantkeni*", which has to represent the "Upper Rhaetian", at most may be considered as an attempt for a more detailed division of the Kössen Beds, which ended unsuccessfully. It has namely not been known whether the base of the Kössen Beds is at the same stratigraphic level here as that in the Alps and whether both ammonite zones are present in them — the Zone with *Rhabdoceras suessi* and the Zone with *Choristoceras marshi* as it is the case in the Alps, or only one of them. I have also mentioned that *Triasina hantkeni* Majzón is found near the community of Hybe in basal banks of the Kössen Beds and in the Dachstein limestones underlying them. We also know this species from the Dachstein limestones with megalodonts, which in the Strážov nappe of the Malé Karpaty Mts. (partial nappe of Havranica) are the underlier of grey limestones containing a "Rhaetian fauna" (M. Kochanová 1967, p. 12, localities no. 11, 12, 13; M. Mahel 1967, p. 97). As the species *Triasina hantkeni* is not an index species, even not for the Rhaetian stage sensu the Zone with *Rhaetavicula contorta* (according to E. Végé — Neubrant 1972, p. 120 it is present in the Norian as well as Rhaetian stage), no importance of an index fossil for the "Upper Rhaetian" can be ascribed to it.

For valuation of the stratigraphic level of the Kössen Beds base thus megalodonts come into consideration. In the area of the Tatras the following species have been found: *Conchodon infraliassicus* Stopp., *Conchodon goeteli* Gaźdz., *Rhaetomegalodon incisus* (Frech), *Rhaetomegalodon taticus* Gaźdz. (A. Gaździcki 1974) and in the Ružbachy Mesozoic only *Conchodon infraliassicus* (Stopp.) (M. Kochanová 1967, p. 77 sub *Megalodon* (*Lycodus*) *cor* (Scharf.)) According to W. Goetel (1917) and A. Gaździcki (1974) the megalodonts of the mentioned genera start to

Foraminifera of the Dachstein limestones and Kössen Beds near the community of Hybe

	Dachstein limestone, with megalodonts	Dachstein limestone, railway cut	Köss, Beds	
			Dark calcitic lime- stone of bed no. 5	Dark shales of bed no. 10
According to: SALAJ, J. — JENDREJÁKOVÁ, O. (1967), SALAJ, J. 1967 (in SALAJ, J. — BIELY, A. — BYSTRICKÝ, J. 1967), JENDRE- JÁKOVÁ, O. 1974 (in BYSTRICKÝ, J., JEN- DREJÁKOVÁ, O., in press)				
<i>Hyperammina stabilis</i> KRIST.-TOLL.				+
<i>Nodosaria aphleloecula alabra</i> KRIST.-TOLL.				+
<i>Nodosaria pupiformis</i> TERQ.				+
<i>Dentalina obsoleta</i> SCHWAGER				+
<i>Margulina solida</i> TERQ.				+
<i>Lenticulina polygonata</i> (FRANKE)				+
<i>Astaculus manutina informis</i> (SCHWAGER)				+
<i>Astaculus pediaca</i> (TAPPAN)				+
<i>Astaculus inoisisita</i> (TERQ.)				+
<i>Falsopalnulla</i> aff. <i>arignota</i> KRIST.-TOLL.				+
<i>Frondicularia rhaetica</i> KRIST.-TOLL.				+
<i>Lenticulina subquadrata</i> (TERQ.)				+
<i>Austrocolomia marshali</i> OBERH.				+
<i>Frondicularia gerkei</i> KRIST.-TOLL.				+
<i>Marginulina solida</i> TERQ.				+
<i>Glomospira</i> sp.			+	+
<i>Glomospirella friedli</i> KRIST.-TOLL.		+	+	
<i>Glomospirella pokornyi</i> (SALAJ)	+	+		
<i>Involutina sinuosa sinuosa</i> (WEYNSCH.)	+			
<i>Involutina sinuosa pragsoides</i> (OBERH.)	+			
<i>Involutina sinuosa oberhauseri</i> (SALAJ)	+			
<i>Involutina tenuis</i> (KRISTAN)		+	+	
<i>Involutina impressa</i> (KRIST.-TOLL.)		+		
<i>Involutina minuta</i> KOEHN-ZANN.		+		
<i>Involutina tumida</i> (KRIST.-TOLL.)	+	+	+	
<i>Involutina communis</i> (KRISTAN)	+			
<i>Nodosaria ordinata</i> TRIFANOVA		+		
<i>Ophthalmidium triadicum</i> (KRISTAN)		+		
<i>Planinvoluta deflexa</i> LEISCHNER		+	+	
<i>Trocholina permodiscoides</i> OBERH.	+		+	
<i>Trocholina acuta</i> OBERH.	+			
<i>Tolypammina</i> sp.				
<i>Triasina hantkeni</i> MAJZON		+		
<i>Triasina</i> aff. <i>hantkeni</i> MAJZON			+	
<i>Triasina oberhauseri</i> KOEHN-ZANN. et BRÖNN. ¹	+			

Note¹ SALAJ, J. 1967 (in SALAJ, J. — BIELY, A. — BYSTRICKÝ, J. sub *Triasina hantkeni* MAJZON, see SALAJ, J. 1974 — VI. Congr. Africain de Micropaléontologie, Tunis 1974).

appear already in banks almost at the base of the Kössen Beds and are also found at their top. Thus they include both "foraminifer zones of the Rhaetian".

Megalodonts of the genera *Conchodon* and *Rhaetomegalodon*, however, are characteristic for the uppermost part of the Rhaetian stage of the Southern Alps (A. Alías i-naz 1962, p. 321: "Zone IV — Assemblage zone with *Conchodon*, *Megalodon*"), of the Hungarian Midmountains (É. Végli — Neubrant 1972, p. 118) and of the Eastern Alps (H. Zapfe 1964, p. 283). I think, we do not make a great mistake if we shall parallelize the Kössen Beds of the Tatras and the Ružbachy Mesozoic, containing banks with these megalodonts, with the uppermost Rhaetian of the mentioned regions. Whether we may ascribe this stratigraphic level to the Kössen Beds of the whole Križna nappe, cannot be said so far. Assignment of the Kössen Beds to the "Upper Rhaetian" (approximately to the Zone with *Choristoceras marshi*) is probable, also because in the uppermost part of the Carpathian Keuper, thus in the direct underlier of the Kössen Beds, M. Limanowski (1903, p. 172—193) found a macroflora, which is supposed to be identical with the macroflora of the Tomanowa Beds. According to M. Raci-borski (1891) the macroflora of the Tomanowa Beds is considered as "Lower Rhaetian" (sensu the Zone with *Rhaetavicula contorta*).

Conclusions

The term "Rhaetian" as a term of chronostratigraphic category cannot be used as a name of a lithostratigraphic unit. I suggest to term the complex designated by D. Stur (1859b) as "dark to black facies of Kössen Beds" (including the Swabian, Carpathian and Kössen facies in the sensu of E. Suess (in E. Suess — E. Mojsi-sovichs 1868)), as Kössen Beds.

The stratigraphic level of the Kössen Beds base is not possible to establish for the time being, neither according to foraminifers, nor according to conodonts. The species *Triasina hantkeni* Majzon (index species of the "Zone with *Triasina hantkeni*" sensu J. Salaj (1969) and A. Gaździcki (1974) is not only restricted to the higher part of the Kössen Beds (= "Upper Rhaetian" sensu J. Salaj [l. c.] and A. Gaździcki [l. c.]) but also found in the direct underlier of the Kössen Beds (probably Sevatian to Middle Norian). The species *Misikella posthernsteini* Kozur et Mock as the only conodont species representing the Zone with *Misikella post-hernsteini* in the Kössen Beds near the community of Hybe cannot be considered as a convincing evidence of their age: "Unteres Untererhät" since this species is known also from the Zone with *Misikella hernsteini* (= uppermost Sevatian, sensu H. Kozur 1973b), also from the Zone with *Choristoceras marshi*. We suppose, however, that the Kössen Beds near the community of Hybe started earlier (as early as the Zone with *Rhabdoceras suessi*) than the Kössen Beds of the Križna nappe in the Tatras (nearly as late as the Zone with *Choristoceras marshi*). Whether these differences in the stratigraphic level of the Kössen Beds base correspond to the individual facial areas of the Upper Triassic (i. e. to the tectonic units) or are a local phenomenon resulting from the morphology of the area before the sedimentation of the Kössen Beds will be shown with further stratigraphic investigation.

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