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ABSTRACT

The Longmen Shan region of NW Sichuan is known for its sections of fossiliferous marine Triassic strata. The Upper Triassic Tianjingshan and Maantang Formations, which have been studied in this investigation, have yielded rich foraminiferal faunas obtained from samples taken along the railway and River Mianyuan between Hanwang and Xiejunmen in the Mianzhu District (N 31° 22', E 104° 11'), Sichuan Province, Central China. One hundred thirty species of Foraminifera are documented by the present authors and some of them are illustrated with over 50 photographs of thin-sectioned specimens and stereo-scanning electron micrographs. The samples have been dated to the Carnian, Norian, and Rhaetian. Comparisons have been made between the Mianzhu fauna and faunas from corresponding stratigraphical levels elsewhere in Asia, New Zealand, Europe, North America and N Africa. A foraminiferal zonation is proposed for the Upper Triassic in Mianzhu and palaeoenvironmental interpretations are made.

KEY WORDS: Upper Triassic, lithostratigraphy, biostratigraphy, Foraminifera, Sichuan, China.

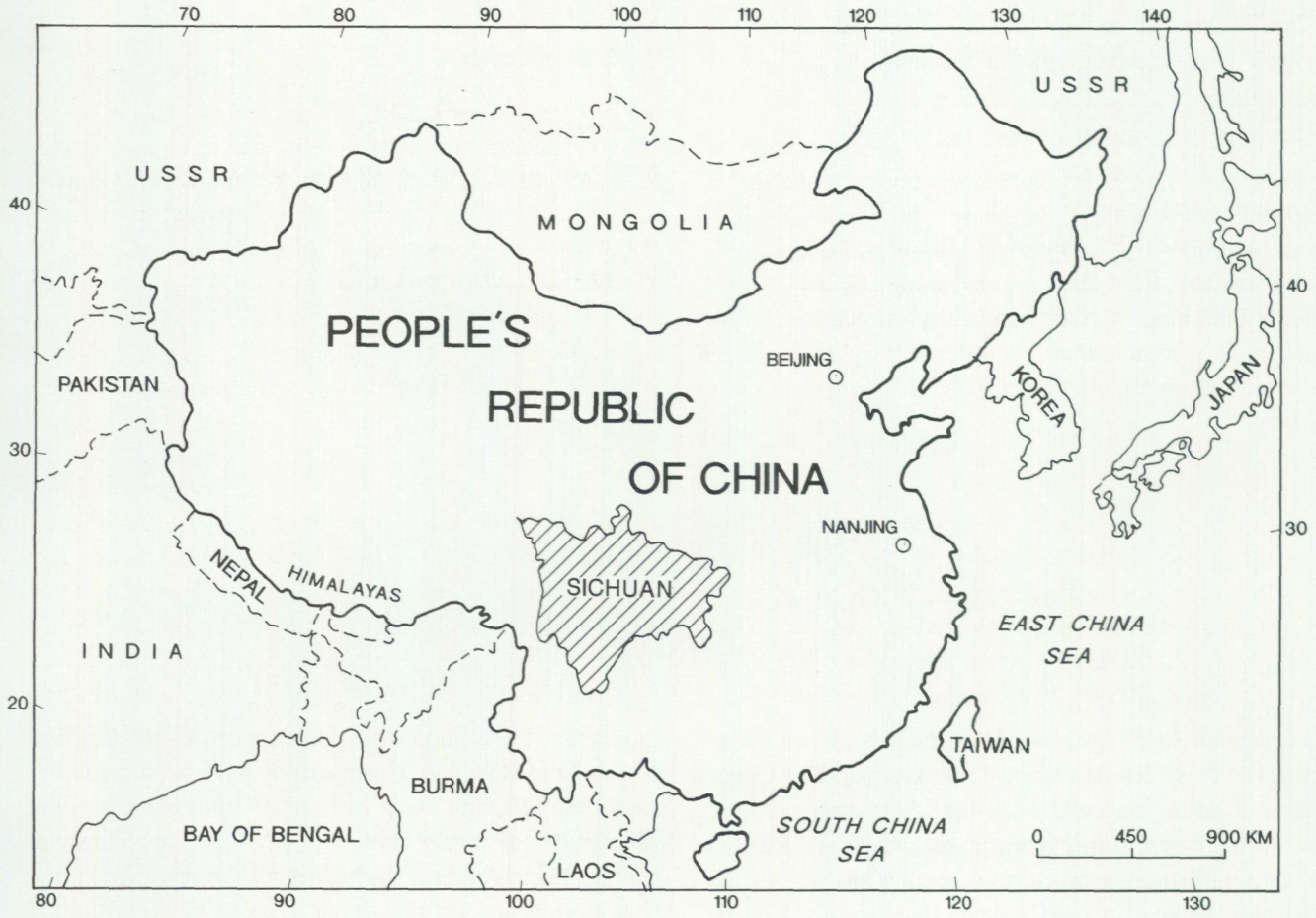

Fig. 1. Location of the Sichuan Province.

Introduction

In the Sichuan Province marine deposits of Late Triassic age have a wide distribution. In the western part of the Red Basin, also known as the Sichuan Basin, they are covered by thick Jurassic and Cretaceous deposits, mainly of continental origin. Along the border of this basin there are, however, frequent outcrops of marine Triassic strata, among which the Upper Triassic ones are fairly well developed in the western part. This is especially true of the Longmen Shan region in NW Sichuan, which is a most important area for the study of Late Triassic marine faunas and the Triassic stratigraphy of China.

The objective of the present investigation is to improve the knowledge of the litho- and biostratigraphy of the Upper Triassic Tianjingshan and Maantang Formations in the Mianzhu District, NW Sichuan. From the foraminiferal species found in the investigation, a new biostratigraphical subdivision for the Upper Triassic sequences of the area is proposed, and the foraminiferal faunas in this region are compared with those of contemporary age from other parts of the world, i.e. the Carpathians, the Tatra Mountains, the eastern Alps, Hungary, Caucasus, Turkey, N. Africa, Alaska and New Zealand. The foraminiferal and microfacies analysis of characteristic rocks are also used for palaeoecological interpretations. Most of the material studied originates from the Maantang Formation (11 sampling levels covering the major part, except for the basal layers). The Upper Triassic of Mianzhu is marine throughout the succession with the exception of the uppermost part, which belongs to the continental Rhaetian.

OUTLINE OF THE TRIASSIC PALAEOGEOGRAPHY OF CHINA

The brief palaeogeographic presentation below is mainly taken from Wang Hongzhen (1985).

Early and Middle Triassic palaeogeography of China has much in common with that of the Late Permian. The northern part of China belonged to Laurasia. Lacustrine clastic sediments were deposited in the Junggarian Inland Basin (NW China), as well as in the Shansi and Shaanxi Provinces of N China. In the NE, the Yanbei Mountains constituted an east-west trending barrier during the Early Triassic, which gave rise to different sedimentary types in the north and south China. In the Middle Triassic the Northeast China Highland was formed by continuous collision and compression within the Suolon-Xar Moron Zone (early Indosinian tectonic events, Fig. 2).

In Triassic times the southern part of China mainly belonged to the Tethyan Sea, but was influenced by Arctic-Pacific marine transgressions in the Early Triassic. A major part of the Tethys was then situated between the Himalayas and the Qiangtang massifs. Fossil records indicate that the Yarlung Zangbo Zone might have formed a boundary separating a southern Tethyan faunal province from a northern Tethyan one. Sea-floor spreading of considerable magnitude occurred along the Jinsha–Tengtiao Zone in western Sichuan and western Yunnan. This resulted in the formation of the Songpan–Garze Sea Trough in the east. In the Early and Middle Triassic the Yangtze Sea was mainly a shallow carbonate platform surrounded by deeper-water basins. Widespread evaporitic deposits were formed as a result of frequent transgressions and regressions during arid climatic conditions (Fig. 2). In Early Triassic times the Hunan-Guangxi region formed an open sea, which successively grew deeper and was finally connected with the Youjiang Trough in the Middle Triassic.

In the southeast a hilly land came into existence early in the Triassic, which supplied adjacent depressions with terrigenous detritus as it expanded during the Middle Triassic. Most likely, this led to the formation of onshore basins in the Lower Yangtze region. The arenaceous, argillaceous and silicious deposits recorded from faulted troughs in the coastal regions of Fujian and Guangdong may indicate the approximate position of a Variscan–Indosinian miogeosyncline. The Taiwan sea trough and the subduction zone to the east of it probably remained unchanged from the Permian throughout the Triassic Period. Early Indosinian movements (Middle Triassic) and the Ladinian marine regression resulted in major changes in the tectonic style and the palaeogeographical pattern of China. As the Yangtze Platform was already connected with northern landmasses to form a continent, the Quinling region had become a high mountainous land acting as a barrier between a southern and a northern floral province since Late Triassic times (Wang Hongzhen, 1985).

In a recent paper, Wang Naiwen (1989) gives an interpretation of the palaeoclimatology of China with reference to its plate tectonic implications. The palaeoclimatic zones of China during Middle Triassic – Middle Jurassic times are given in the inset map in Fig. 2. According to Wang Naiwen (1989), a northward drifting of North China regions resulted in a climatic cooling. The presence of Boreal or Arctic-Pacific biotas in the Heilongjiang Province in northeasternmost China indicates the ecoclimatic assignment of this region to the northern subfrigid zone. As for south China, firmly located in the tropic zone, the northward drifting from the Middle Triassic onwards had transferred this region to the northern subtropic zone, characterized by arid conditions. An exception is the condition during

the Late Triassic, when a humid climate prevailed. The ecoclimatic conditions of the Changtang–Sanjiang block appeared to be similar to those of South China. North Tibet and the Himalayas experienced most remarkable warming during Middle Triassic – Middle Jurassic times as a result of transformation to the tropic and the southern warm temperate zones, respectively. Wang Naiwen (1989) points out the possible absence of the southern subtropic zone between the tropic zone of North Tibet and the warm-temperate one of the Himalayas. He interprets this phenomenon as due to subsequent crustal shortening and a long-distance separation of North Tibet and the Himalayas at that time.

According to Wang Naiwen (1989), the transformation of South China from the Early Permian tropic ecoclimatic environment to the Mid Triassic – Mid Jurassic subtropic type (Fig. 2), illustrates its northward drift for a longitudinal distance, roughly equal to the width of a single climatic zone.

MARINE TRIASSIC DEPOSITS

Marine Triassic deposits are widely distributed over a vast area south of a line through the Kunlun Mountains – Qinling Mountains (Fig. 2). Lower Triassic strata are recorded from many provinces. To a major extent they comprise carbonate sediments. Towards the west within the area of its distribution, the Lower Triassic is rich in dolomitic rocks. Argillaceous deposits are especially frequent in the lower part of the succession.

In Anisian times the Triassic sea began to retreat from the eastern provinces. In the east it resulted in deposition of alternating marine and continental sediments, whereas in the western provinces marine pelagic and reef facies deposits predominated. A regressive phase persisted in Ladinian times not only in the eastern provinces, where a marine influence was most limited, but also in the west. Ladinian marine strata have a more restricted distribution in SW China. They comprise both clastic and calcareous rocks (Yin Hongfu 1982). In the Sichuan province Ladinian limestones are often rich in siliceous nodules.

Marine deposits of Late Triassic age only occur in western China, viz. in Qinghai and further towards the southwest. Carnian deposits include limestones, marls and clastic rocks, whereas Norian strata mainly comprise clastic rocks with carbonate intercalations in some areas, and predominating limestones and marls in other areas.

The Norian clastic rocks are mainly marine, but plant-bearing continental beds have also been recorded (Yin Hongfu 1982). There has been much debate in China concerning the presence of marine strata corresponding to the Rhaetian Stage. Some ammonite researchers have argued that alleged Rhaetian strata in China actually are equivalent to the Upper Norian. Certain bivalves and Foraminifera, which are restricted to the Rhaetian in W Europe, however, have actually been recorded from the uppermost Triassic in SW China. Evidence for the presence of marine Rhaetian in Sichuan will be presented in a following section (p. 11).

In applied geology reports, in geological maps and accompaning descriptions, various exploration project reports etc., marine deposits containing "Rhaetian fossils" are grouped together with Upper Norian strata for lithostratigraphical reasons, whereas continental, plant-bearing deposits from the upper part of the Triassic are tentatively referred to the Rhaetian. It is of obvious importance to improve the knowledge, subdivision and definitions of Chinese Upper Triassic stratigraphy.

THE TRIASSIC OF SICHUAN

In the Sichuan Province (Fig. 1) marine Triassic deposits are mainly exposed along the border of a great basin, the Sichuan Basin (or Red Basin). In the very basin, Triassic strata are essentially covered by thick Jurassic and Cretaceous deposits of continental origin. Marine Triassic strata are also exposed in some of the anticlines of the basin. Thick Triassic deposits also occur in the western Sichuan Plateau, where they are more or less metamorphosed. In the western part of the Sichuan Basin, marine Triassic deposits are fairly well developed. This is especially true of the Longmen Shan region in NW Sichuan, which has been regarded as one of the most important areas for the study of Triassic fossil faunas and for the Triassic stratigraphy of China. In the eastern part of the Sichuan Basin, marine beds of Anisian age only have been recorded.

The chrono- and lithostratigraphical subdivision of the Triassic in Sichuan is given in Fig. 4. The Jialingjiang Formation *sensu stricto* corresponds to the lower part of the previously used lithostratigraphical unit known as the "Jialingjiang Limestone", whereas the Leikoupo Formation forms the upper part of the same "Jialingjiang Limestone". Based on ammonite records the two formations can be referred to the Lower Triassic, and the Middle Triassic respectively (Fig. 4)

UPPER TRIASSIC STRATIGRAPHY OF SICHUAN

The Tianjingshan Formation, which generally comprises greyish-white, massive limestones with intercalations of yellow mudstones and oolithic limestones, is widely distributed along the southern slope of the Longmen Mountains. It has been referred to the Carnian Stage (He Yan 1979).

The Kuahongdong Formation has somewhat different facies in different parts of the Sichuan Province (Fig. 4). In its type area in SW Sichuan carbonate facies predominates, in the NW part of the province the influx of clastic material

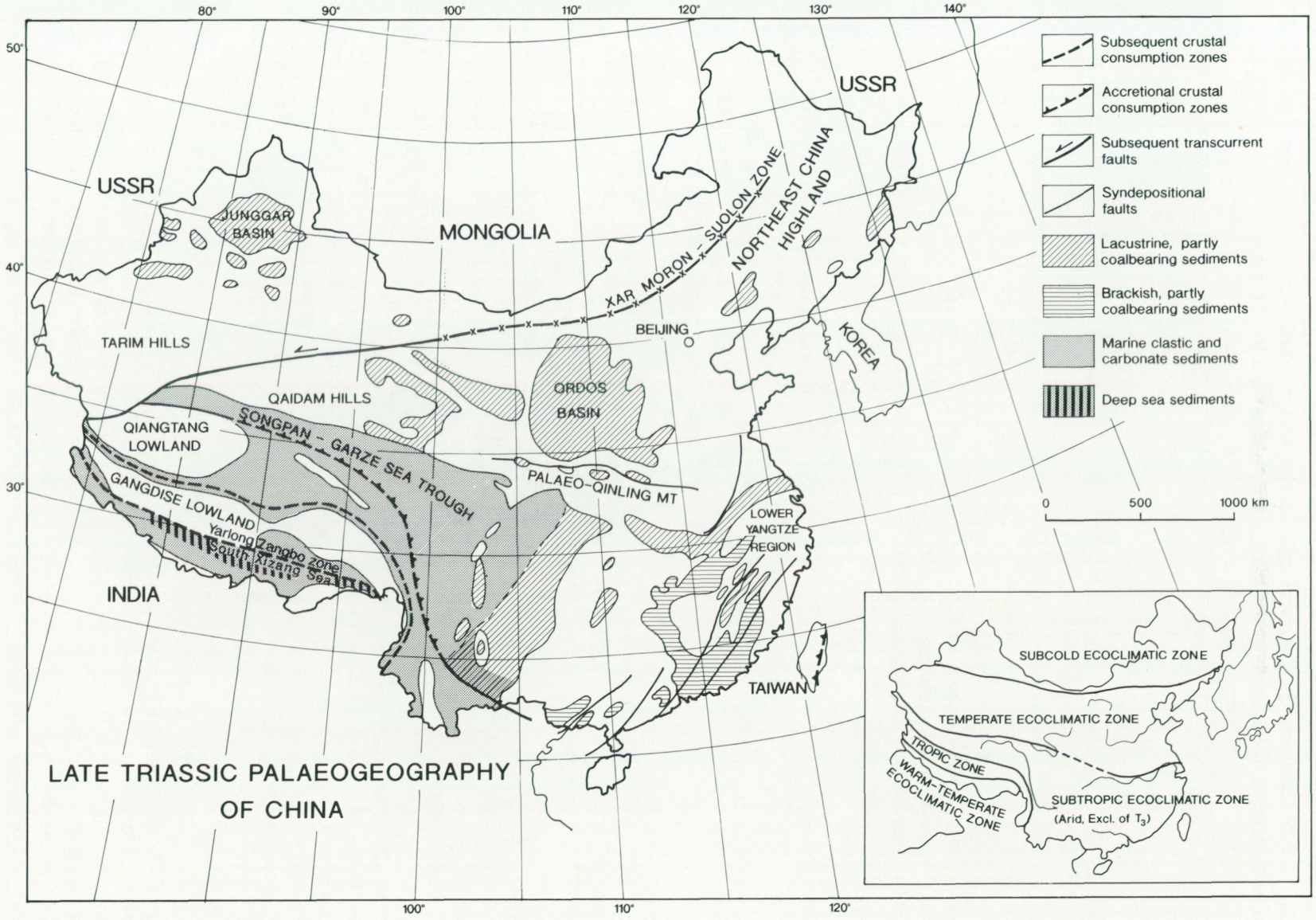

Fig. 2. Upper Triassic palaeogeography of China (after Wang Hongzhen et al. 1985). Inset map shows climatic zones of China in Middle Triassic-Middle Jurassic times (after Wang Naiwen 1989).

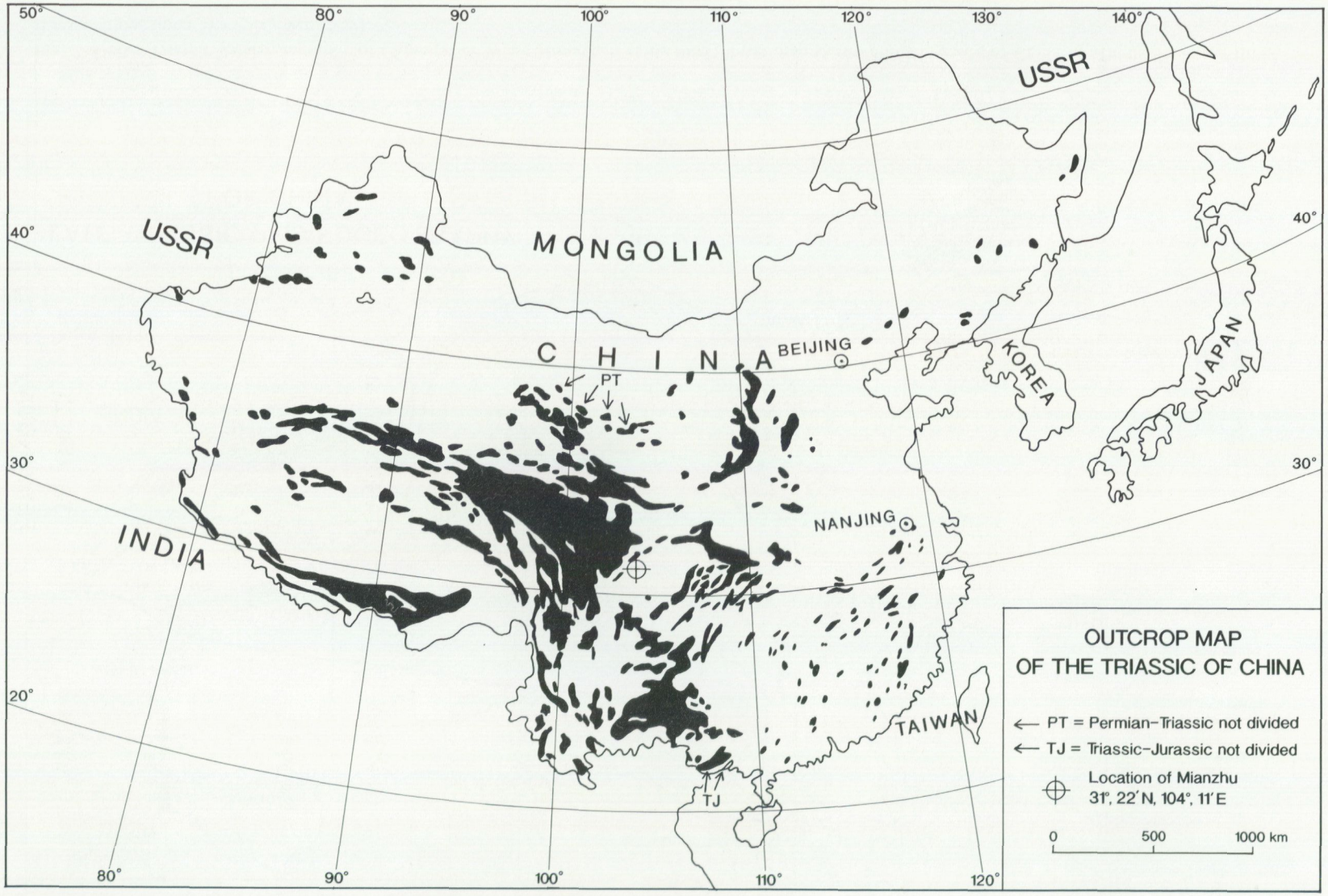

Fig. 3. Outcrop map of the Triassic of China (after Wang Hongzhen senior ed., 1985).

is important. According to He Yan (1979) this formation has yielded a foraminiferal fauna indicating an Early Norian age. Among the species obtained, she mentions *Variostoma helicta, Trocholina laevis, Trocholina multispira,* and *Involutina tenuis*. With partly Carnian-Norian, partly Norian-Rhaetian stratigraphical ranges the fauna as a whole indicates a Norian age as stated by He Yan. To be noted is, however, that in the European Alps *T. multispira* has been recorded from Carnian strata only (Oravecz-Scheffer pers. com.). The Maantang Formation (Figs. 4, 5) is composed of hard limestones, partly oolithic in its major lower part, and by grey, bedded limestones with intercalations of calcareous shales succeeded by a sequence of alternating, thin-bedded muddy siltstones and calcareous shales in its upper part. Above the Maantang Formation continental Rhaetian deposits follow (Fig. 5).

In the type section of the Maantang Formation at Jiangyou some 90 km NE of Mianzhu, *Triasina hantkeni* has been found. This foraminiferal species is regarded as an excellent index fossil of the Rhaetian. It was originally described by Majzon (1954) from the Dachstein Limestone Formation in N Bakony, Hungary. The finds from Jiangyou have been described by He Yan (1979). The present study supports a Rhaetian age for the uppermost part of the Maantang Formation. The major part of this lithostratigraphical unit is, however, of Norian age (Fig. 5).

The Rhaetian of western Sichuan includes another two formations, viz. Xiaotangzi and Xujiahe Formations, both representing continental deposits (Fig. 4). The latter one is also present in the eastern part of the province. In eastern Sichuan a major part of the Triassic, including Lower Triassic and lower Middle Triassic strata, is of marine origin.

TRIASSIC STRATIGRAPHY OF SICHUAN, CHINA

CHRONOSTRATIGRAPHICAL SUBDIVISION		LITHOSTRATIGRAPHICAL SUBDIVISION (FORMATIONS)	
SERIES	STAGES	WESTERN SICHUAN	EASTERN SICHUAN
UPPER TRIASSIC	RHAETIAN	XUJIAHE	XUJIAHE
		XIAOTANGZI	MISSING
	NORIAN	MAANTANG CLASTIC FACIES / KUAHONGDONG CARBONATE FACIES	
	CARNIAN	TIANJINGSHAN	
MIDDLE TRIASSIC	LADINIAN	HUANGLIANGQIAO	
	ANISIAN	LEIKOUPO	LEIKOUPO
LOWER TRIASSIC	SCYTHIAN	JIALINGIANG TONGJIEZI FEIXIANGUAN	JIALINGJIANG
			FEIXIANGUANG

Fig. 4. Stratigraphical subdivision of the Triassic succession in Sichuan.

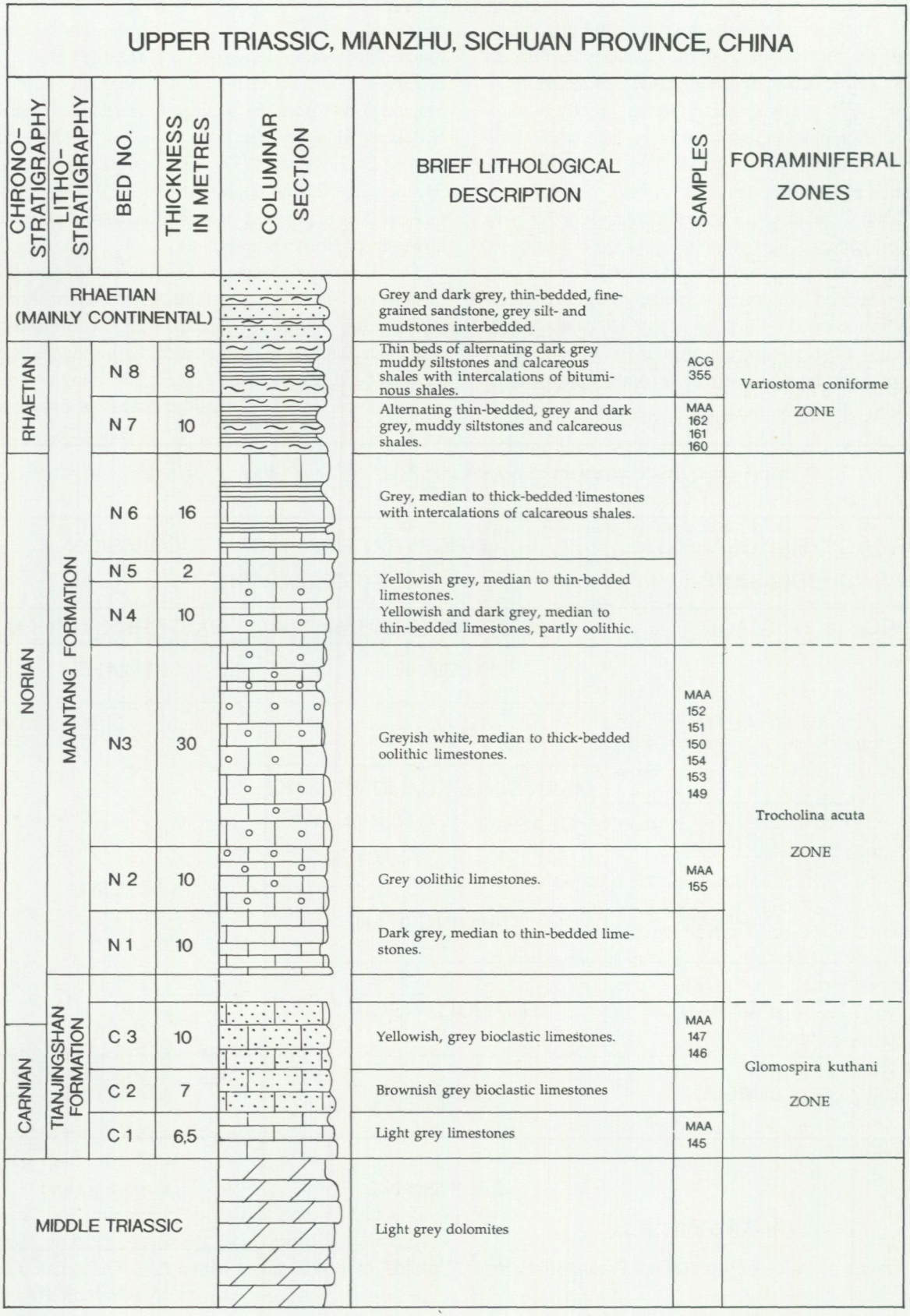

Fig. 5. Lithologic column and stratigraphy of the Upper Triassic stratum, Tianjingshan and Maantang Formations (Bed C1-N8), from the Glomospira kuthani Zone to the Variostoma coniforme Zone.

Foraminifera

PREVIOUS FORAMINIFERAL RESEARCH

He Yan was the first to publish on Triassic Foraminifera from Sichuan (Ho Yen 1959). The major part of the fauna studied by her was obtained from hard dolomites and dolomitic limestones of the Jialingjiang Limestone (p. 9, Fig. 4), which meant that the fauna had to be examined in thin sections. Recent papers on this topic have been published by He Yan (1980, 1981), He Yan & Yue Zhilan (1988), Sun Yuxian & Fu Yingqi (1980), and Wang Naiwen (1985, 1986). In his 1985 paper Wang Naiwen proposed a biostratigraphical subdivision of the Triassic foraminifer-bearing strata into 13 assemblage zones, ranging from the Early Triassic into the Norian Stage of the Late Triassic. There are two zones for the Early Triassic (Scythian), two for the Middle Triassic (one each for Anisian and Ladinian), and nine zones for the Late Triassic (Carnian 4, Norian 5). Apart from three zones corresponding to the Ladinian and Early Carnian, Wang Naiwen (1985, p. 51) correlated the foraminiferal assemblage zones with ammonite zones. As to the Scythian–Norian interval of the Sichuan Triassic, Wang Naiwen (1985) has also correlated his zones with those of Salaj (1978) from the Triassic of Chechoslavakia. Foraminiferal assemblages corresponding to Salaj's three zones of the Rhaetian, however, have not been obtained by Wang Naiwen. As pointed out by the present authors (p. 9), however, *Triasina hantkeni*, denominator of Salaj's uppermost foraminiferal zone of the Rhaetian, has actually been obtained from the Maantang Formation in Jiangyou. The same is true of species such as *Variostoma coniforme, Trocholina eduardi, Falsopalmula arignota*, and other Rhaetian forms occurring along with several forms which have not been recorded from pre-Rhaetian strata.

Wang Naiwen's (1985) foraminiferal zonation has mainly been based on studies of Foraminifera in thin-sections. Attempts have shown that it is very difficult to compare foraminiferal assemblages, e.g. from the Upper Triassic of Hanwang of Mianzhu, with Wang's zonal Foraminifera identified in thin-sections only.

A new foraminiferal zonation for the Upper Triassic is proposed in this paper.

MATERIAL AND METHODS

A prolific fauna of fairly well preserved Foraminifera has been obtained from dark mudstones in the Maantang Formation at Qingyangou, Hanwang, Mianzhu County (Figs. 3, 6).

This material, marked ACG 355, was collected in 1970 by Professor Chen Chu-zhen and collaborators, Nanjing Institute of Geology and Palaeontology, Academia Sinica and was made available for this investgation.

The material listed below was collected in 1978 by one of the present authors, He Yan, together with Duan Wei-Wu and other geologists from the Petroleum Geological Bureau of SW China. The locations of the sampling localities are given in Fig. 6.

Maa 145 – Maa 147. Samples are from a limestone interval of the Tianjingshan Formation, exposed between Guanyinyan and Xiejunmen, north of Hanwang.

Maa 149, Maa 150. Samples were collected from oolitic limestones of the Maantang Formation outcropping near the Xiaoemei railway tunnel in the Shuguang coal mine, Hangwang.

Maa 151, Maa 152. Samples were collected from bioherm limestone, Maantang Formation, collected in an exposed section on the Mianyuan River, near Guanyinyan, Hangwang.

Maa 153 – Maa 155. Samples were taken from the Maantang Formation, collected in a gully near the Xiaoemei railway tunnel in Hanwang.

Maa 160 – Maa 162. Samples were collected from dark grey mudstone, Maantang Formation at Qingyangou, Hanwang (rich in well-preserved Foraminifera).

Thin-sections were made from hard limestone samples. Samples from softer rocks were disaggregated by washing and sieving, using a standard micropalaeontological technique (Brasier 1980). The entire sample available was used. The dried residues were then scanned on a picking tray, and the Foraminifera were separated from mineral grains and placed in slides for microscopic examination in transmitted light.

For the study of internal microstructures of foraminiferal tests, some representative and well-preserved specimens were sectioned.

The micrographs, sectioned Foraminifera and various microfacies characteristics of the Upper Triassic succession studied, have been taken with a Leitz Orthoplan photo microscope, the scanning micrographs with a Philips Stereoscanning Microscope.

The foraminiferal material is the property of Nanjing Institute of Geology and Palaeontology, Academia Sinica, where the collection is stored.

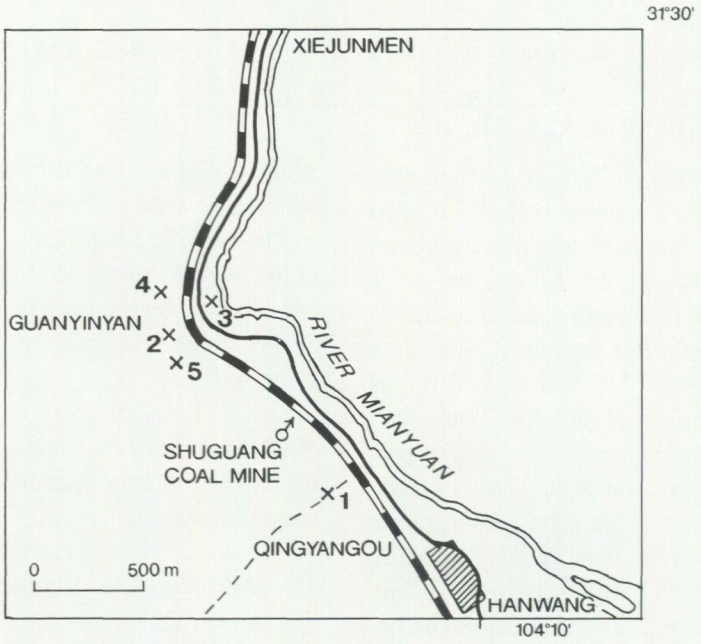

Fig. 6. Sampling localities in the Hanwang-Xiejunmen region: 1) Qingyangou, 2) Section near Xiaoemei railway tunnel, 3) Bioherm limestone unit on River Mianyan, 4) Gully near Xiaoemei railway tunnel (samples from outcrop section between Guanyinyan and Xiejunmen), and 5) Sampling site in section near Guanyinyan.

FORAMINIFERAL CONTENT

All of the 14 samples studied have yielded Foraminifera. The variation in the number of taxa per sample is great. A few samples contained 2–3 taxa only, whereas the two richest ones contained 45 and 63 taxa, respectively. The total number of taxa identified is 130. A complete list of foraminiferal species (and non-specified forms referred to different genera) is shown in Fig. 12.

In Fig. 7, histograms illustrate the number of species within the different foraminiferal families represented in the material studied. With few exceptions the classification by Loeblich & Tappan (1988) is applied. In the samples from the Tianjingshan Formation (Fig. 5) involutinid taxa dominate along with ammodiscid, verneuilinid and ophthalmidid Foraminifera, whereas nodosariids are very rare (Fig. 7). The foraminiferal composition of the Tianjingshan Formation indicates a Carnian age and was most likely associated with deeper (mostly pelagic) facies (See p. 23). The lower part of the Maantang Formation (Fig. 5), referred to the Norian, is not especially rich in Foraminifera, the fauna being dominated by involutinid, spirillinid, and milioliporid Foraminifera. The upper part of this formation, however, is rich with a very strong predominace of nodosariid Foraminifera (63 taxa) and related forms (*Ichthyolariidae:* 30 taxa, *Geinitziniidae:* 12 taxa) (Fig. 7). This fauna, essentially of Rhaetian age, represents an environment different from that of the Tianjingshan Formation. The prolific nodosariid fauna of the upper Maantang Formation indicates a shelf-sea environment, partly near-shore.

Tianjingshan Formation

The three samples from this formation, Maa 145–147 (Figs. 5, 6) have been taken in exposures between Guanyinyan and Xiejunmen, north of Hanwang. The foraminiferal content of two of the samples (Maa 145 and Maa 147) is very meagre, while the fauna of Maa 146 is rich, containing some 35 species. Involutinid Foraminifera predominate, along with ammodiscid and verenuilinid species (Fig. 7). To be noted is the occurrence of species such as *Glomospira kuthani, Endothyra kuepperi, Lamelliconus ventroplana,* and *Variostoma pralongense*. The first mentioned species is restricted to the Carnian Stage, where it is known to occur elsewhere in the world; the other three species have been recorded from Ladinian and Carnian strata.

Maantang Formation

The Maantang Formation has been sampled at several localites in the vicinity of Hanwang, viz. near the Xiaoemei railway tunnel (samples Maa 149, 150, 153, 154, 155), on the River Mianyuan near Guanyinyan (Maa 151, 152), and at Qingyangou (Maa 160, 161, 162, ACG 355, Fig. 6).

The foraminiferal content of the samples from the lower

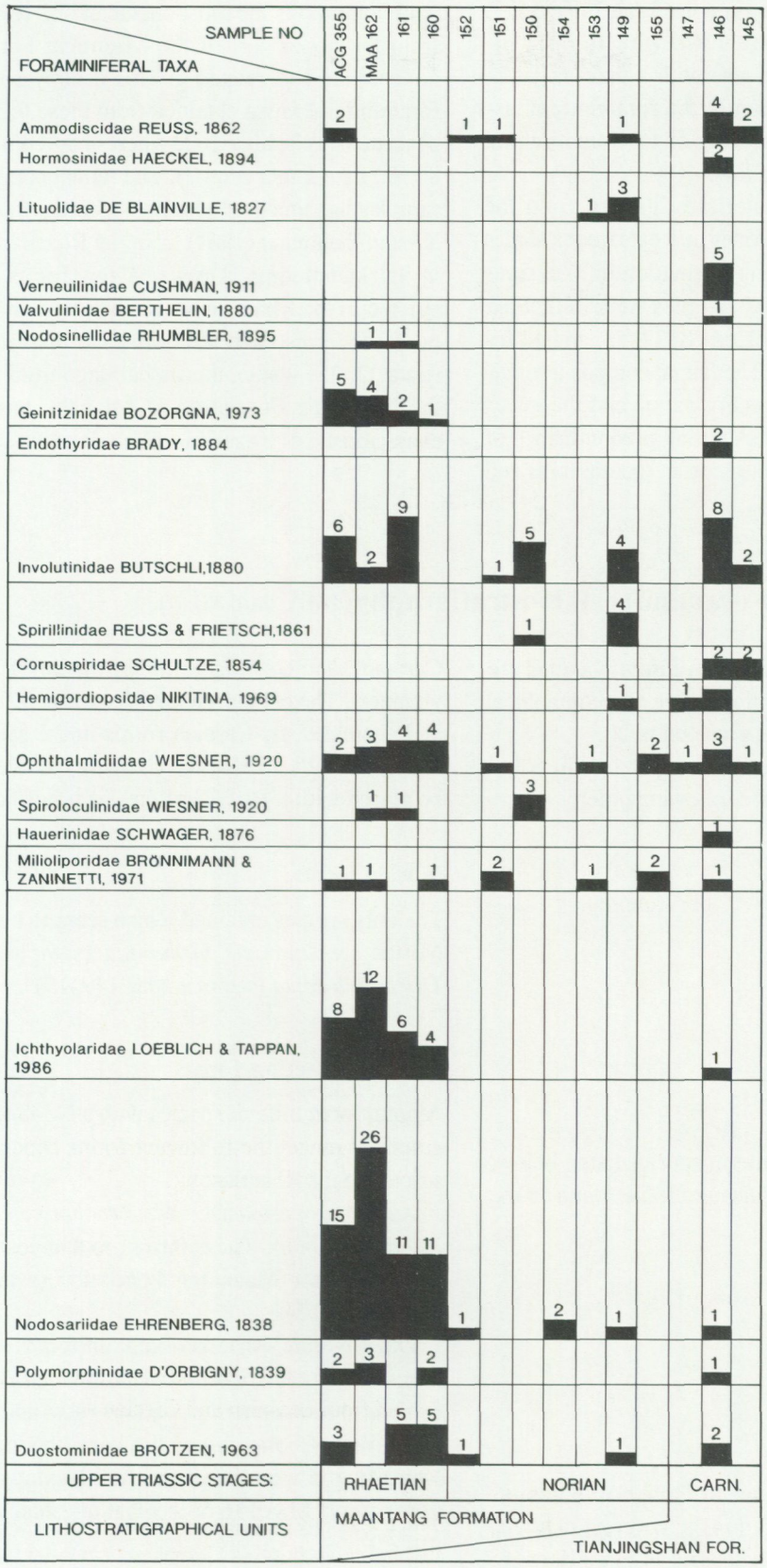

Fig. 7. Histograms showing the frequency of species within different foraminiferal families recorded in the material studied. As to stratigraphical position of the samples, see Fig. 5.

part of the Maantang Formation (samples Maa 149–155) is meagre. The fauna includes some short-ranging forms, indicating a Norian and/or Rhaetian age with a main focus in the Norian, as to the composition of the foraminiferal assemblage. The stratigraphical bearing of the foraminiferal fauna studied will be discussed below.

The richest foraminiferal material originates from the samples taken in the marly siltstones and calcareous shales in the upper part of the Maantang Formation in exposures at Qingyangou (Figs. 5, 6). The samples Maa 160, Maa 161, Maa 162, and ACG 355 yielded 28, 39, 53, and 44 foraminiferal species respectively. The faunal composition differs from that of the Tianjingshan Formation and the lower part of the Maantang Formation. A strong predominance of nodosariid Foraminifera and related forms (geinitzinids and ichthyolarids) is the most characteristic feature of the fauna from the upper part of the Maantang Formation. In fact, nodosariids and related groups occupy some 65 % of the foraminiferal fauna obtained from these four samples with a peak in sample Maa 162, where they constitute more than 80 % of the fauna (Fig. 7). The faunal composition of these samples has much in common with the fauna described by Kristan-Tollmann (1964) from the Rhaetian Zlambach Marl in Salzkammergut, Austria. A few forms obtained are restricted to the Rhaetian Stage elsewhere in the world; several other forms have not been recorded from pre-Rhaetian strata. On the whole, this assemblage from the upper part of the Maantang Formation in Mianzhu has a composition characteristic of Rhaetian – Early Jurassic shelf seas.

Foraminiferal biostratigraphy and zonation

The stratigraphical ranges of the Foraminifera obtained are given in Fig. 12. More detailed information on geographical and stratigraphical distribution is given on p. 28.

From a biostratigraphical point of view the foraminiferal fauna studied can be grouped in the following order:

- Rhaetian–Jurassic forms
- Rhaetian forms
- Norian–Rhaetian forms
- Norian forms
- Carnian–Norian forms
- Carnian and older forms

Carnian and older forms

This group includes the foraminiferal species listed below. Author names and publication dates are to be found in the Appendix (p. 28).

Endothyra kuepperi
Ophthalmidium tricki
Glomospira kuthani
Lamelliconus ventroplana
Pragsoconulus robustus
Variostoma praelongense
Gsollbergella spiroloculiformis

The fauna is restricted to the two samples Maa 145 and Maa 146 from Beds C1 and C3 of the Tianjingshan Formation. This part of the formation is thus referred to the Carnian on the basis of *Glomospira kuthani* (Carnian), *Ophthalmidium tricki* (Carnian or older)), *Endothyra kuepperi* (Anisian-Carnian), *Lamelliconus ventroplana* (Ladinian-Carnian), and *Gsollbergella spiroloculiformis* (Carnian or younger). The concurrence of *Duotaxis birmanica* (Norian) and characteristic Carnian forms in the same sample (Maa 146), may indicate that the Carnian–Norian boundary could be placed within Bed C3 of the Tianjingshan Formation.

Norian forms

The only species obtained which seem to be restricted to the Norian are *Duotaxis birmanica* (sample Maa 146), and *Trocholina acuta* (samples Maa 149–151).

Norian-Rhaetian forms

Among foraminiferal species with a Norian–Rhaetian stratigraphical range, the following forms concur with forms restricted to the Rhaetian:

Auloconus permodiscoides, *Trocholina eduardii*, and *Angulodiscus tenuis*. These forms are thus restricted to the upper part of the Maantang Formation (samples Maa 160–162, ACG 355).

Other Norian–Rhaetian Foraminifera are species such as *Semiinvoluta clari*, *Coronipora austriaca*, *Turrispirillina* cf *minima*, *Agathammina parafusiformis*, and *Reophax rudis*. This group of Foraminifera has been obtained from samples Maa 149 and Maa 150 from the Maantang Formation and from sample Maa 146 of the Tianjingshan Formation.

Rhaetian forms

The following species are referred to this group: *Variostoma coniforme*, *"Lingulina"* aff. *placklesensis*, *Pseudonodosaria simpsonensis*, *Pseudonodosaria plumirocostata*, and *Falso-*

palmula arignota. The forms are also restricted to the upper part of the Maantang Formation. Even if some Foraminifera in the assemblage composed of the two above-mentioned groups (Norian–Rhaetian forms and Rhaetian forms) may indicate a particular facies rather than the age, the great number of post-Norian Foraminifera, along with those few restricted to the Rhaetian, is taken as evidence for a Rhaetian age of the upper part of the Maantang Formation.

Rhaetian-Jurassic forms

This group of Foraminifera includes 18 species, all of them belonging to the superfamily Nodosariacea. Regarded separately, the group could be characteristic of a Lower Jurassic shelf-sea fauna. The group concurs, however, with Foraminifera restricted to the Rhaetian Stage. The group is restricted to the upper part of the Maantang Formation, where it has been obtained from Beds No. 7 and No. 8, from samples Maa 160-Maa 162, and ACG 355, respectively. Together with this group such Foraminifera also occur, which have been determined to the generic, but not to the specific level, and whose stratigraphical ranges are unknown.

Foraminiferal zonation of the Upper Triassic in Hanwang, Mianzhu District

Based on the foraminiferal fauna obtained from the Tianjingshan and Maantang Formations the following zonation is proposed.

Glomospira kuthani Zone

Apart from the zonal denominator, *Glomospira kuthani* (Carnian), this zone is characterized by a rich fauna of benthic Foraminifera, including species such as *Variostoma pralongense, Gsollbergella spiroloculiformis, Endothyra kuepperi, Ophthalmidium tricki, Lamelliconus ventroplana, Aulotortus praegaschei*. The stratigraphical ranges of the species of this assemblage are listed in Fig. 12. The *Glomospira kuthani* Assemblage Zone has many species in common with corresponding Carnian strata in Taurus, Turkey (Altiner & Zaninetti 1980), West Carpathians (Salaj et al. 1983), and the Alps (Oberhauser 1957; Kristan-Tollmann 1957, 1964, 1970; Zaninetti 1969, 1976).

This zone includes Beds C1, C2, and C3 (lower part) of the Tianjingshan Formation. Locality: Exposure between Guanyinyan and Xiejunmen N of Hanwang, Mianzhu District, Sichuan (Figs. 5, 6).

Trocholina acuta Zone

Apart from the zonal denominator, *Trocholina acuta* (Norian), this zone includes *Angulodiscus tumidus, Coronipora austriaca, Palaeomiliolina oculata, Ophthalmidium carinatum, Turrispirillina cf minima*, and *Miliolipora cuvillieri*. Forms referred to *Variostoma* occur, but they have not been determined to species. The zone includes Beds N2 and N3 of the Maantang Formation (Beds N4–N6 have not been sampled). Localities: A gully near Xiaoemei Railway Tunnel, Shuguang Coal Mine, Hanwang; Xiaoemei Railway Tunnel; exposed section on the Mianyuan River near Guanyinyan, Hanwang, Mianzhu District, Sichuan (Fig. 6). This zone has many species in common with corresponding Norian strata elsewhere in the world (Appendix, p. 28).

Variostoma coniforme Zone

The zonal denominator, *Variostoma coniforme*, is restricted to the Rhaetian Stage in Europe. This species was originally described from the Eastern Alps by Kristan-Tollmann (1964). Other forms characteristic of this zone are: *Semiinvoluta clari, "Lingulina" placklesensis, Variostoma crassum*, and a rich fauna of nodosariid Foraminifera, the latter forms also characterizing the Rhaetian – Lower Jurassic in shelf-sea facies. (See the range chart of Foraminifera; Fig. 12).

This zone includes Beds N7 and N8 of the Maantang Formation. Locality: Exposure at Qingyangou, Hanwang, Mianzhu District, Sichuan Province (Figs. 5, 6).

The foraminiferal zonation of the Upper Triassic of Hanwang, Mianzhu District in Sichuan is illustrated in Table 1.

Comparison with other foraminiferal faunas

The foraminiferal faunas from the Upper Triassic of the Mianzhu District have been compared with those of similar age elsewhere in the world, viz. West Carpathians (Salaj et al. 1983), Tatra Mountains (Gazdzicki & Zawidzka 1973), Eastern Alps (Oberhauser 1957, Oberhauser 1960, Kristan 1957, Kristan-Tollmann 1964a, b, Tollmann & Kristan-Tollmann 1970), Hungary (Oravecz-Scheffer 1987 and others), Europe, Asia, and N Africa (Zaninetti 1969, 1976), Caucasus (Efimova 1974), Turkey (Altiner & Zaninetti 1981, Sellier De Civrieux & Dessauvagie 1965), Alaska (Tappan 1951), and New Zealand (Strong 1984). As indicated in the references also other regions and authors have been considered.

Table 1. Upper Triassic stratigraphy of Hanwang, Mianzhu.

LITHOSTRATIGRAPHICAL UNITS		FORAMINIFERAL ZONES	CHRONO-STRATIGRAPHICAL UNITS
FORMATIONS	BEDS		
MAANTANG FORMATION upper part	N8	*Variostoma coniforme* ZONE	RHAETIAN
	N7		
MAANTANG FORMATION lower part	N6	*Trocholina acuta* ZONE	NORIAN
	N5		
	N4		
	N3		
	N2		
	N1		
TIANJINGSHAN FORMATION	C3	*Glomospira kuthani* ZONE	CARNIAN
	C2		
	C1		
MIDDLE TRIASSIC			

West Carpathians

Out of the 130 foraminiferal taxa recorded from Mianzhu, 31 of the forms are common to those recorded from the Upper Triassic of the West Carpathians (Fig. 8). The Foraminifera in common may be grouped in superfamilies as follows:

Involutinaceaa	9 species
Lituolacea	3 species
Miliolacea	8 species
Discorbacea	3 species
Nodosariacea	3 species
Spirillinacea	1 species
Endothyracea	3 species

The prolific fauna of Nodosariacean Foraminifera characteristic of the Upper Maantang Formation has no parallel in the West Carpathians. *Glomospira kuthani*, recorded from the Tianjingshan Formation (sample Maa 146), is used as a denominator of the Lower Carnian foraminiferal zone in the West Carpathians by Salaj et al. (1983).

As zone fossil for the Norian in the Carpathians, Salaj et al. (1983) have used *Semiinvoluta clari*. This species has also been recorded from the Lower Rhaetian the Carpathians, as well as in the Eastern Alps (Oberhauser et al. 1960, Kristan-Tollmann 1964 a, b).

In the Mianzhu Triassic *Semiinvoluta clari* has been recorded from the upper part of the Maantang Formation, along with species rather indicating a Rhaetian than a Norian age. The zonal denominator of the Rhaetian in the West Carpathians and Hungary, *Triasina hantkeni*, has not been found in the material studied here. It is, however, recorded from the type section of the Maantang Formation in the Jiangyou County, Sichuan (He Yan 1979). Among the other Foraminifera recorded by Salaj et al. (1983) as characteristic of the Rhaetian, the following species have been found in the Mianzhu material: *Falsopalmula arignota, Grillina sp., Auloconus permodiscoides, Angulodiscus tenuis*, and *Coronipora austriaca* (the last three species were recorded from the uppermost Norian too).

Based on comparisons between the Mianzhu foraminiferal fauna and the Upper Triassic fauna of the West Carpathians, the present authors are inclined to refer the assemblage containing *Glomospira kuthani*, that is the fauna of the Tianjingshan Formation (Beds C1, C3) to the Carnian Stage and the fauna from the upper part of the Maantang Formation (Beds N7, N8) to the Rhaetian Stage. The fauna of Beds N2 and N3, referrable to the lower part of the Maantang Formation, might well be of Norian age. The stratigraphy is further discussed on page 14.

Tatra Mountains

Gazdzicki & Zawidzka (1973) described Triassic foraminiferal assemblages from the Choc Nappe of the Tatra Mountains. Some of the species recorded from Anisian and Rhaetian limestones also occur in the Mianzhu Triassic, viz. *Agathammina austroalpina* and *Endothyra kuepperi, Angulodiscus tenuis, Trocholina acuta, Auloconus permodiscoides.*

The Tatra fauna is devoid of nodosariid Foraminifera; the Rhaetian fauna is characterized by predominance of larger benthic Foraminifera of the family Involutinidae, a group of

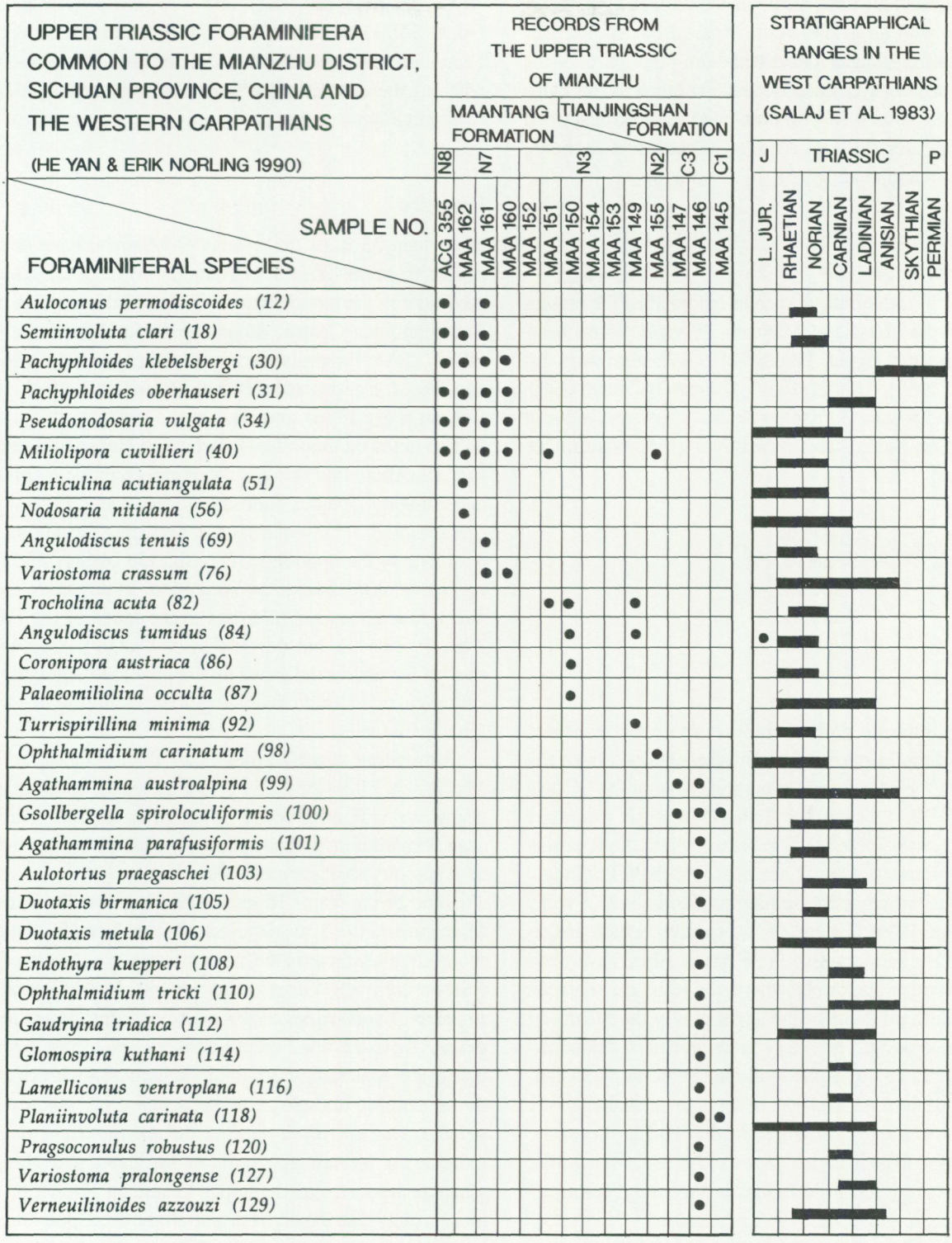

Fig. 8. Upper Triassic Foraminifera common to Mianzhu and the west Carpathians. (Figures within brackets refer to number in Range Chart of Foraminifera, Fig. 12).

major stratigraphical importance in the Alpine–Carpathian syncline, as well as in SW Asia. Apart from similarities with foraminiferal faunas described from other parts of the Alpine–Carpathian syncline, the Anisian fauna of the Tatra Mountains has much in common with faunas described from the Dinarides and East Asia (e.g. Pantic & Rampnoux, 1972, Brönnimann et al. 1975).

Eastern Alps

Among the 130 foraminiferal species recorded by the present writers from the Triassic of Mianzhu, 39 species have been reported from the Upper Triassic of the Eastern Alps by Oberhauser (1960), Kristan (1957), Kristan-Tollmann (1960, 1964 a,b), and Koehn-Zaninetti (1969). This fauna is listed in Fig. 9. The fauna has the following composition of superfamilies:

Nodosariacea	21 species
Involutinacea	5 species
Endothyracea	4 species
Miliolacea	3 species
Lituolacea	3 species
Duostominacea	3 species

The great majority of foraminiferal species common to Mianzhu and the Eastern Alps has been obtained from the upper part of the Maantang Formation. Among the 37 taxa listed in Fig. 9, 17 span the Triassic–Jurassic boundary (Rhaetian – Lower Jurassic), 6 are restricted to the Rhaetian Stage in the Eastern Alps, 2 are recorded from Ladinian–Carnian strata, whereas the remaining forms have a wider vertical range. Even if some of the species, which are restricted to Rhaetian strata in the Eastern Alps, have been found also in other stages elsewhere, the Rhaetian character of the foraminiferal fauna of the upper part of the Maantang Formation is striking. The heavy predominance of nodosariid Foraminifera (54 % of the total fauna common to Mianzhu and the Eastern Alps) does not seem to be characteristic of any Triassic Stage, elsewhere in the world, except the Rhaetian in shelf-sea facies. An exception is Australia, where fairly rich nodosariid faunas are recorded from pre-Rhaetian Triassic stages too (He Yan herein).

The foraminiferal fauna of the Triassic of Mianzhu was also compared with the fauna of the Eastern Alps, described by Tollmann & Kristan-Tollmann (1970) from the Hallstätter Zone. Most of the Mianzhu Foraminifera in common with the Hallstätter fauna are included in the list (Fig. 9), which is also based on comparisons with Oberhauser (1960) and earlier publications by Kristan, Kristan-Tollmann and Tollmann (e.g. 1957, 1960, 1964). The species *Trocholina acuta* (samples Maa 149–151), *Trocholina eduardi* (samples ACG 355, Maa 160, 161), and *"Lingulina" placklesensis* (ACG 355, Maa 161, 162) have been added to the list. *Trocholina acuta* occurs in Norian and Rhaetian strata, whereas the other two species seem to be restricted to the Rhaetian Stage.

Hungary

More than 25 % of the species of Mianzhu have been recorded from the Triassic of Hungary. Most of these species are found in the monograph on Triassic Foraminifera of the Transdanubian Central Range by Anna Oravecz-Scheffer (1987). Other Hungarian foraminiferal papers have also been considered, e.g. papers by Bérczi-Makk (1981, 1985, 1986), Goczan et al. (1986), and Haas et al. (1988).

The fauna common to Mianzhu and Hungary is listed in Fig. 10. About one third of the fauna common to Mianzhu and Hungary includes nodosariids and related Foraminifera (geinitzinids, ichthyolarids). In Mianzhu the nodosariids dominate in the uppermost Triassic; top Norian, and Rhaetian strata of the Maantang Formation. In this sense the Mianzhu fauna shows similarities to the fauna of the Eastern Alps (p. 18, 19), but not to that of Hungary. Representatives of the nodosariid fauna of Hungary have a greater vertical range, or another range altogether, obviously due to differences in facies.

Dominating superfamilies other than Nodosariacea are Miliolacea, Lituolacea, and Duostominacea, whereas endothyracean, ammodiscacean, involutinacean, and spirillinacean Foraminifera played a more subordinate role in the fauna common to Mianzhu and Hungary.

Some of the forms from the Tianjingshan Formation of Mianzhu and the Transdanubian Central Range in Hungary represent a characteristic Carnian fauna, e.g. *Gsollbergella spiroloculiformis, Glomospira kuthani, Lamelliconus ventroplana, Triadodiscus eomesozoicus* and *Variostoma pralongense*. As to the few Foraminifera obtained from the lower part of the Maantang Formation, in common with Hungary, the concurence of three particular species, viz. *Duotaxis birmanica, Turrispirillina minima* and *Angulodiscus tumidus* indicates a Norian age both in Mianzhu and Hungary, whereas the forms of the upper Maantang Formation were more widely distributed from a stratigraphical point of view, in the Hungarian Triassic (Fig. 10).

Comparison with Upper Triassic foraminiferal faunas recorded by Zaninetti (1976) from Europe, Asia, and North Africa

Among the 130 species which were recorded by us from the Mianzhu District in Sichuan, some 25 have been described by Zaninetti (1976). Zaninetti's (1969) records of Triassic

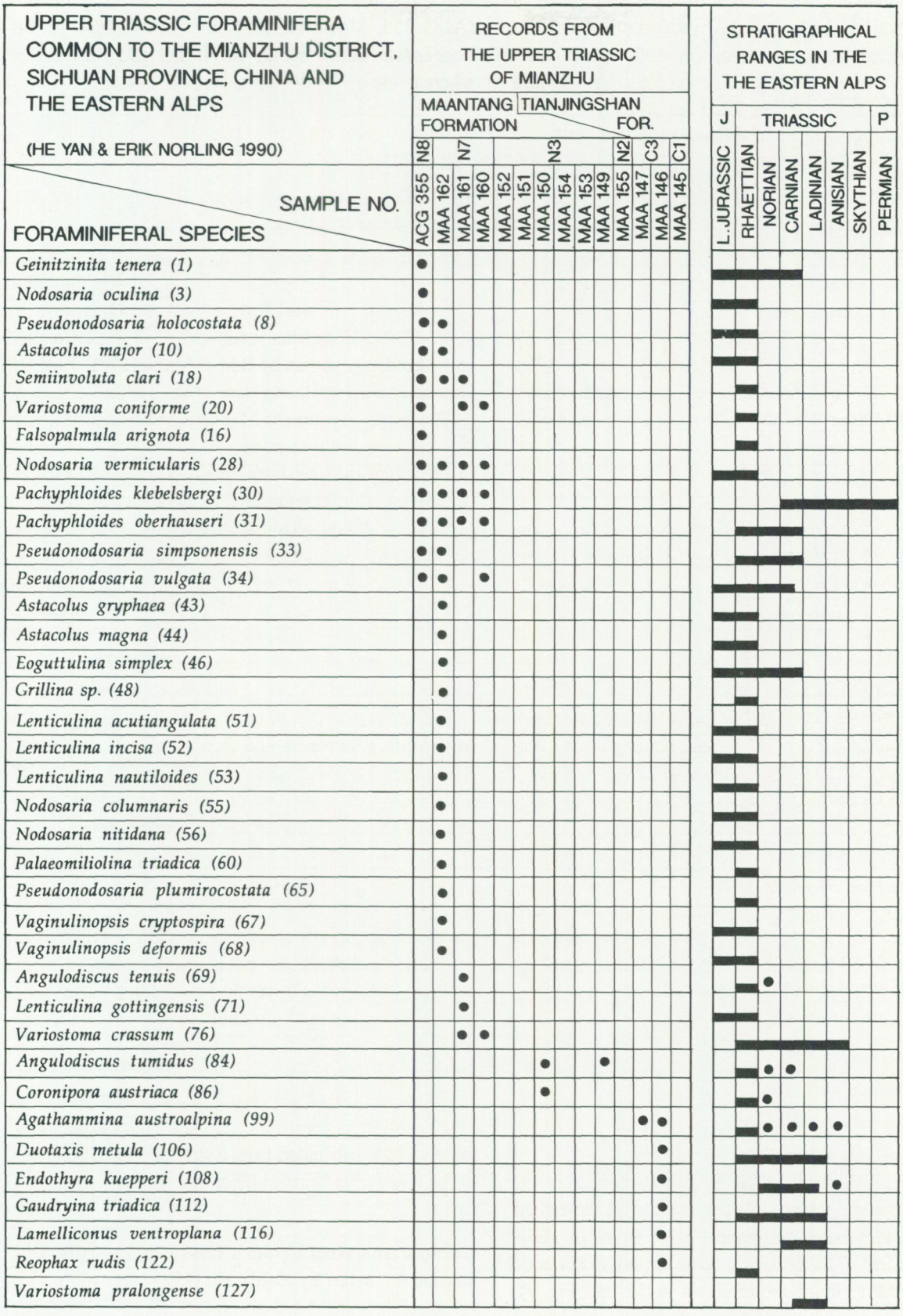

Fig. 9. Upper Triassic Foraminifera common to Mianzhu and the eastern Alps. For other details, see caption of Fig. 8. (Figures within brackets refer to number in Range Chart of Foraminifera, Fig. 12).

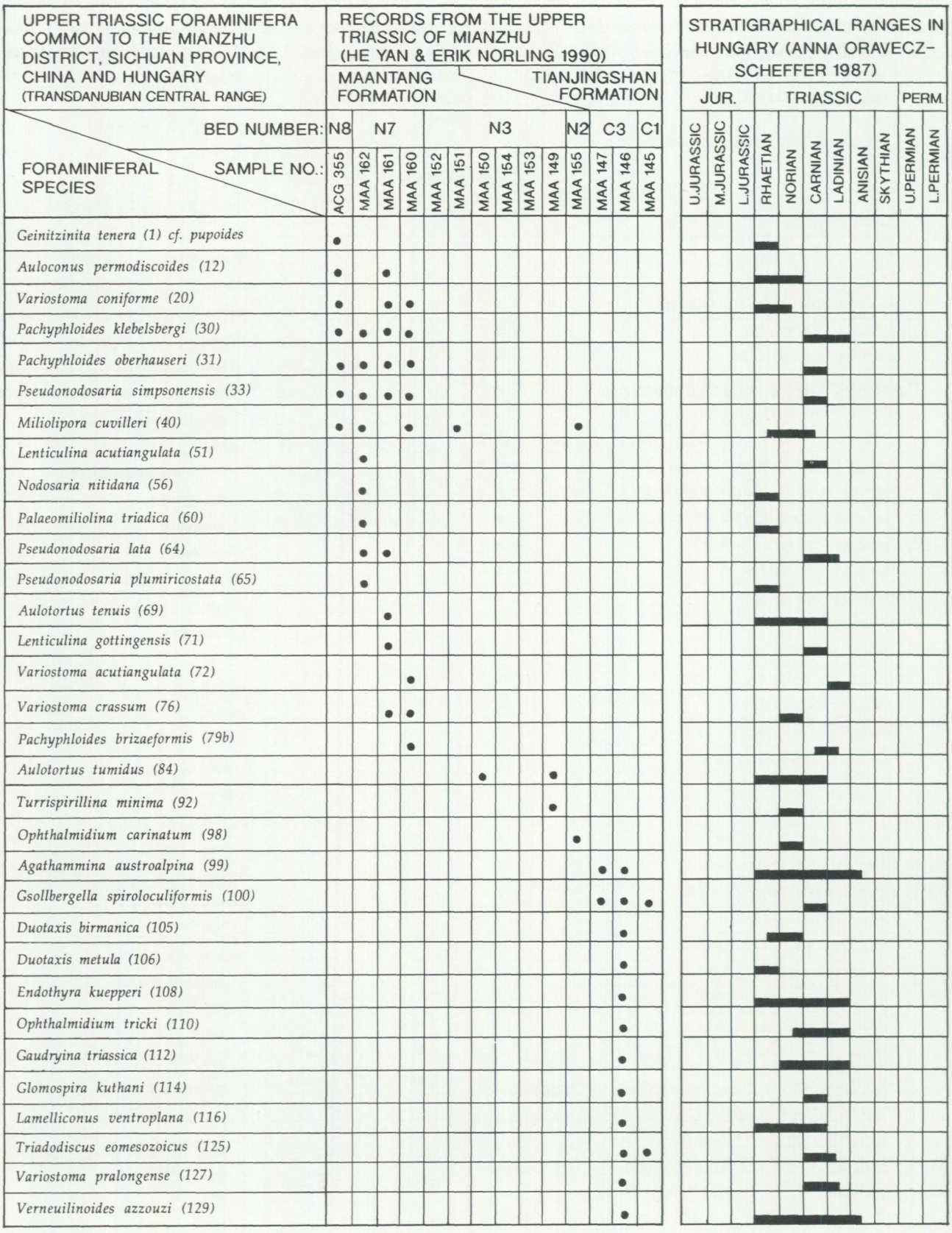

Fig. 10. Upper Triassic Foraminifera common to Mianzhu and the Transdanubian Central Range, Hungary. (Figures within brackets refer to number in Range Chart of Foraminifera, Fig. 12).

Foraminifera from "Haute-Autriche" have also been considered. To be noted is that Zaninetti has excluded nodosariids, inspite of their presence, from her faunal descriptions in her comprehensive 1976 work (Fig. 11; compare also Fig. 12). Grouped into superfamilies the Foraminifera from Mianzhu in common with forms described by Zaninetti (1976) have the following composition:

Involutinacea	10 species
Miliolacea	6 species
Lituolacea	3 species
Duostominacea	2 species
Ammodiscacea	1 species
Endothyracea	1 species
Spirillinacea	1 species

Glomospira kuthani, used as Carnian zone fossil by Salaj et al. (1983), is reported by Zaninetti (1976) from the Balkans and the Carpathians, and used also by her as an index fossil for the Carnian. In the Mianzhu Triassic this species has been obtained from the Tianjingshan Formation between Guanyinyan and Xiejunmen, North of Hanwang. *Trocholina eduardi* and *Variostoma coniforme*, obtained from the upper part of the Maantang Formation (in several samples from Beds N7 and N8), are species restricted to the Rhaetian according to Zaninetti (1976). These two species are recorded from the Alps and from China only. Apart from *Duotaxis birmanica*, no forms from the Mianzhu fauna common to those recorded by Zaninetti (1976) from different parts of the world, can be used to delimit the Norian Stage.

NW Caucasus

Among the Upper Triassic Foraminifera recorded by us from Mianzhu, some 10% of the species are in common with the fauna reported from the NW Caucasus by Efimova (1974). (Compare Fig. 12):

1. *Geinitzinita tenera* Carnian – Lower Jurassic
10. *Astacolus major* Rhaetian – Lower Jurassic
30. *Pachyphloides klebelsbergi* Permian–Carnian
31. *Pachyphloides oberhauseri* Ladinian–Rhaetian
33. *Pseudonodosaria simpsonensis* Carnian–Rhaetian
34. *Pseudonodosaria vulgata* Carnian–Jurassic
36. *Trocholina eduardii* Norian–Rhaetian
51. *Lenticulina acutiangulata* Rhaetian – Lower Jurassic
60. *Ophthalmidium triadica* Carnian–Rhaetian
71. *Lenticulina gottingensis* Rhaetian – Lower Jurassic
76. *Variostoma crassum* Anisian–Rhaetian
82. *Trocholina acuta* Norian
99. *Agathammina austroalpina* Anisian–Rhaetian
110. *Ophthalmidium tricki* Anisian–Carnian

Most foraminiferal species common to Mianzhu and Caucasus have a long vertical range. The exceptions are *Trocholina eduardi*, (top Norian–Rhaetian), *Astacolus major*, *Lenticulina acutingulata*, and *Lenticulina gottingensis* spanning the Triassic–Jurassic boundary, and *Trocholina acuta* restricted to the U. Norian. The post-Norian Foraminifera have been obtained from the uppermost samples of the Maantang Formation; *Trocholina acuta* was obtained from samples from the lower part of this formation.

Taurus, Turkey

Altiner and Zaninetti (1981) described a foraminiferal fauna from Taurus Oriental in Turkey. A meagre fauna was obtained from the Kokarkuyu Formation referred to the Scythian Stage of the Lower Triassic, whereas the fauna recorded from top Ladinian, Carnian and Norian strata is richer. All the species common to Sichuan and Taurus were obtained from Upper Triassic strata. The species in common are the following: *Agathammina austroalpina*, *Angulodiscus tumidus*, *Duotaxis birmanica*, *Ophthalmidium carinatum*, *Gaudryina triadica*, *Lamelliconus ventroplana*, *Palaeomiliolina fusiformis*, and *Triadodiscus eomesozoicus*.

Agathammina austroalpina, *Duotaxis birmanica* and *Gaudryina triadica* are recorded from Middle and Upper Triassic strata in Europe, whereas *Angulodiscus tumidus*, *Ophthalmidium carinatum* and *Lamelliconus ventroplana* seem to be restricted to the Upper Triassic.

Alaska

Tappan (1951) described Triassic Foraminifera from the Arctic slope of Alaska. Her 26 species were the first records of Late Triassic Foraminifera in the western hemisphere. Few forms are in common with the species from the Mianzhu Triassic. The species in common are the following: *Variostoma helicta* (Tappan), *Pseudonodosaria densa* (Tappan), *Pseudonodosaria lata* (Tappan), and *Pseudonodosaria simpsonensis* (Tappan). The *Pseudonodosaria* forms are of little biostratigraphical value. *Variostoma helicta* has a wide geographical distribution. It is recorded from the Norian of NW Yunnan, and from Yushu in Qinghai (He & Wang pers. com.). In Mianzhu this species has been obtained from dark grey marls in the upper part of the Maantang Foramation (10 specimens in samples Maa 160 and Maa 161), which is referred to the Rhaetian Stage.

New Zealand

Strong (1984) described a Triassic foraminiferal fauna from the Southland Syncline of New Zealand. Few species are

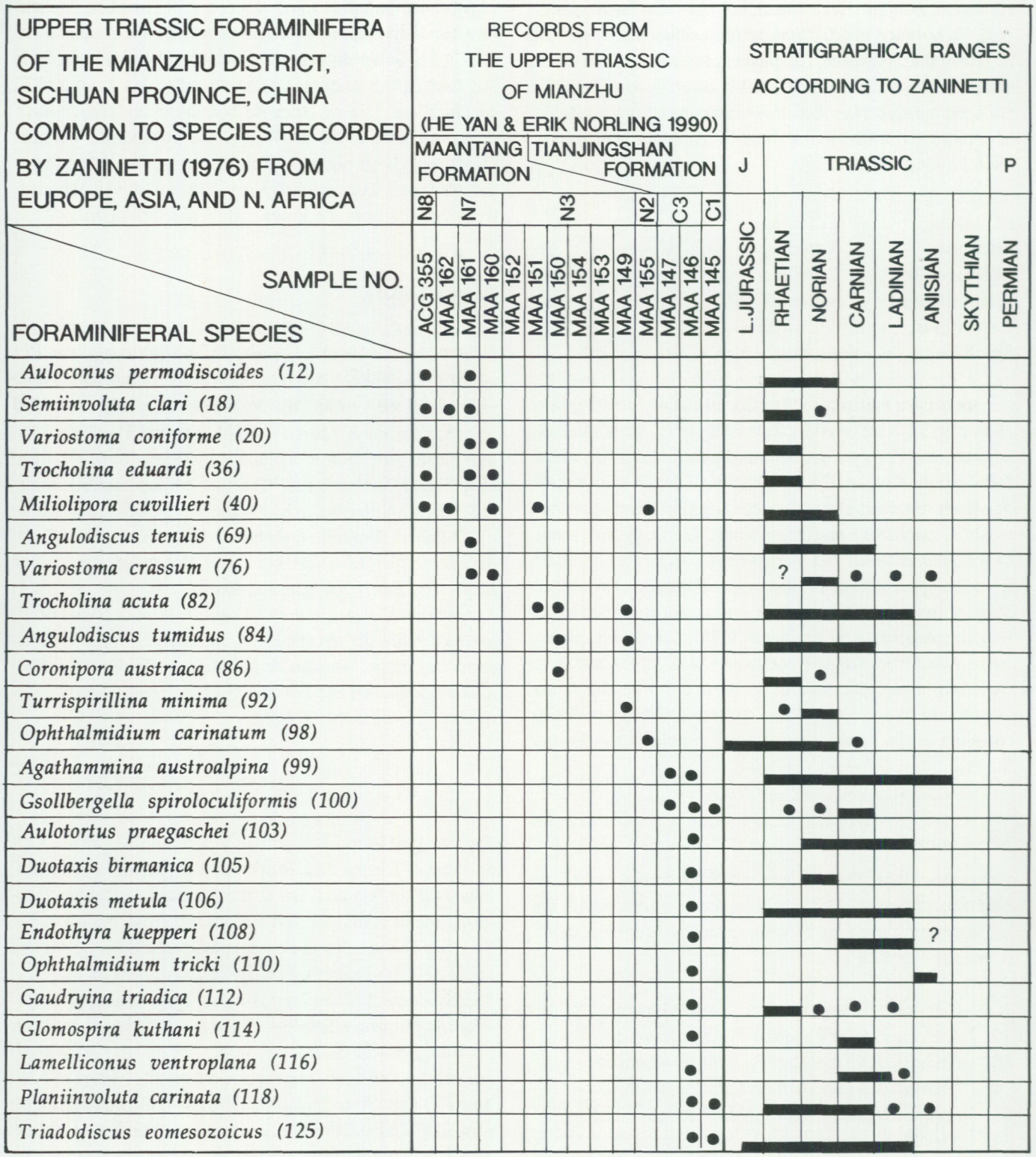

Fig. 11. Upper Triassic Foraminifera from Mianzhu, China common to species recorded by Zaninetti (1976) from Europe, Asia, and N. Africa (nodosariids not included). (Figures within brackets refer to number in Range Chart of Foraminifera, Fig. 12).

common to the Mianzhu fauna, viz.: *Lenticulina acutiangulata, L. gottingensis, Grillina grilli, Geinitzinita tenera,* and *Pseudonodosaria lata.* The fauna described by Strong has a great predominance of nodosariid Foraminifera, characteristic of a shallow shelf-sea. The fauna seems to be of an Early Jurassic style rather than a Triassic one. As demonstrated by Kristan-Tollmann (1964), however, the Rhaetian in shelf-sea facies has a predominance of nodosariid Foraminifera, the fauna includes many species in common with the Early Jurassic. Most of the foraminiferal species described by Strong (1984) have been given a Norian age (Otamitan Stage equivalent to the Early – Middle Norian).

Facies distribution, palaeoecology and foraminiferal associations

The oldest part of the Triassic sequence studied belongs to the Tianjingshan Formation, which is represented by light grey limestones (Bed C1), succeeded by brownish grey bioclastic limestones (Bed C2), and yellowish grey bioclastic limestones (Bed C3). Bed C1 is of Carnian age, C2 may be of Carnian or Norian age, whereas Bed C3 is referred to the Norian Stage.

From some levels within the Tianjingshan Formation and the succeeding Maantang Formation, thin-sections have been made for microfacies analysis.

Microfacies characteristics are important tools for the interpretation of the palaeoenvironment (Flügel 1972). Studies on palaeoenvironmental reconstructions have been published with increasing frequency. As to the Triassic, works by Resch (1979), Hohenegger & Piller (1975), Oravecz-Scheffer (1987) and Jenkins & Murray (1989) may be mentioned.

Thin-sections from the basal Bed C1 (Pl. V, Fig. 1) show a microfacies characterized as pelletal micrite with a foraminiferal association including miliolid species of the genera *Gsollbergella* and *Planiinvoluta* (dominant), and involutinid species of the genus *Triadodiscus*. Species of ammodiscid and nodosariid genera also occur, but play a subordinate role.

The predominance of miliolid Foraminifera may indicate a relatively deep environment (Zaninetti 1976, Salaj et al. 1983). The pellets and micritic matrix indicate fairly calm water and high salinity (Hohenegger & Piller, 1975). The occurrence of *Agathammina,* one of the Foraminifera strongly adapted to such an environment, supports such an interpretation. According to Oravecz-Scheffer (1987), however, pelletal microbiofacies with *Agathammina* is characteristic of a fairly shallow warm and calm water environment. The predominance of miliolids, but concurrence of nodosariids (and indications of minor wave influence) may indicate an outer rather than an inner sublittoral location.

The microfacies shown in Pl.V, Fig. 2 from a thin-sectioned rock sample of Bed C3, upper part of the Tianjingshan Formation is defined as sparite with miliolid and nodosariid Foraminifera. The predominating miliolid fauna from this bed includes some 10 species of the genera *Agathammina, Galeanella, Gsollbergella, Ophthalmidium, Planiinvoluta,* and *Sigmoilina.* The nodosariid group is represented by species of *Austrocolomia, Eoguttulina,* and unspecified nodosariids. On the whole the fauna from this level is fairly rich, including also ammodiscid forms *(Ammovertellina, Glomospira),* lituolids *(Duotaxis, Gaudryina, Reophax, Valvulina, Verneuilinoides)* , endothyrids, duostominids *(Variostoma),* and involutinids (8 species of the genera *Aulotortus, Lamelliconus, Pragsoconulus* and *Triadodiscus.* The rich, diversified fauna indicates an environment with good oxygen supply. The overbearing miliolid fauna in relation to the poor nodosariid fauna may indicate a fairly deep sedimentary environment. *Aulotortus* species were highly specialized and adapted to habitats of closed or open back-reef lagoons (Piller 1978).

The studied section of the Tianjingshan Formation is referred to the Carnian on the basis of Foraminifera such as *Glomospira kuthani, Ophthalmidium tricki,* and *Gsollbergella spiroloculiformis.* The occurrence of other Foraminifera ranging from Ladinian to Carnian, and Anisian to Carnian supports this stratigraphical dating. The concurrence of *Duotaxis birmanica* (Norian) along with characteristic Carnian forms in one sample from Bed C3 suggests that the Carnian–Norian boundary may be placed here (p. 10, Fig. 5).

The major part of the Maantang Formation (Beds N1–N5) has a carbonate-dominated facies represented by limestones of various kinds, viz. dark grey, median to thin bedded limestones in the basal part (Bed N1), succeded by grey to white oolitic limestones (Beds N2–N3). The following beds, N4 and N5, include yellowish and dark grey, partly oolitic limestones. The ooids indicate strong water turbulence and normal salinity (Hohenegger & Piller 1975). Succeeding strata are represented by alternating greyish limestones and calcareous shales, that is the sediments show an increasing influx of clastic material. In the top beds of the Maantang Formation (Beds N7 and N8), the limestones are completely replaced by deposits of clastic material, viz. alternating silty and argillaceous strata.

The upper part of the Maantang Formation was obviously formed under conditions quite different from those of the major previous part of the sequence. The rich influx of clastic material into the marine basin may reflect a change from an arid to a humid climate with effects on the transport of erosional products. It may also indicate tectonic activities.

The change in facies in the upper part of the Maantang Formation is accompanied by a most pronounced change in the composition of the foraminiferal fauna (Fig. 7). The earlier predominace of miliolid-involutinid assemblages is abruptly replaced by a predominance of nodosariid Foraminifera. Another characteristic feature of the upper Maantang Formation is the increase of duostominid forms.

In terms of foraminiferal zones the lower and middle parts of the Maantang Formation are referred to the *Trocholina acuta* Zone (Norian), whereas the upper part is referred to the *Variostoma coniforme* Zone (Rhaetian). The latter part represents a characteristic shelf-sea environment at the border of the Tethyan Sea, as far as facies and foraminiferal faunas are concerned. There is much here in common with corresponding strata along the northern margin of the Tethyan Sea in Europe (e.g. Eastern Alps).

In Pl. V, Figs. 3–6 some examples of different microfacies within the Maantang Formation are shown. Plate V, Fig. 3 for example, shows a facies characterized as micrite with interclasts of sponge spicules, Foraminifera *(Ophthalmidium)*, ostracodes and bivalves from the lower part of the formation (Sample Maa 153, Bed N3). According to Oravecz-Scheffer (1987), *Ophthalmidium* showed a preference for protected micritic cavities within reef bodies.

No microfacies illustrations are given from the Rhaetian part of the Maantang Formation (Beds N7 and N8). The lithology (Fig. 5), as well as the composition of the foraminiferal fauna with a great predominance of nodosariid forms (Fig. 7) indicate, however, a near-shore, sublittoral environment. It should be noted that when *Trocholina* forms disappear, nodosariids increase considerably (Figs. 7 and 12). According to Oberhauser (1964) and Piller (1978), *Trocholina* forms were adapted to high pressure conditions appearing in deeper parts of a basin. The increase of nodosariids, on the other hand, indicates typical shelf-sea environment with nearby lands that feed coarse to fine terrigenous sediments into the sea, where carbonate deposition is also progressing (Gordon 1970). As seen in p. 19, the facies and foraminiferal associations of the Rhaetian part of the Maantang Formation in Mianzhu, show great similarities to the corresponding part of the Upper Triassic in the Eastern Alps.

Descriptions of new foraminiferal taxa

Superfamily LITUOLACEA de Blainville, 1825
Family *Lituolidae* de Blainville, 1825
Genus *Ammobaculites* Cushman, 1910

Ammobaculites hanwangensis nov. sp.
(Plate 1, Fig. 3)

HOLOTYPE.- HY Maa 149-2a

TYPE STRATUM AND TYPE LOCALITY. – Maantang Formation, Bed N3, (sample Maa 149), near Xiaoemei Railway Tunnel, N of Hanwang, Mianzhu County, Sichuan Province, China.

DESCRIPTION. – Test planispiral in early stage, having two coils, the last coil with 4 wide chambers. Later stage uniserial, slightly curved with 2-3 chambers. In longitudinal section almost triangular. Wall thin, agglutinated, fine-grained. Aperture terminal, simple.

DIMENSIONS. – Length: 0.35–0.37 mm; breadth, 0.2 mm.

MATERIAL. – Two specimens. In thin-section HY Maa 149-2.

DISTRIBUTION. – In Norian strata of the Maantang Formation, Hanwang, Mianzhu, Sichuan, China.

Ammobaculites orientalis nov. sp.
Plate 1, Fig. 4

1975 *Ammobaculites* sp. Brönnimann, Whittaker & Zaninetti, p.10, Pl. 2, Figs. 17–21.

HOLOTYPE. – HY Maa 149-2

TYPE STRATUM AND TYPE LOCALITY. – Maantang Formation, Bed N 3 (sample Maa 149), near Xiaoemei Railway Tunnel, N of Hanwang, Mianzhu County, Sichuan Province, China.

DESCRIPTION. – Test elongate, early part planispiral with few chambers; later stage of test uniserial. Chambers 3–7, triangular in longitudinal section. Wall thick, agglutinated, built of fine-grained material. Aperture terminal, simple.

DIMENSIONS. – Length: 0.33-0.53 mm, breadth 0.12 mm

MATERIAL. – Two specimens in thin sections.

REMARKS. – This form is characterized by its straight, uniserial part and subtriangular chambers (in longitudinal section).

DISTRIBUTION.- In Norian strata of the Maantang Formation, China and in strata of the same age in the northern Shan State, Burma.

Superfamily ENDOTHYRACEA Brady, 1884
Family *Tournayellidae* Dain, 1953
Genus *Auloconus* Piller, 1978

Auloconus rotundata nov. sp.
Plate 2, Figs. 5, 6

1978 *Semiinvoluta ?* sp., Piller, p. 88, Pl. 21, Figs. 6–8.

HOLOTYPE. – HY Maa 161-1a

TYPE STRATUM AND TYPE LOCALITY.- Maantang Formation (Bed N8, sample ACG 355) at Qingyangou, N of Hanwang, Mianzhu Country, Sichuan Province, China.

DESCRIPTION. – Test small, dorsal side rounded conical, ventral side involute, slightly concave; initial chamber spherical, subsequent chambers tubular, spirally wound, whorls 8-11 (8 in holotype specimen). Umbilical part thickened as in *Auloconus permodiscoides* (Oberhauser) (cf. Piller 1978, p. 20, Text-Fig. 9). Dorsal side not thickened; wall transparent.

DIMENSIONS. – height: 0.16–0.18 mm; diameter, 0.29–0.44 mm.

MATERIAL. – 10 specimens extracted from calcareous mudstone.

REMARKS. – This species can be distinquished from *Auloconus permodiscoides* by its low conical-concave shape and thin tubular chambers.

DISTRIBUTION. – In Rhaetian strata of the Maantang Formation at Qingyangou, N of Hanwang, Mianzhu, Sichuan (obtained from two levels; sample Maa 161 and ACG 355). Recorded also from the Lias of Austria.

Superfamily NODOSARIACEA Ehrenberg, 1838
Family *Nodosariidae* Ehrenberg, 1838
Nov. Genus *Septalingulina*

DIAGNOSIS. – Test elongate, subtriangular, lenticular in transverse section. Initial chamber globular, succeeded by low and wide chambers rapidly increasing in size in early stage, but slowly in later stage. Chambers arranged in uniserial, rectilinear series. Sutures slightly curved and depressed. Internal side of the test having four plate-like partitions inside each chamber. Wall calcareous, hyaline, radial in structure. Aperture terminal, short, slit-like in centre of apertural face.

TYPE SPECIES. – *Septalingulina tetrasepta* nov. sp.

REMARKS. – The genus differs widely from other representatives of Family *Nodosariidae* in having this internal partition. Exterior similar to that of *Geinitzinita* and *Lingulina*.

OCCURRENCE. – In Upper Triassic (Rhaetian) strata of Sichuan, China.

Septalingulina tetrasepta nov. gen and nov. sp.
Plate IV, Figs. 5, 6, 8–10, 12, 13

HOLOTYPE. – HY Ma 162-8

TYPE STRATUM AND TYPE LOCALITY. – In Rhaetian strata (samples Maa 161, 162, ACG 355) in Beds N7 and N8 of the Maantang Formation at Qingyangou, N of Hanwang, Mianzhu County, Sichuan Province, China.

DIAGNOSIS. – As for genus.

DESCRIPTION. – Test acute in initial end, almost plane in terminal end; about 1 1/2 times as long as broad, lenticular in transverse section. Periphery acute, early stage rapidly expanding in breadth, later part with almost parallel sides. Chambers 8-10, slightly inflated in adult specimens. Internal side of test with four plate-like partitions,two on each side of central axis. Sutures smoothly curved and depressed, slightly oblique. Wall calcareous with radial texture. Aperture short, slit-like, terminal.

DIMENSIONS. – Length: 0.38-0.60 mm; width, 0.33-0.39 mm; thick- ness, 0.17 mm.

MATERIAL. – 36 specimens.

DISTRIBUTION. – Obtained from Rhaetian strata of the Maantang Formation at four different levels, Mianzhu, Sichuan.

CONCLUSIONS

Marine deposits of Late Triassic age are restricted to western China. NW Sichuan is one of the most important areas for the study of marine fossils of this age, and for the Triassic stratigraphy of China. There has been much debate in China concerning the presence of marine strata corresponding to the Rhaetian Stage in spite of records as early as in 1979 by one of the present writers, He Yan, of some microfossils from Mianzhu, which are restricted to the Rhaetian Stage elswhere in the world. This investigation which has documented a fairly rich foraminiferal fauna from the Tianjingshan and Maantang Formations in the Mianzhu District, including many species useful in stratigraphy, has clearly shown that the upper part of the Maantang Formation is of Rhaetian age. As seen in the range chart of Foraminifera (Fig. 12) a great number of species documented has never been recorded from pre-Rhaetian strata. Among these species there are several forms regarded as good index fossils for the Rhaetian. When the whole foraminiferal associations, obtained from the upper part of the Maantang Formation are studied and the stratigraphical ranges of individual species are compared, the Rhaetian age of this fauna is still more obvious. Our study of the facies distribution, paleoecology and foraminiferal associations indicates that the major change in facies in the upper part of the Maantang Formation from carbonate sediments to clastic sediments, accompanied by a most pronounced change in the foramini-

feral fauna, may reflect a change from an arid to a humid climate. From Norian to Rhaetian times the environment also seems to change from deeper Tethyan conditions to more shallow shelf-sea facies, as indicated by the change in the foraminiferal faunas from predominant miliolid-involutinid assemblages to a strong predominance of nodosariid Foraminifera. Later in Rhaetian times the marine regression resulted in continental conditions in NW Sichuan, which seem to have prevailed throughout the Mesozoic.

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APPENDIX

STRATIGRAPHICAL RECORDS OF TRIASSIC FORAMINIFERA FROM MIANZHU
Figures within brackets mark number in range chart, Fig. 12.

Agathammina austroalpina Kristan-Tollman (99). Plate 1, Fig. 10

Occurrence in China. – Tianjingshan Formation between Guanyinyan and Xiejunmen, N of Hanwang (samples Maa 146, 147), Mianzhu District, Sichuan Province.

Distribution. – Anisian-Rhaetian. Recorded from the Alps (Kristan-Tollmann 1964, Zaninetti 1976), from the Carpathians (see references in Salaj et al. 1983), the Balkans (Trifonova 1962), the Dinarides (Pantic 1967), Turkey (Taurus), Iran and Burma (Zaninetti 1976).

Agathammina parafusiformis Salaj, Borza & Samuel (101). Plate 1, Fig. 7.

Occurrence in China. – Recorded in the Tianjingshan Formation, north of Hanwang, Mianzhu, Sichuan (sample Maa 146). Recorded also from Upper Triassic strata in Yushu, Qinghai Province.

Distribution. – Norian and Rhaetian strata in western Carpathians (Salaj et al. 1983).

Ammobaculites hanwangensis nov sp.(91). Plate 1, Fig. 3.

Occurrence in China. – Recorded from the Maantang Formation, near Xiaoemei railway tunnel, north of Hanwang, Mianzhu District, Sichuan (sample Maa 149).

Ammobaculites orientalis nov. sp. (96). Plate 1, Fig. 4.

Occurrence in China. – Recorded from Maantang Formation, near Xiaoemei railway tunnel, north of Hanwang, Mianzhu District, Sichuan (sample Maa 149).

Distribution. – Previously recorded from Norian strata in Burma (form identical to *Ammobaculites* sp.; Brönnimann et al. 1975).

Angulodiscus tenuis Kristan (69). Plate 2, Fig. 14.

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan Province (sample Maa 161).

Distribution. – Uppermost Norian-Rhaetian. Recorded from the Alps and the Carpathians (Kristan-Tollmann 1964, Salaj et al.1983).

Angulodiscus tumidus Kristan-Tollman (84). Plate 2, Fig. 4.

Occurrence in China. – Recorded from Maantang Formation, near Xiaoemei railway tunnel, north of Hanwang, Mianzhu, Sichuan (sample Maa 149, 150). Known also from Norian strata in Yushu, Qinghai Province.

Distribution. – Upper Triassic in the Eastern Alps, the Dinarides, Turkey (Taurus), West Carpathians, Burma (Salaj et al. 1983).

Astacolus gryphaea (Kübler & Zwingli) (43)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162).

Distribution. – Upper Triassic in the Austrian Alps (Kristan-Tollmann 1964), Lower Jurassic in the Jura Mountains (Kübler & Zwingli 1870).

Astacolus magna (Kristan-Tollman) (44)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162).

Distribution. – Rhaetian strata in the Austrian Alps (Kristan-Tollmann 1964). Originally described from the Upper Jurassic in the USSR (Myatliuk 1939).

Astacolus major (Bornemann) (10)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (samples Maa 162, ACG 355).

Distribution. – Rhaetian-Lower Jurassic.

Astacolus neoradiata Neuweiler (11)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (samples Maa 162, ACG 355).

Distribution. – Hettangian to Pliensbachian strata in Europe. Recorded from France, West Germany, Denmark, Sweden among other countries (Norling 1972).

Auloconus permodiscoides (Oberhauser) (12). Plate 2, Fig. 3.

Occurrence in China. – Obtained from Maantang Formation at Qingyangou, north of Hanwang, Mianzhu District, Sichuan (samples ACG 355 and Maa 161). Recorded also from Upper Triassic strata of Yunnan.

Distribution. – Recorded from Norian and Rhaetian beds in Eastern Alps, western and central Carpathians, the Dinarides, Greece, Turkey, Iran (Zaninetti 1976, Salaj et al. 1983).

Auloconus rotundata nov. sp. (13)

Occurrence in China. – Obtained from samples from the Maantang Formation at Qingyangou, N of Hanwang, Mianzhu, Sichuan (samples ACG 355, Maa 161).

Aulotortus praegaschei (Koehn-Zaninetti) (103). Plate 2, Fig. 10.

Occurrence in China. – Tianjingshan Formation between Guanyinyan and Xiejunmen (sample Maa 146).

Distribution. – Upper Ladinian-Norian in the Alps and the Carpathians (Salaj et al. 1983, Zaninetti 1968, 1969). Recorded also from Iran (Brönnimann et al. 1975).

Austrocolomia sp. (50)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan Province, (sample Maa 146). Recorded also from the Tianjingshan Formation of Hanwang, and from Upper Norian strata of Xizang (Tibet) (He Yan 1982).

Distribution. – Genus *Austrocolomia* Oberhauser, 1960 has been recorded from M. Triassic (Anisian) to U. Triassic (Rhaetian) strata in Austria, Czechoslovakia and Turkey (Loeblich & Tappan, 1988).

Coronipora austriaca (Kristan) (86). Plate 2, Fig. 12.

Occurrence in China. – Maantang Formation at Xiaoemei railway tunnel, Shuguang coal mine, Hanwang, Mianzhu District, Sichuan (sample Maa 150). Recorded also from the Maantang Formation in other parts of Sichuan, e.g. Jiangyou (He Yan & Yue 1988).

Distribution. – Uppermost Norian-Lower Rhaetian strata in the West Carpathians and the Austrian Alps (Kristan 1957, Salaj et al. 1983). Recorded also from Tunisia (Atlas Mountains) according to Zaninetti 1976.

Cryptoseptida fragilis Sellier de Civrieux & Dessauvagie (61)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162).

Distribution. – Upper Permian of Turkey (Sellier De Civrieux & Dessauvagie 1965).

Duotaxis birmanica Zaninetti & Brönnimann (105)

Occurrence in China. – In Tianjingshan Formation N of Hanwang, Mianzhu County, Sichuan (sample Maa 146). Recorded also from Norian strata in Yushu, Qinghai Province.

Distribution. – Norian strata in Burma and in the western Carpathians (Brönnimann et al. 1975, Salaj et al. 1983).

Duotaxis metula Kristan (106)

Occurrence in China. – Recorded from Tianjingshan Formation, N of Hanwang, Mianzhu District, Sichuan (sample Maa 146).

Distribution. – Described from Norian–Rhaetian strata of the Austrian Alps (Kristan 1957, Kristan-Tollmann 1964, Tollmann & Kristan-Tollmann 1970).

Endothyra kuepperi Oberhauser (108). Plate 1, Fig. 2.

Occurrence in China. – Recorded from Tianjingshan Formation, N of Hanwang, Mianzhu District, Sichuan (sample Maa 146), and from Anisian strata of Guiyang, Guizhou Province (He Yan 1984).

Distribution. – Recorded from Ladinian to Carnian strata in the Austrian Alps, Western Carpathians, Italy, the Dinarides and the Balkans (Salaj et al. 1983).

Eoguttulina simplex Terquem (46).

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162).

Distribution. – Upper Triassic – Lower Jurassic (Kristan-Tollmann 1964).

Falsopalmula arignota (Kristan-Tollmann) (16)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample ACG 355). According to He & Yue (1988) this species does also occur in the Tianjingshan Formation of Maantang, Jiangyou, Sichuan.

Distribution. – Rhaetian. Originally described from the Rhaetian of Austria (Kristan-Tollmann 1964).

Gaudryina triadica Kristan-Tollmann (112)

Occurrence in China. – Tianjingshan Formation, from exposure between Guanyinyan and Xiejunmen, N of Hanwang, Mianzhu District, Sichuan (sample Maa 146).

Distribution. – Originally described from the Rhaetian of Austria (Kristan-Tollmann 1964). Recorded also from Ladinian to Lower Rhaetian of West Carpathians (Salaj et al. 1983).

Geinitzinita tenera (Bornemann) (1)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample ACG 355).

Distribution. – Various forms, regarded as subspecies of *Geinitzinita tenera*, have been recorded from the Rhaetian of the Austrian Alps (Kristan-Tollmann 1964). Stratigraphical range in Europe: Rhaetian-Lower Jurassic (Norling 1972). No pre-Rhaetian records are known to the present writers.

Glomospira kuthani (Salaj) (114). Plate 1, Figs. 1, 5

Occurrence in China. – Obtained from the Tianjingshan Formation, north of Hanwang, Mianzhu, Sichuan (sample Maa 146).

Distribution. – Recorded from Carnian strata in West Carpathians and Balkan (Salaj et al. 1983).

Gsollbergella spiroloculiformis Oravecz-Scheffer (100). Plate 1, Fig. 8

Occurence in China. – Recorded in Tianjingshan Formation, north of Hanwang, Mianzhu, Sichuan (samples Maa 145, 146, 147).

Distribution. – In Carnian strata of Hungary (Scheffer 1968), Austrian Alps (Zaninetti, 1976), West Carpathians (Salaj et al. 1983), and northern Italy (Zaninetti 1976).

Lamelliconus ventroplana (Oberhauser) (116). Plate 2, Fig. 9.

Occurrence in China. – Recorded from Tianjingshan Formation, N of Hanwang, Mianzhu District, Sichuan (sample Maa 146). Recorded also from Norian strata of Lanping, Yunnan.

Distribution. – Known from Ladinian to Carnian strata (Middle to Upper Triassic) in the Alps, Carpathians and Turkey (Zaninetti 1976, Salaj et al. 1983).

Lenticulina acutiangulata (Terquem) (51)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162), and from Norian strata of Lanping, Yunnan.

Distribution in Europe. – Recorded from Rhaetian strata in the Austrian Alps (Kristan-Tollmann 1964). Common in Liassic strata in different parts of Europe (Norling 1972).

Lenticulina gottingensis (Bornemann) (71)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 161). Recorded also from the Tianjingshan Formation of Maantang, Jiangyou, Sichuan and from Norian strata of Lanping, Yunnan.

Distribution. – Carnian - Aalenian strata in Europe (Kristan-Tollmann 1964, Oravecz-Scheffer 1965, Norling 1972).

Lenticulina incisa (Terquem) (52)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162).

Distribution. – Rhaetian-Lower Jurassic in Europe (Kristan-Tollmann 1964).

Lenticulina nautiloides (Bornemann) (53)

Occurrence in China. – Maantang Formation, Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162), and in Norian strata of Lanping, Yunnan.

Distribution. – Rhaetian-Lower Jurassic in Europe (Kristan-Tollmann 1964, Bornemann 1854, Franke 1936, Rabitz 1963).

"Lingulina" placklesensis Kristan-Tollmann (27)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (samples Maa 161, 162, ACG 355).

Distribution. – Rhaetian strata in Nieder-Osterreich (Kristan-Tollmann 1970).

Synonymy.- ? *Septalingulina tetrasepta* nov. sp.

Marginulina lamellosa Terquem & Berthelin (79)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 160).

Distribution. – Hettangian-Pliensbachian strata in Europe (Norling 1972)

Miliolipora cuvillieri Brönnimann & Zaninetti (40). Plate 1, Figs. 14, 15, 17, 18.

Occurrence in China. – Obtained from the Maantang Formation; from a gully near the Xiaoemei railway tunnel (sample Maa 155); in an exposure on ther Mianyan River, near Guanyinyan (Maa 151), and at Qingyangou (Maa 160–162, ACG 355), Mianzhu District, Sichuan.

Distribution. – Recorded from Upper Carnian – Rhaetian strata in the Austrian Alps, West Carpathians, the Dinarides, Iran, and from the Carnian of Turkey (Salaj et al. 1983), and Hungary (Oravecz-Scheffer 1987).

Nodosaria columnaris Franke (55)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162).

Distribution.- Forms showing affinity to *N. columnaris* recorded from the Rhaetian of Austria by Kristan-Tollmann (1964, p.72). Hettangian-Aaalenian in Europe (Norling 1972).

Nodosaria nitidana BRAND (56)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162).

Distribution. – Rhaetian-Lower Jurassic in Europe (Brand 1937, Usbeck 1952, Seibold & Seibold 1955, Pietrzenuk 1961, Kristan-Tollmann 1964). Recorded also from Carnian strata in the West Carpathians (Salaj et al. 1983).

Nodosaria oculina Terquem & Berthelin (3)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (samples Maa 160, 161, 162, ACG 355).

Distribution. – Rhaetian-Lower Jurassic in Europe (Kristan-Tollmann 1964).

Nodosaria vermicularis Terquem (28). Plate 3, Fig. 11.

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (Maa 160–162, ACG 355).

Distribution. – Rhaetian-Lower Jurassic in Europe (Terquem 1866, Franke 1936, Bartenstein & Brand 1937, Kristan-Tollmann 1964, Norling 1968).

Ophthalmidium carinatum (Leischner) (98)

Occurrence in China. – Obtained from Maantang Formation, Xiaomei railway tunnel, north of Hanwang, Mianzhu District, Sichuan (sample Maa 155).

Distribution. – Recorded from the Austrian Alps, the Dinarides, and from Taurus Oriental in Turkey in Norian, Rhaetian and Liassic strata (Zaninetti 1976, Salaj et al. 1983).

Ophthalmidium fusiformis (Trifonova) (75)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 161). Recorded also from the Nyalam District, Xizang (Tibet).

Distribution. – Carnian-Norian of Balkan and Hungary (Zaninetti 1976) and the West Carpathians (Salaj et al. 1983).

Ophthalmidium triadica (Kristan-Tollmann) (60)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162). Recorded also from the Tingri District, Xizang (Tibet).

Distribution. – Norian–Rhaetian of the Austrian Alps, Hungary, and Caucasus (Kristan-Tollmann 1964, Oravecz-Scheffer 1987, Efimova 1974).

Ophthalmidium tricki (Langer) (110)

Occurrence in China. – Tianjingshan Formation, in exposure between Guanyinyan and Xiejunmen, N of Hanwang, Mianzhu District, Sichuan (sample Maa 146).

Distribution. – Upper Anisian in Turkey and Caucasus (Zaninetti 1976), Carnian strata in the West Carpathians (Salaj et al. 1983).

Pachyphloides brizaeformis (Bornemann) (79b)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 160).

Distribution. – Lower Jurassic in Britain and Europe (Sellier De Civrieux & Dessauvagie 1965, Norling 1972).

Pachyphloides klebelsbergi (Oberhauser) (30)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (samples Maa 160, 161, 162, ACG 355).

Distribution. – Upper Permian of Turkey, Ladinian of the Austrian Alps, Lower Carnian of the West Carpathians (Salaj et al. 1983)

Pachyphloides oberhauseri Sellier de Civrieux & Dessauvagie (31). Plate 3, Fig. 4.

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (samples Maa 160, 161, 162, ACG 355).

Distribution. – Carnian to Rhaetian in Europe (Sellier De Civrieux & Dessauvagie 1965).

Palaeomiliolina oculata (Antonova) (87)

Occurrence in China. – Maantang Formation; from an exposure in Xiaoemei railway tunnel, near Shuguang coal mine, Hanwang, Mianzhu District, Sichuan (sample Maa 150).

Distribution. – Ladinian and Rhaetian strata in the West Carpathians (Salaj et al. 1983). Originally described from the Bajocian of Caucasus (Antonova 1958).

Palaeomiliolina tenuis Ho (59)

Occurrence in China. –Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162), Upper Triassic strata in Xizang (Tibet) (Ho Yan et al., 1976).

Distribution. – Norian-Rhaetian strata in China.

Planiinvoluta carinata Leischner (118). Plate 1, Fig. 13.

Occurrence in China. – Tianjingshan Formation, north of Hanwang, Mianzhu District, Sichuan (sample Maa 146).

Distribution. – Recorded from the Austrian Alps, Jura Mountains, the Carpathians, Greece and Burma; in Middle - Upper Triassic and Jurassic strata.

Pragsoconulus robustus Oberhauser (120)

Occurrence in China. – In Tianjingshan Formation, north of Hanwang, Mianzhu District, Sichuan (sample Maa 146).

Distribution. – Recorded from the Upper Ladinian of the Austrian Alps (Oberhauser 1960).

Pseudonodosaria densa (Tappan) (63)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162)

Distribution. – Originally described from the Upper Triassic of Alaska (Tappan 1951).

Pseudonodosaria holocostata (Kristan-Tollmann) (8)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (samples Maa 162, ACG 355).

Distribution. – Originally described from the Rhaetian of the Austrian Alps (Kristan-Tollmann 1964). Recorded also from the Lower Jurassic (Hettangian) of Sweden (Norling 1972).

Pseudonodosaria lata (Tappan) (64)

Occurrence in China. – Maantang Formation at Qingyangou. Hanwang, Mianzhu District, Sichuan (samples Maa 161, 162). Recorded also from Upper Triassic strata of Jinggu District, Yunnan (He Yan herein).

Distribution. – Originally described from the Upper Triassic of Alaska (Tappan 1951).

Pseudonodosaria plurimicostata (Kristan-Tollmann) (65)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162).

Distribution. – Originally described from the Rhaetian of Austria (Kristan-Tollmann 1964).

Pseudonodosaria sexcostata (Bornemann) (9)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample ACG 355).

Distribution. – Lower Jurassic in Europe (Norling 1972).

Pseudonodosaria simpsonensis (Tappan) (33). Plate 3, Fig. 10.

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (samples Maa 160, 161, 162, ACG 355). Recorded also from the Tianjingshan Formation of Maantang, Jiangyou, Sichuan and from Upper Triassic strata of Jinggu, Yunnan (He Yan herein).

Distribution. – Originally described from the Upper Triassic of Arctic Alaska (Tappan 1951). Recorded also from the Rhaetian of Austria (Kristan-Tollmann 1964).

Pseudonodosaria vulgata (Bornemann) (34)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (samples Maa 160, 162, ACG 355).

Distribution. – Rhaetian strata in the Austrian Alps (Kristan-Tollmann 1964). Jurassic – Lower Cretaceous in Europe (Norling 1972).

Reophax rudis Kristan-Tollman (122)

Occurrence in China. – Tianjingshan Formation, N of Hanwang, Mianzhu District (sample Maa 146).

Distribution. – Recorded from Upper Norian-Rhaetian strata in the Austrian Alps (Kristan-Tollmann 1964).

Semiinvoluta clari Kristan (18)

Occurence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (samples Maa 161, 162, ACG 355).

Distribution. – Norian-Lower Rhaetian in the Austrian Alps and West Carpathians (Kristan 1957, Salaj et al. 1983). Restricted to the Rhaetian according to Zaninetti (1976).

Triadodiscus eomesozoicus (Oberhauser) (125)

Occurrence in China. – Tianjingshan Formation, exposed between Guanyinyan and Xiejunmen, N of Hanwang, Mianzhu District, Sichuan (samples Maa 145, 146). Recorded also from Ladinian strata of Maantang, Jiangyou, Sichuan (He Yan herein).

Distribution. – Described under the generic name *Involutina*. Recorded from Ladinian-Hettangian strata according to Zaninetti (1976). Widespread in Europe as well as in Asia (the Alps, West Carpathians, the Dinarides, Taurus in Turkey, Iran, Pakistan, Burma).

Trocholina acuta Oberhauser (82). Plate 2, Fig. 8.

Occurrence in China. – Maantang Formation, N. of Hanwang, Mianzhu, Sichuan (samples Maa 149, 150). Recorded also from Maantang Formation in Jianyou County, Sichuan.

Distribution. – In Norian strata in the Austrian Alps, Carpathians, and in Tunisia (Kristan-Tollmann 1964, Zaninetti 1976, Salaj et al. 1983).

Trocholina eduardii Tollmann & Kristan-Tollmann (36). Plate 1, Fig. 16.

Occurrence in China. – Recorded from Maantang Formation at Qingyangou, N of Hanwang, Mianzhu, Sichuan (samples Maa 160, 161, ACG 355).

Distribution. – In Norian–Rhaetian strata in the Austrian Alps.

Turrispirillina minima Pantic (92). Plate 2, Fig. 13.

Occurrence in China. – Maantang Formation at Shuguang coal mine, near Xiaoemei railway tunnel, Hanwang, Mianzhu District, Sichuan (sample Maa 149).

Distribution. – Norian-Rhaetian of the Dinarides, Norian-Rhaetian of West Carpathians (Pantic 1967, Salaj et al. 1983).

Vaginulinopsis cryptospira (Paalzow) (67)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162). Recorded also from Ladinian strata of Maantang, Jiangyou District, Sichuan (He Yan herein).

Distribution. – Rhaetian – Lower Jurassic strata in Austria and Germany (Kristan-Tollmann 1964).

Vaginulinopsis deformis (Bornemann) (68)

Occurrence in China. – Maantang Formation at Qingyangou, Hanwang, Mianzhu District, Sichuan (sample Maa 162).

Distribution. – Rhaetian-Lower Jurassic in Europe (Kristan-Tollmann 1964).

Variostoma acutiangulata Kristan-Tollmann (72)

Synonymy.-? *Variostoma angulata* (Trifonova)

Occurrence in China. – Maantang Formation, Mianyuan River, near Guanyinyan (sample Maa 152), and from Qingyangou (sample Maa 160). Recorded also from Norian strata of Lanping, Yunnan (He Yan herein).

Distribution. – In Upper Norian-Lower Rhaetian strata in E. Alps, West Carpathians, Hungary (Salaj et al. 1983, Oravecz-Scheffer 1987), Norian strata of the Balkan Peninsula (Trifonova 1962).

Variostoma coniforme Kristan-Tollmann (20). Plate 2, Fig. 15.

Occurrence in China. – Maantang Formation at Qingyangou, N of Hanwang, Mianshu, Sichuan (samples Maa 160, 161, ACG 355). Recorded also from Norian strata in Heqing, Yunnan (He Yan herein).

Distribution. – Rhaetian in Eastern Alps (Kristan-Tollmann 1964).

Remarks. – Zaninetti (1976) does not identify Rhaetian as an individual stage. She refers Rhaetian to the uppermost Norian. Harland et al (1989), in their revised geologic timescale, regard Rhaetian as an individual stage, as do the present authors.

In fact *Variostoma coniforme* has never been recorded from other strata than Rhaetian.

Variostoma crassum Kristan-Tollmann (76)

Occurrence in China. – Maantang Formation, Qingyangou, N of Hanwang, Mianzhu, Sichuan (samples Maa 160, 161). Recorded also from Norian strata of Yushu, Qinghai Province (He Yan herein).

Distribution. – Austrian Alps , in Norian? - Rhaetian strata.

Variostoma helicta (Tappan) (77). Plate 2, Fig. 16.

Occurrence in China. – Maantang Formation, N of Hanwang, Mianzhu, Sichuan (samples Maa 160, 161). Recorded also from Norian strata of NW Yunnan and Yushu in Qinghai (He Yan herein).

Distribution. – A species widely spread in China. Originally described from Alaska (Tappan 1951). Known also from Bulgaria. Carnian–Rhaetian.

Variostoma pralongense Kristan-Tollmann (127). Plate 1, Fig. 9.

Occurrence in China. – Tianjingshan Formation, N of Hanwang, Mianzhu, Sichuan (sample Maa 146).

Distribution. – Austrian Alps (Carnian), West Carpathians (Ladinian-Carnian).

Verneuilinoides azzouzi (Salaj) (129). Plate 1, Fig. 6.

Occurrence in China. – Tianjingshan Formation, N of Hanwang,. Mianzhu, Sichuan (sample Maa 146). Recorded also from Norian limestones in Yushu and Zadoi Districts, Qinghai Province.

Distribution. – In Anisian - Rhaetian strata in the West Carpathian (Salaj et al. 1983).

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PLATE I

Figs. 1–13: Specimens from thin sections of rock.
Figs. 14–15, 18: Thin sections of isolated specimens.
Fig. 17: Micrograph in reflected light.

1. *Glomospira kuthani* (Salaj). X 100. Sample Maa 146-3. Cat. No. 114220.

2. *Endothyra kuepperi* Oberhauser. X 100. Sample Maa 146-4. Cat. No.114221.

3. *Ammobaculites hanwangensis* nov. sp. X 80. Sample Maa 149-2. Cat. No. 114222.

4. *Ammobaculites orientalis* nov. sp. X 80. Sample Maa 149-2. Cat. No. 114223.

5. *Glomospira kuthani* (Salaj). X 223. Sample Maa 146-4. Cat. No. 114224.

6. *Verneuilinoides azzouzi* (Salaj). X 38. Sample Maa 146-2. Cat. No. 114225.

7. *Agathammina parafusiformis* Salaj, Borza & Samuel. X 154. Maa 146-2. Cat. No. 114226.

8. *Gsollbergella spiroloculiformis* (Oreveczne Scheffer). X 100. Sample Maa 146-3. Cat. No. 114227.

9. *Variostoma pralongense* Kristan-Tollmann. X 100. Sample Maa 146-1. Cat. No. 114228.

10. *Agathammina austroalpina* Kristan-Tollmann & Tollmann. X 100. Sample Maa 146-5. Cat. No. 114229.

11. *Ammodiscus* sp. X 100. Sample Maa 149-7. Cat. No. 114230.

12. *Ammovertellina* sp. X 100. Sample Maa 146-1. Cat. No. 114231.

13. *Planiinvoluta carinata* Leischner. X 60. Sample Maa 146-2. Cat. No. 114232.

14. *Miliolipora cuvillieri* Brönnimann & Zaninetti. X 63. Sample Maa 160-4. Cat. No. 114233.

15. Ditto. X 104. Sample Maa 162-4. Cat. No. 114234.

16. *Trocholina eduardi* Tollmann & Kristan-Tollmann. X145. Sample Maa 160-2. Cat. No. 114235.

17. *Miliolipora cuvillieri* Brönnimann & Zaninetti. X 64. Sample Maa 162. Cat. No. 114236.

18. Ditto. X 104. Sample Maa 160-5. Cat. No. 114237.

I


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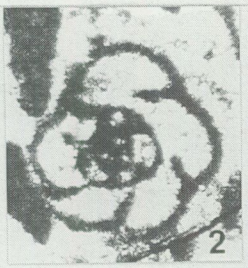
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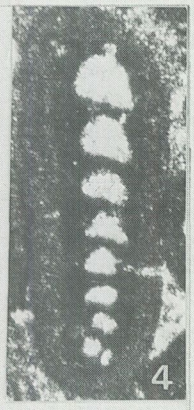
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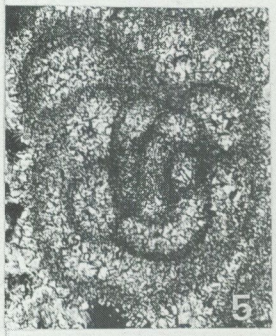
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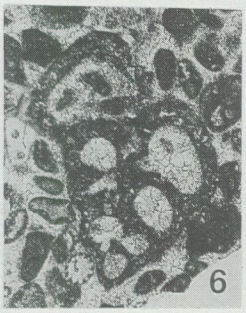
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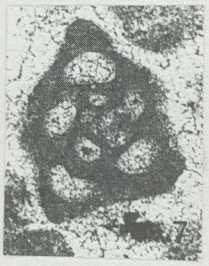
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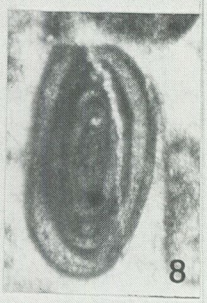
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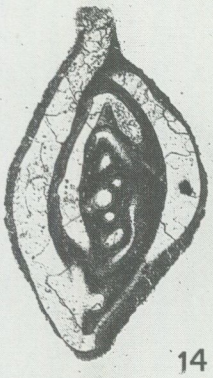
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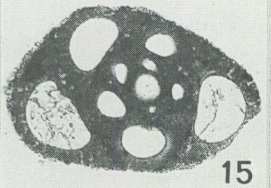
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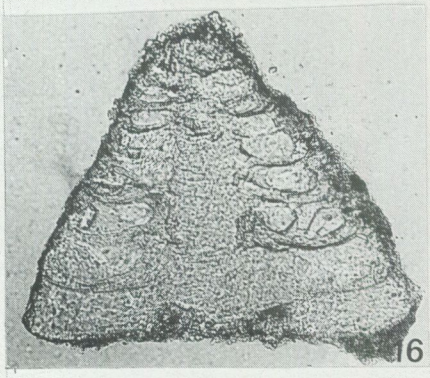
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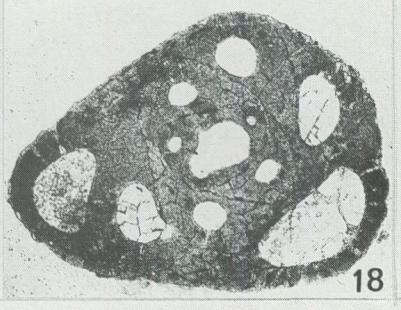

18

PLATE II

Figs. 1-3, 5, 6, 14, 16: Thin sections of isolated specimens.
Figs. 4, 7-13: Specimens from thin sections of rock.
Fig. 15: Scanning electron micrograph.

1. *Ophthalmidium* sp. X 144. Sample Maa 160-3. Cat. No. 114238.

2. *Ophthalmidium* sp. X 102. Sample Maa 160-6. Cat. No. 114239.

3. *Auloconus permodiscoides* (Oberhauser). X 62. Sample Maa 161-2. Cat. No. 114240.

4. *Angulodiscus tumidus* Kristan-Tollmann. X 100. Sample Maa 149-3. Cat. No. 114241.

5. *Auloconus rotundata* nov. sp. X 147. Sample Maa 161-1. Cat. No. 114242. Holotype.

6. *Auloconus rotundata* nov. sp. X 105. Sample Maa 161-3. Cat. No. 114243.

7. *Eoguttulina* sp. X 93. Sample Maa 146-8. Cat. No. 114244.

8. *Trocholina acuta* Oberhauser. X 145. Sample Maa 150-3. Cat. No. 114245.

9. *Lamelliconus ventroplana* (Oberhauser).X 138. Sample Maa 146-9. Cat. No. 114246.

10. *Aulotortus praegaschei* (Koehn-Zaninetti). X 143. Sample Maa 146-10. Cat. No. 114247.

11. *Variostoma* sp. ? X 80. Sample Maa 149-6. Cat. No. 114248.

12. *Coronipora austriaca* (Kristan). X 139. Sample Maa 150-5. Cat. No. 114249.

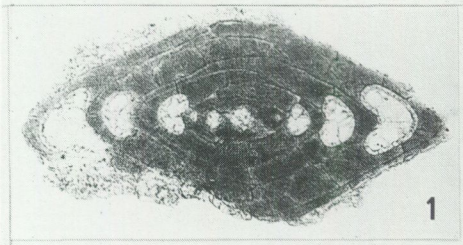
13. *Turrispirllina cf minima* Pantic. X 106. Sample Maa 150-2. Cat. No. 114250.

14. *Angulodiscus tenuis* Kristan. X 106. Sample Maa 161-4. Cat. No.114251.

15. *Variostoma coniforme* Kristan-Tollmann. X 108. Sample Maa 160. Cat. No. 114252.

16. *Variostoma helicta* (Tappan). X 106. Sample Maa 160-1. Cat. No.114253.

II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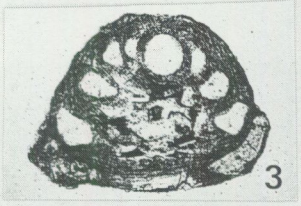
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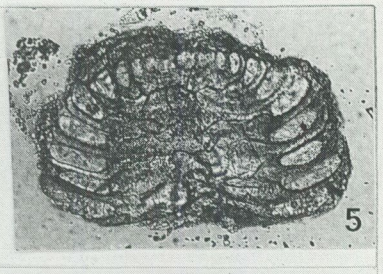
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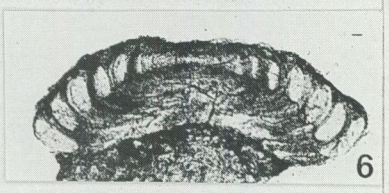
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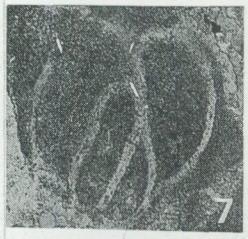
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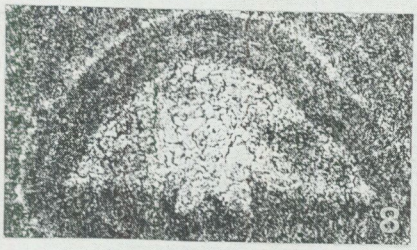
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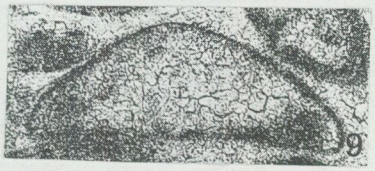
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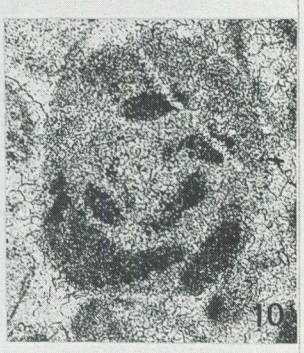
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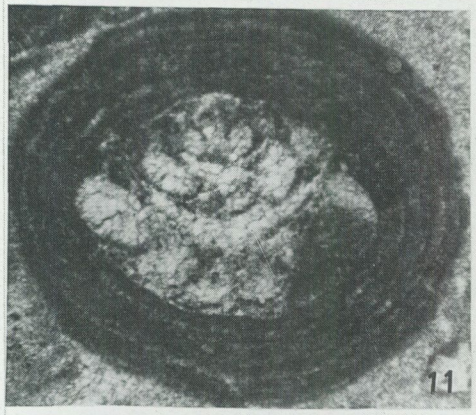
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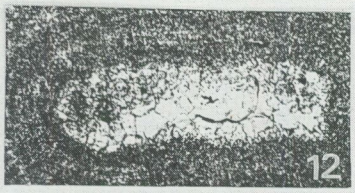
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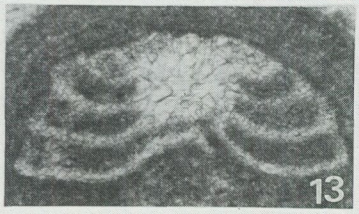
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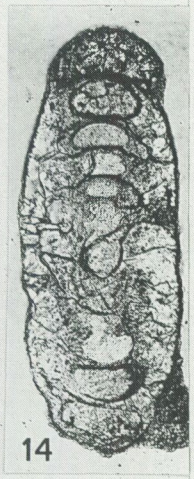
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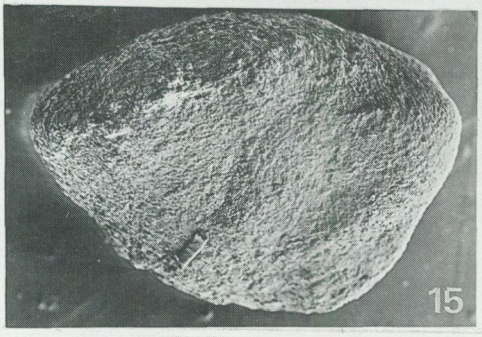
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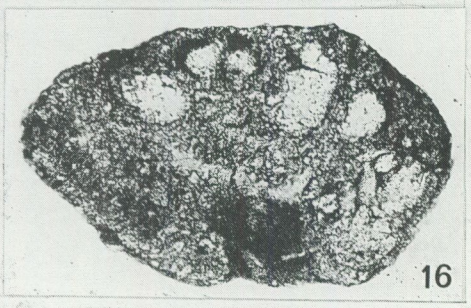

16

PLATE III

Longitudinal sections of nodosariid Foraminifera.

1. *Pseudonodosaria* sp. X 150. Sample Maa 162-8. Cat. No. 114254.

2. *Pseudonodosaria* sp. X 100. Sample Maa 162-7. Cat. No. 144255.

3. *Pachyphloides* sp. X 100. Crossed nicols. Sample Maa 161-8. Cat. No. 114256.

4. *Pachyphloides oberhauseri* Sellier de Civrieux & Dessauvagie. X 100. Sample Maa 161-5. Cat. No. 114257.

5. *Falsopalmula* sp. X 90. Sample Maa 162-5. Cat. No. 114258.

6. *Lenticulina* sp. X 60. Sample Maa 162-11. Cat. No. 114259.

7. *Lenticulina* sp. X 40. Sample Maa 161-6. Cat. No. 114260.

8. *Geinitzinita* sp. X 150. Sample Maa 162-10. Cat. No. 114261.

9. Same specimen as in Fig. 8. Crossed nicols.

10. *Pseudonodosaria simpsonensis* (Tappan). X 120. Sample Maa 161-7. Cat. No. 114262.

11. *Nodosaria vermicularis* (Terquem). X 120. Sample Maa 162-13. Cat. No.114263.

III

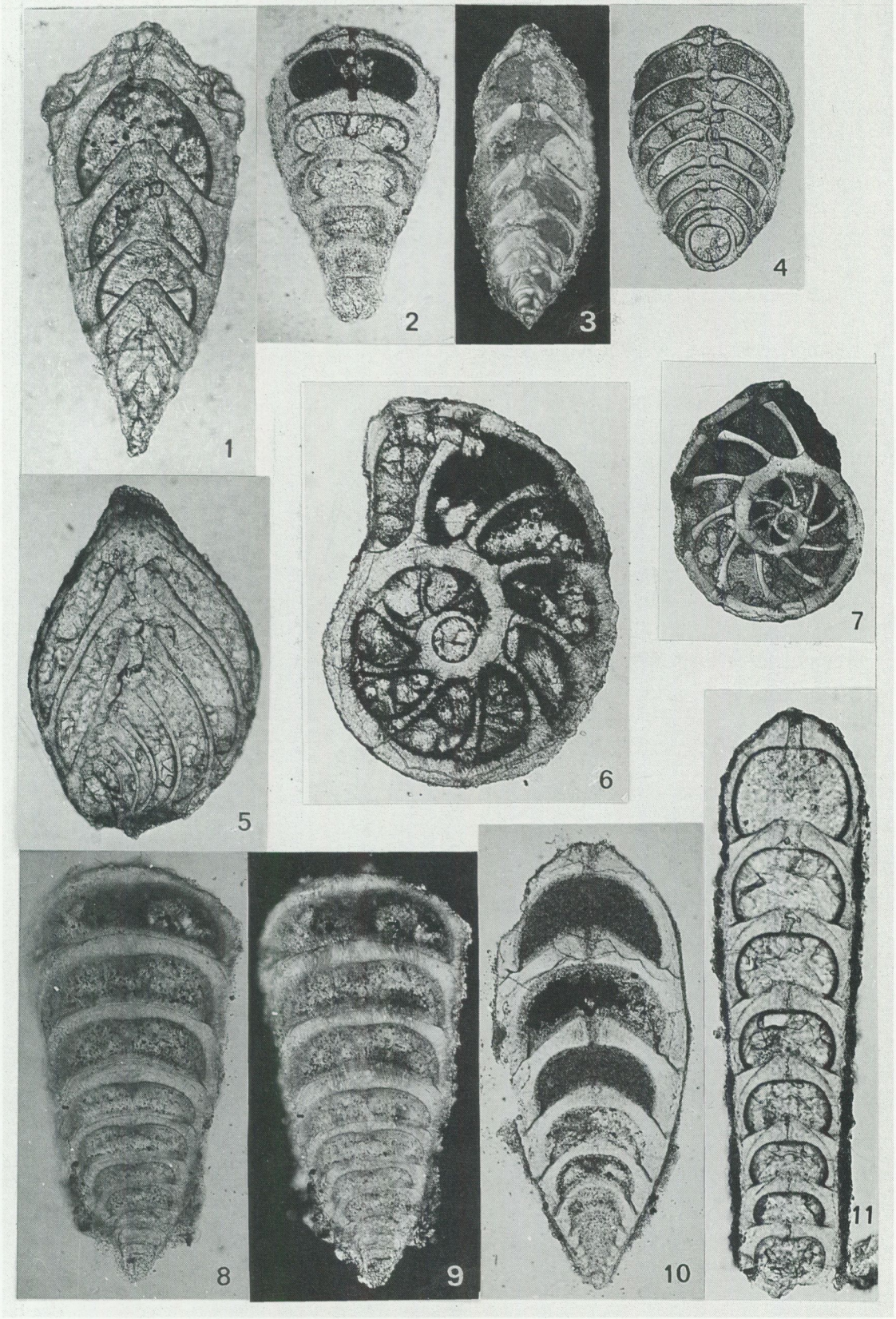


PLATE IV

Figs. 1-9. Thin sections of isolated foraminiferal specimens.
Fig. 10. Micrograph taken in common photomicroscope.
Figs. 11-14. Scanning electron micrographs.

1. *Austrocolomia* sp. X 164. Sample Maa 146-8. Cat. No. 114264.

2. *Pseudonodosaria* sp. X 80. Sample Maa 149-5. Cat. No. 114265.

3. *Pseudonodosaria* sp. X 62. Sample Maa 150-4. Cat. No. 114266.

4. *Septalingulina* sp. ? X 170. Sample Maa 150-3.Cat. No. 114267.

5. *Septalingulina tetrasepta* nov. sp. X 230. Transverse section. Sample Maa 162-2. Cat. No. 114268.

6. Same specimen as in Fig. 5. Transverse section. X 100.

7. *Austrocolomia* sp. X 150. Sample Maa 146-4. Cat. No. 114269.

8. *Septalingulina tetrasepta* nov. gen., nov sp. X 100. Sample Maa 162-3. Longitudinal section. Cat. No. 114270.

9. Ditto. X 100. Sample Maa 162-1. Cat. No. 114271.

10. *Septalingulina tetrasepta* nov. sp. X 80. Sample ACG 355. Micrography in reflected light. Cat. No. 114272.

11. *Pseudonodosaria holocostata* Kristan-Tollmann. X 115. Sample ACG 355. Cat. No. 114273.

12. *Septalingulina tetrasepta* nov. gen. nov. sp. X 115. Sample Maa 162. Holotype. Cat. No. 114274.

13. *Septalingulina tetrasepta* nov. gen. nov. sp. X 115. Sample Maa 162. Cat. No. 114275.

14. *Falsopalmula* sp. X 42. Sample ACG 355. Cat. No. 114276.

IV

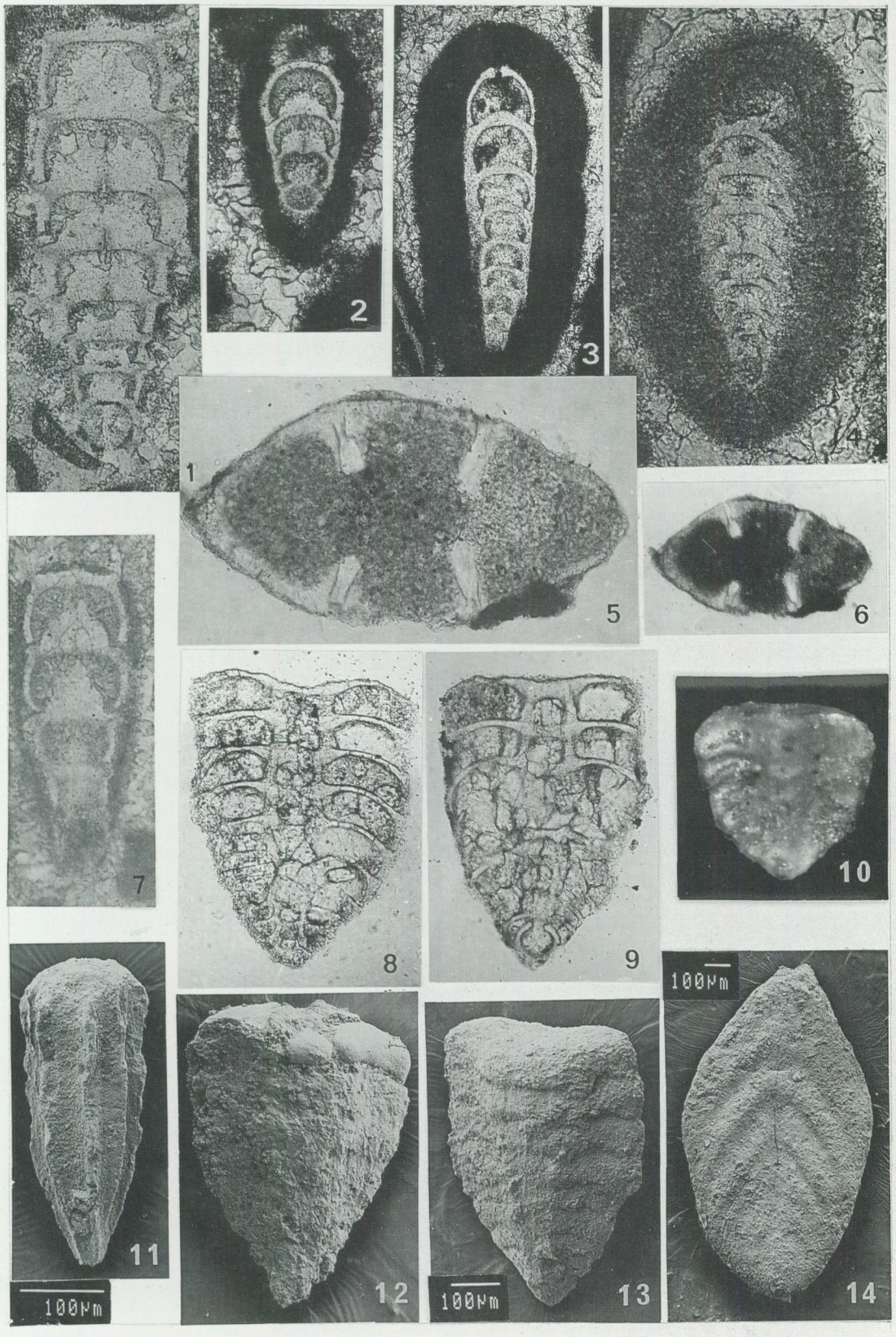


PLATE V

UPPER TRIASSIC MICROFACIES

1. Biopelmicrite with Foraminifera, including *Planiinvoluta carinata* Leischner. X 62. Sample Maa 145. Tianjingshan Formation. Carnian.

2. Sparite with nodosariid and miliolid Foraminifera. X 20. Sample Maa 146-9. Tianjingshan Formation. Carnian.

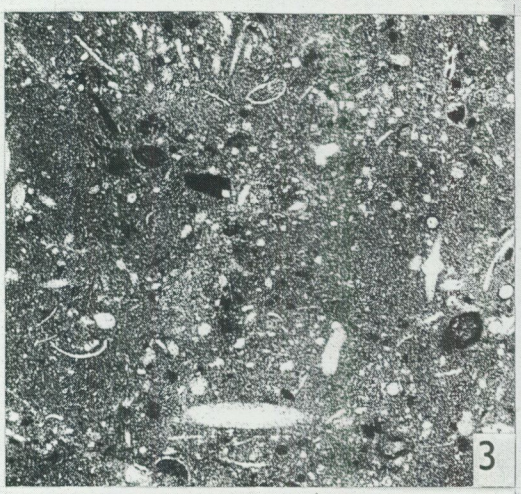
3. Micrite with interclasts of sponge spicules, Foraminifera *(Ophthalmidium)*, ostracods, and bivalves. X 33. Sample Maa 153. Maantang Formation. Norian.

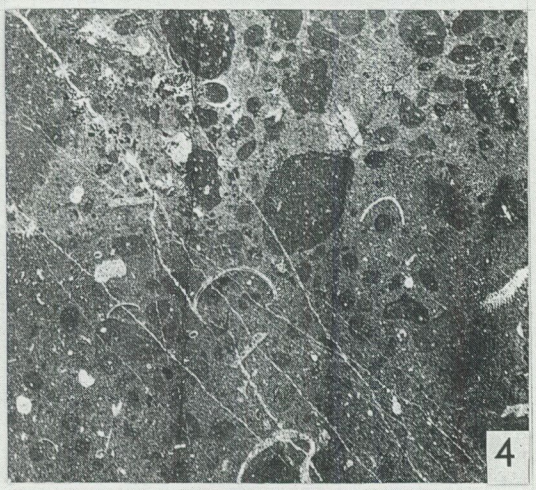
4. Micrite with interclasts of bivalves and echinoderms. X 9.5. Sample Maa 151. Maantang Formation. Norian.

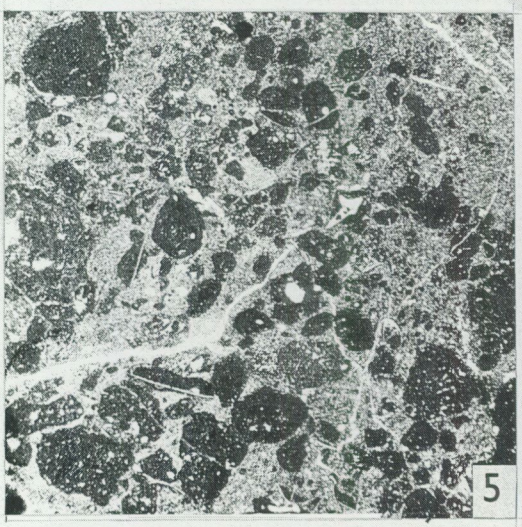
5. Microsparite with intramicrite and reophacid and miliolid Foraminifera. X 9.5. Sample Maa 155. Maantang Formation. Norian.

6. Oosparite with bioclasts of miliolid Foraminifera. X 9.5. Sample Maa 149-7. Maantang Formation. Norian.

V







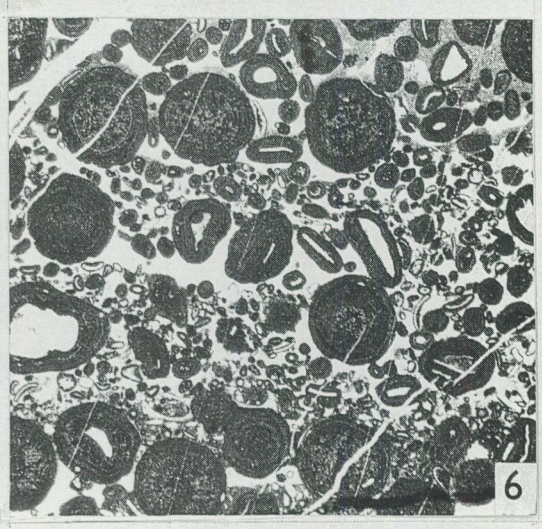


Fig. 12

RANGE CHART OF FORAMINIFERA FROM THE UPPER TRIASSIC OF MIANZHU, SICHUAN CHINA

HE YAN & ERIK NORLING, 1990

* Index fossil

RANGES IN MIANZHU SICHUAN, CHINA

MAANTANG FORMATION / TIANJINGSHAN FORMATION

N8 | N7 | N3 | N2 | C3 | C1

ACG 355 | Maa 162 | Maa 161 | Maa 160 | Maa 152 | Maa 151 | Maa 150 | Maa 154 | Maa 153 | Maa 149 | Maa 155 | Maa 147 | Maa 146 | Maa 145

STRATIGRAPHICAL RANGES (MAINLY BASED ON RECORDS FROM ASIA, EUROPE AND NORTH AFRICA)

JUR. | TRIASSIC | U. PAL

U. Jurassic | M. Jurassic | L. Jurassic | Rhaetian | Norian | Carnian | Ladinian | Anisian | Skythian | U. Permian | L. Permian | Carboniferous

	1	Geinitzinita tenera
	2	Eoguttulina sp. No. 1
	3	Nodosaria oculina
	4	Saracenaria sp.
	5	Geinitzinita sp. No. 1
	6	Prodentalina sp.
	7	Cryptoseptida sp.
	8	Pseudonodosaria holocostata
	9	Pseudonodosaria sexcostata
	10	Astacolus major
	11	Astacolus neoradiata
	12	Auloconus permodiscoides
	13	Auloconus rotundata nov. sp.
	14	Pachyphloides sp.
	15	Falsopalmula sp.
*	16	Falsopalmula arignota
	17	Semiinvoluta sp.
*	18	Semiinvoluta clari
	19	Vaginulinopsis sp.
*	20	Variostoma coniforme
	21	Astacolus sp.
	22	Duostomina sp.
	23	Eoguttulina sp. No. 2
	24	Ophthalmidium sp. No. 1
	25	Geinitzinita sp. No. 2
	26	Lenticulina sp.
	27	"Lingulina" aff. placklesensis
	28	Nodosaria vermicularis
	29	Pachyphloides sp.
	30	Pachyphloides klebelsbergi
	31	Pachyphloides oberhauseri
	32	Pseudonodosaria sp. No. 1
	33	Pseudonodosaria simpsonensis
	34	Pseudonodosaria vulgata
	35	Pseudonodosaria sp. No. 2
	36	Trocholina eduardii
	37	Nodosaria sp.
*	38	Septalingulina tetrasepta nov. sp
	39	Ophthalmidium sp. No. 2
	40	Miliolipora cuvilleri
	41	Trochlina sp.
	42	Variostoma sp.
	43	Astacolus gryphaea
	44	Astacolus magna
	45	"Dentalina" sp.
	46	Eoguttulina simplex
	47	Eoguttulina sp. No. 3
	48	Grillina sp.
	49	Ichthyolaria sp.
	50	Austrocolomia sp.
	51	Lenticulina acutiangulata
	52	Lenticulina incisa
	53	Lenticulina nautiloides
	54	Marginulina sp.
	55	Nodosaria columnaris
	56	Nodosaria nitidana
	57	Nodosaria sp.
	58	Nodosinellidae sp.
	59	Palaeomiliolina tenuis
*	60	Ophthalmidium triadica
	61	Cryptoseptida fragilis
	62	Pseudolangella sp.
	63	Pseudonodosaria densa
	64	Pseudonodosaria lata
	65	Pseudonodosaria plurimicostata
	66	Vaginulina sp.
	67	Vaginulinopsis cryptospira
	68	Vaginulinopsis deformis
	69	Angulodiscus tenuis
	70	Aulotortus sp.
	71	Lenticulina gottingensis
	72	Variostoma acutiangulata
	73	Ophthalmidium sp. No. 3
	74	Palaeomiliolina sp.
	75	Ophthalmidium fusiformis
	76	Variostoma crassum
	77	Variostoma helicta
	78	Ophthalmidium sp. No. 4
	79a	Marginulina lamellosa
	79b	Pachyphloides brizaeformis
	80	Ammodiscus sp.
	81	Miliolipora aff. cuvilleri
*	82	Trocholina acuta
	83	Nodosariidae indet.
	84	Angulodiscus tumidus
	85	Coronipora sp.
*	86	Coronipora austriaca
	87	Palaeomiliolina occulata
	88	Palaeomiliolina sp. No. 1
	89	Palaeomiliolina sp. No. 2
	90	Turrispirillina sp.
	91	Ammobaculites hanwangensis
	92	Turrispirillina cf. minima
	93	Turrispirillina sp. No. 2
	94	Agathammina sp.
	95	Ammobaculites aff. hanwangensis
	96	Ammobaculites orientalis
	97	Spirillina sp.
	98	Ophthalmidium carinatum
	99	Agathammina austroalpina
*	100	Gsollbergella spiroloculiformis
	101	Agathammina parafusiformis
	102	Ammovertellina sp.
	103	Aulotortus praegaschei
	104	Austrocolomia sp.
*	105	Duotaxis birmanica
	106	Duotaxis metula
	107	Endothyra sp.
	108	Endothyra kuepperi
	109	Eoguttulina sp. No. 4
	110	Ophthalmidium tricki
	111	Galeanella sp.
	112	Gaudryina cf. triadica
	113	Glomospira sp.
*	114	Glomospira kuthani
	115	Lamelliconus sp.
	116	Lamelliconus ventroplana
	117	Planiinvoluta sp.
	118	Planiinvoluta carinata
	119	Pragsoconulus sp.
	120	Pragsoconulus robustus
	121	Reophax sp.
	122	Reophax rudis
	123	Sigmoilina sp. ?
	124	Triadodiscus sp.
	125	Triadodiscus eomesozoicus
	126	Valvulina sp.
	127	Variostoma pralongense
	128	Verneuilinoides sp.
	129	Verneuilinoides azzouzi

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