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Editor: Hans Kerp
c/o ALBERTIANA
Laboratory of Palaeobotany and Palynology
University Utrecht
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3584 CS Utrecht
The Netherlands

The primary aim of ALBERTIANA is to promote the interdisciplinary collaboration and understanding among the members of the I.U.G.S. Subcommission on Triassic Stratigraphy. Within this scope ALBERTIANA serves both as a newsletter for the announcement of general information and as a platform for discussion of developments in the field of Triassic stratigraphy. ALBERTIANA thus encourages the publication of announcements, literature reviews, progress reports, preliminary notes etc. - i.e. those contributions in which information is presented relevant to current interdisciplinary Triassic research.

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Cover: Muschelkalk fossil community (from Hagdorn, 1991)

TRIASSIC SEQUENCE STRATIGRAPHY, THE NEW CHALLENGE

Henk Visscher

At present, applied stratigraphy is profoundly influenced by the concept of sequence stratigraphy, originally formulated through the interpretation of seismic sections and later applied to well data and outcrop information. The method is aimed at identifying sea-level changes that can be used as a basis for achieving high resolution chronostratigraphical frameworks in which to place well log and seismic data.

In the concept of sequence stratigraphy it is often claimed that the major control on sea level changes is induced by the waxing and waning of polar ice caps. Recognized cycles are frequently linked to orbital-climatic cyclicity and resultant curves of eustatic sea-level change are believed to have a global character. However, widespread confidence in the belief that current cycle charts could have a worldwide application potential became a matter of animated debate. Alternative views consider, for example, that relative sea-level changes could well be related to tectonics.

Despite this controversy, sequence stratigraphy is now at the forefront of geological research aimed at the prediction of the distribution of potential source rocks and reservoirs. Although the concept is still developing, in individual basins depositional sequences are already being recognized and analyzed on a routine basis. Novel results include, for example, the correlation of marine and terrestrial deposits. Indeed, sequence stratigraphy is likely to become the integrating stratigraphical methodology which combines data from many branches of geology in a form from which the large-scale geometries of sedimentary rock packages emerge as a natural product.

Thus, to-day, the principal challenge in the practice of Triassic stratigraphy has become the integration of the physical, chemical and biological record within sequence stratigraphical models of basinal development.

Sequence stratigraphy by no means replaces biostratigraphy. The importance of the fossil record is obvious. In every individual basin, the temporal aspect in sequence stratigraphical models can only be validated by means of accurate biostratigraphy. This implies the establishment of refined, time-significant zonation schemes. Accuracy should be improved by integrating multiple zonations based on different categories of organisms.

Uncertainties and controversies in conventional biostratigraphical classification and correlation - at present frequently understated by the provider and underappreciated by the user - have to be resolved, even if this forces the subsurface biostratigrapher to go back into the field to re-study relevant type and reference sections. Unacceptable margins of error or biases with respect to the calibration of biostratigraphies against numerical time scales should be identified.

Sequence stratigraphy will increasingly demand relative biochronology with a temporal resolution of better than 0.5 m.y. Such resolutions can only be achieved by promoting the quantitative analysis of (micro)fossil assemblages. Moreover, quantitative analysis provides the possibility of independently constructing environmental models for each time-successive depositional sequence. Patterns of high-sea-level vs. low-sea-level biofacies distributions can reflect the shift of water masses and substrates, independent of configurations predicted by physical analysis. Cyclicity can be independently recognized, whereas quantitative shifts may also provide the necessary proxy records that may discriminate between eustatic or tectonically induced sea-level fluctuations. The greatest single barrier to integrate quantitative studies of the fossil record in sequence stratigraphy is imposed by the very nature of biostratigraphy: an essentially biological approach to historical geology. The reliability of biological interpretations stands or falls with the biostratigrapher's knowledge and insight in a variety of essentially biological disciplines, such as morphology, taxonomy, biogeography, ecology and taphonomy.

With respect to the establishment of a global scheme of chronostratigraphical subdivision and correlation of Triassic rocks, sequence stratigraphical considerations could well play an important role. Already in 1976 the 'International Stratigraphic Guide' recognized the potential of the analysis of alternating eustatically induced transgressions and regressions in chronostratigraphical considerations: *"If the level of the sea did indeed rise and fall periodically during geologic time, the evidence in the rock sequence of these eustatic changes can furnish an excellent basis for establishing a worldwide 'natural' chronostratigraphic framework"*. A globally applicable scheme of sea-level fluctuations has not yet been established. Apart from developing the regional biochronological framework for sequence stratigraphy in individual basins, Triassic biostratigraphical research should therefore concentrate on the problem whether regional sequence boundaries and surfaces of maximum marine flooding can be globally correlated. Moreover, all type areas, stratotypes and (proposed) boundary stratotypes of Triassic stages and substages should be re-studied with an open eye for sequence stratigraphical information that may be used in characterizing and defining these units.

The Subcommission on Triassic Stratigraphy has the responsibility to develop meaningful schemes of chronostratigraphical subdivision and correlation that can be practically applied by the many stratigraphers who have to study Triassic basins throughout the world on a routine basis. These stratigraphers are not helped by the Subcommission's endless discussions on the characterization and definition of stages and their boundaries on the basis of ranges or rare occurrences of single groups of organisms in remote areas. The multidisciplinary approach of sequence stratigraphy, integrating all relevant physical, chemical and biological information, should become part of the Subcommission's interest in order to re-establish a - hopefully refreshing - contact with stratigraphers engaged in basinal analysis.

It is hoped that the possibilities and limitations of sequence stratigraphy in Triassic research will topics of regular discussion in ALBERTIANA. The present issue already includes two original contributions, emphasizing the potential of sequence stratigraphy in Europe and North America. Recently published sequence stratigraphical schemes for the Triassic of Australia, the Arctic and the Southern Alps have been reproduced in the chapter 'Annotated Triassic Literature'.

ERRATUM

Unfortunately, the membership list published in ALBERTIANA 8 included a number of errors. Therefore an updated membership list is given here. If you still encounter incorrect or incomplete addresses, please let us know. Also those who are not listed as officers, voting or corresponding members but who receive ALBERTIANA on a regular basis are kindly requested to keep us informed on changes of address.

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Hans Kerp	ALBERTIANA, c/o Laboratory of Palaeobotany and Palynology, Rijksuniversiteit Utrecht, Heidelberglaan 2, 3584 CS Utrecht, The Netherlands

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HALOBIID BIOSTRATIGRAPHY AND A CARNIAN-NORIAN STAGE BOUNDARY IN NORTHEAST OREGON

C.A. McRoberts and G.D. Stanley, Jr.

Introduction

Since Mojsisovics (1869) erected the Carnian and Norian stages from Hallstatt facies in the Salzkammergut, workers have debated the limits of those stages and their mutual boundary. Discussions continue with refinement of ammonoid, conodont, and halobiid chronologies from the Alpine-Mediterranean Triassic (e.g., Krystyn, 1973, 1980) and North American sequences (e.g., Tozer 1967; Silberling and Tozer, 1968; Carter, et al., 1989). Like the "Rhaetian problem", correlation of the Carnian-Norian boundary between Alpine and North American localities is difficult for lack of an unambiguous Norian stratotype in the Hallstatt and the lack of diagnostic sections and define the Kerri Zone in North America (Tozer, 1974).

The few North American localities where the Carnian-Norian boundary may be present occur in western Nevada, northeast and western British Columbia, and northern Alaska (Silberling and Tozer, 1968, Bloom et al., 1988; Carter, et al.,1989) We add to this list the Martin Bridge Formation (Ross, 1938) for the section in northeastern Oregon located between Eagle and Paddy Creeks in the southern Wallowa Mountains (Smith, 1927). The Martin Bridge at its stratotype is calcareous shale and limestone beds while nearby at Hells Canyon (Vallier, 1977) it consists entirely of carbonate rock. At the Martin Bridge Formation stratotype Smith (1927) recognized *Halobia oregonensis*, *H. salinarum*, and *H. halorica* (= *H. dilatata*). In the absence of ammonoids, Smith placed the Carnian-Norian boundary in 121 m of barren shale and limestone between *H. oregonensis* and an overlying Coral Zone of Lower Norian age. Subsequently, others have reported on shallow-water invertebrates from the section, but only Gruber (in Kristan-Tollmann et al., 1983) reported *H. rugosa* and *H. radiata radiata*. This preliminary report summarizes the halobiid biostratigraphy of northeastern Oregon and work that has been accomplished at the University of Montana.

Although halobiids satisfy the requirements of good zone fossils, taxonomic problems occur from specific to familial levels due to ambiguity in the definition and recognition of taxon-level characters (cf. Gruber, 1976; Campbell, 1985; Polubotko, 1984, 1988, 1990). For lack of a satisfying generic concept and for nomenclature stability, we place forms such as *Parahalobia* Yin and Hsu, *Perihalobia* Gruber, *Indigirohalobia* Polubotko, *Zittelihalobia* Polubotko, and *Pacifihalobia* Polubotko, tentatively under the form genus "*Halobia*". A complete systematic treatment of *Halobia* species listed here is in preparation by the first author.

The Carnian-Norian Sequence in Oregon

Figure 1 shows halobiid zonation at the Martin Bridge stratotype. Here the section is folded and faulted into a number of blocks. Few workers have recognized the structural complexity of the

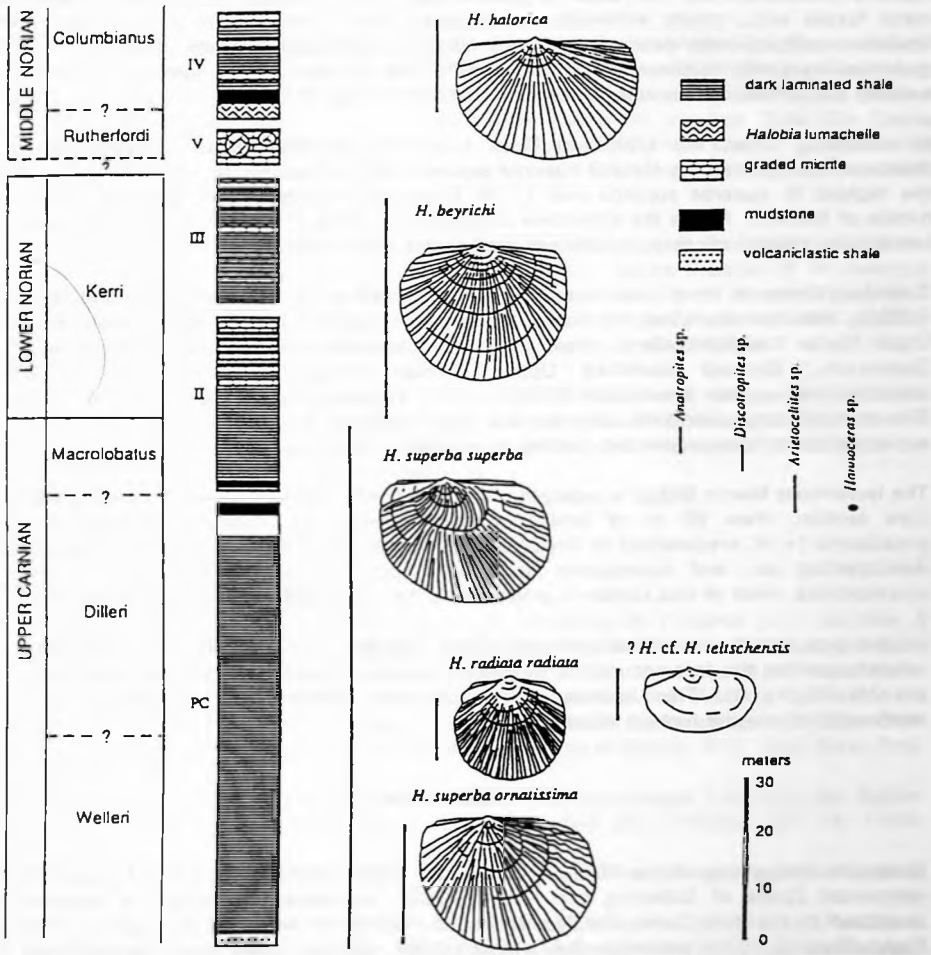

Fig. 1. The zonation of *Halobia* in the Martin Bridge stratotype in the Wallowa Mountains of Oregon. Structural complexities result in at least five blocks which have been reassembled in their most probable stratigraphic arrangement.

stratotype. Most of it is finely-laminated, slightly calcareous, organic rich shale containing abundant halobiids and rare ammonoids and conodonts. Intercalated with the shales are massive mudstones and thin beds of graded micrite with broken and abraded shallow-water reefal fossils (e.g., corals, echinoids, gastropods). High in the section a 10 m thick massive limestone conglomerate debris flow (Block V) with well-rounded clasts up to 1 m containing reefal faunas similar to those in Blocks II and III. This conglomerate in turn is overlain by a 2 m halobiid lumachelle, mudstones, shales and bedded micrites of Block IV.

In ascending order, the shales of Block I contain the ammonoids *Discotropites* sp. and *Arietoceltites* sp. overlain *Halobia superba superba* and *Anatropites* sp.. Beginning 2.7 m above the highest *H. superba superba* and 3.6 m above *Anatropites* sp., *H. beyrichi* ranges to the middle of Block III. Above the limestone conglomerate of Block V, *H. halorica* is abundant in the lumachelle, bedded micrites, mudstones, and shales of Block IV.

Conodont elements have been recovered and identified by M. Orchard (GSC) and B. Wardlaw (USGS). Wardlaw identified mid Norian *Epigondolella primata* and *E. postera* from Block I and Upper Norian *Neogondolella* sp. from about 5 m above the lowest *Halobia beyrichi* in Block II. Conversely, Orchard identified Upper Carnian *Metapolynathadus nodosus* and *M. pseudoechinatus* from the middle of Block III and *Epigondollela* sp. from Block 7 (not shown). The contradictory conodont ages for the upper part of Block II and Block III can not be explained apart from undetected faulting or reworking of the elements.

The lowermost Martin Bridge is exposed on the east side of Paddy Creek 1 km northeast of the type section. Here 90 m of laminated shales contain *H. superba superba*, *H. superba ornatissima* (= *H. oregonensis* of Smith), and *H. radiata* 30 m below a mudstone bed containing *Arietoceltites* sp. and *Hannoceras* sp.. Based on lithologic similarity and calibrated to *Arietoceltites*, most of this section is presumed to be stratigraphically below the type section.

At the type locality, the Carnian-Norian stage boundary is within the 2.7 m barren interval which separates the last occurrence of *Halobia superba superba* and the first occurrence of *H. beyrichi* (Figure 1). This boundary has not been independently confirmed with Norian ammonoids above the highest *Anatropites*.

Discussion

Except for recognition of the Macrolobatus Zone, fossil-bearing levels are not resolvable to the ammonoid Zones of Silberling and Tozer (1968); although, *H. beyrichi* is believed to be restricted to the Kerri Zone. The Mediterranean *Halobia stryiaca* and *H. halorica* Zones of De Capoa Bonardi (1984) occurs in the Oregon section. *Halobia* characteristic of northeast Siberia (Polubotko, 1984) is not present but some correlation with eastern USSR, (Korayak terrane) is possible (Mel'nikova and Bychkov, 1986; Polubotko et al., 1990).

The stratigraphic range of *Halobia superba superba* is not well known from either the Alpine or North American realms. At the Martin Bridge locality, *H. superba superba* is confined to beds mostly above *Discotropites* and *Arietoceltites*, and only slightly above beds with *Anatropites*. This species is known from the Upper Carnian of Alaska, British Columbia, and Nevada where it occurs with *Discotropites* from the Welleri and Dilleri Zones and with *Anatropites* of the Macrolobatus Zone (e.g., Tozer, 1967; Silberling and Tozer, 1968). Although *Halobia superba*

superba is primarily an Upper Carnian species, it does range into the Norian (Gruber, 1976; Cafreio and De Capoa Bonardi, 1980). Recognition of the Macrolobatus Zone in Oregon thus also relies on *Anatropites*.

In addition to undescribed occurrences throughout the North American Cordillera, *Halobia beyrichi* has been reported from Kerri Zone of the Shoshone Mountains in Nevada (Gruber, in Kristan-Tollmann et al., 1983) where it occurs with *Stikineoceras kerri*. In the Alpine-Mediterranean region, this species occurs in the Lower Norian *H. stryiaca* Zone (De Capoa Bonardi, 1984). *H. beyrichi* has never been found in undisputable Carnian strata. Localities with *H. stryiaca* thought to be Upper Carnian (Allasinaz et al., 1974) are now considered lowermost Norian (De Capoa Bonardi, 1984).

The stratigraphic position of *Halobia halorica* seems well-established in the upper part of the Lower Norian and throughout the lower Middle Norian. Similar species (*Halobia* cf. *H. halorica*) are known from the Brooks range of Alaska above Lower Norian *H.* cf. *H. cordillerana* and below Middle Norian *H.* cf. *H. plicosa* and species of *Monotis* (Bloom et al., 1988). This position agrees with sequences throughout the Alpine Triassic (De Capoa Bonardi, 1984).

Although structural problems confound the stratotype of the Martin Bridge, we wish to emphasize that the Oregon Section represents one of the few fossiliferous sequences where a case may be made for the Carnian-Norian transition. Further work in progress on halobiids for this locality may prove valuable for global correlations.

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SEQUENCE STRATIGRAPHIC CORRELATION OF NONMARINE AND MARINE LATE TRIASSIC BIOCHRONOLOGIES, WESTERN UNITED STATES

Spencer G. Lucas

Abstract

Upper Triassic nonmarine strata of the Chinle Group in the western United States encompass three, unconformity-bounded depositional sequences and yield tetrapod fossils that represent four late Carnian-Norian faunachrons. Sequence stratigraphic models provide a correlation of these sequences with marine Upper Triassic strata of the shelfal terrane in Nevada that produce late Carnian-Norian index ammonoids. This correlation establishes a correspondence between nonmarine tetrapod biochronology and marine ammonoid biochronology of the Late Triassic.

Introduction

The work of the STS focuses on establishing a timescale for the Triassic based primarily on marine biochronology. However, there is a need to refine the nonmarine biochronology of the Triassic and to correlate that biochronology with that established from marine fossils, primarily ammonoids and conodonts (Lucas, 1990b). The most straightforward correlations between nonmarine and marine biochronologies occur when nonmarine and marine fossils are found in association. Palynomorphs present the greatest potential for such associations, but nonmarine Triassic tetrapods (amphibians and reptiles) also are found occasionally in marine facies and provide some key correlations, especially during the Early Triassic (e.g., Cosgriff, 1984).

During the Late Triassic, only one such occurrence is known, a partial skull of the phytosaurian reptile *Paleorhinus* found in late Carnian (Tuvalian) marine strata of the Opponitzer Schichten in the Austrian Alps (Hunt and Lucas, 1991b). *Paleorhinus* also occurs in nonmarine strata of the western United States, Morocco, Germany and India, and thus provides a critical late Carnian tiepoint between nonmarine tetrapod biochronology and the marine biochronology of the Late Triassic.

Although no other direct tiepoints exist between Late Triassic tetrapod and marine biochronologies, recent sequence-stratigraphic analyses of Upper Triassic strata in the western United States provide a means of correlating these two, disparate biochronologies. My purpose here is to review these analyses and present the correlation they suggest between tetrapod-based nonmarine biochronology and ammonoid-based marine biochronology of the Late Triassic.

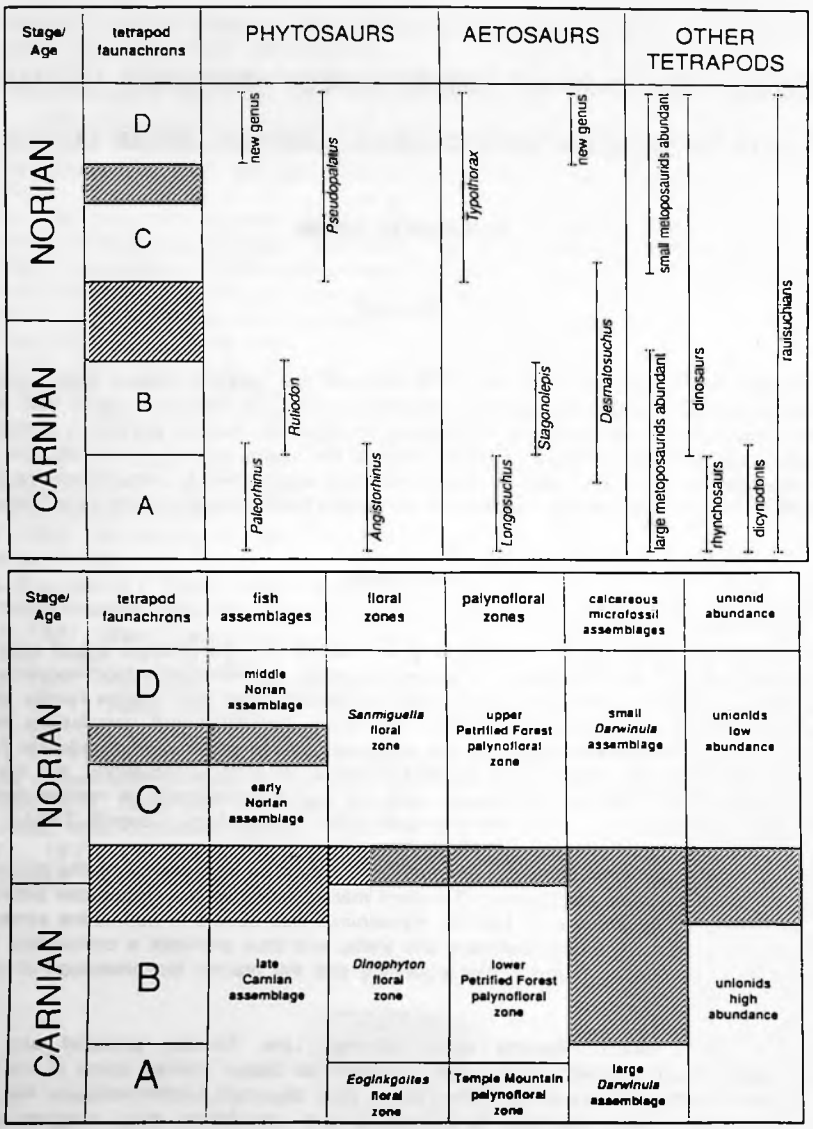

Fig. 1 Chronological distribution of large tetrapods of the Chinle Group (above) and relationships of tetrapod biochronology to other Chinle Group biostratigraphies/ biochronologies (below). See Lucas (1991c) for sources.

Nonmarine Sequence Stratigraphy and Biochronology

Upper Triassic nonmarine strata in the western United States pertain to the Chinle Group and are exposed over an area of 2.3 million square km that extends from Wyoming to Texas and from Nevada to Oklahoma (Lucas, 1991c). The Chinle Group is as much as 550 m thick and is composed of fluvial, lacustrine and eolian red beds with an extensive fossil record of palynomorphs, megafossil plants, ostracodes, charophytes, conchostracans, gastropods, unionids, arthropods and vertebrates (see articles in Lucas and Hunt, 1989a).

Four distinct intervals of Late Triassic time can be recognized from Chinle Group fossils using tetrapods, principally phytosaurs and aetosaurs (Lucas and Hunt, 1989c; Hunt and Lucas, 1990; Lucas, 1990a, 1991b, c). These four faunachrons (= land-vertebrate "ages") are referred to here as A, B, C and D (oldest to youngest: Fig. 1). Key to the recognition of these faunachrons is the Chinle Group sequence in east-central New Mexico where vertebrate-fossil assemblages representing three of the four faunachrons (B, C and D) are found in stratigraphic sequence (Lucas and Hunt, 1989b). Also, three of the four faunachrons (A, B and C) are represented by superposed vertebrate fossils from the Dockum Formation of West Texas (Chatterjee, 1986; Lucas, 1991c).

The oldest faunachron, A, is identified by the primitive phytosaurs *Paleorhinus* and *Angistorhinus* and the primitive aetosaur *Longosuchus* as well as rhynchosaurs (Hunt and Lucas, 1990, 1991c). The characteristic faunachron B phytosaur is *Rutiodon* (sensu Ballew, 1989), and the characteristic aetosaurs are *Stagonolepis* (= *Calyptosuchus*) and *Desmatosuchus*, although the latter continues into faunachron C (Long and Ballew, 1985; Hunt and Lucas, 1990). The first North American dinosaurs appear in the Chinle Group during faunachron B.

Faunachron C is the oldest Norian faunachron because it begins with the first appearance of the phytosaur *Pseudopalatus* (sensu Ballew, 1989). The phytosaurs *Nicrosaurus* and *Mystriosuchus* from the Norian portion of the German Keuper, are very similar to, closely related to, and possibly synonymous with *Pseudopalatus* (Ballew, 1989). *Desmatosuchus* has its last occurrence during faunachron C, and the faunachron C-D aetosaur *Typothorax* first appears (Hunt and Lucas, 1990). Large metoposaurid amphibians (*Metoposaurus, Buettneria*) are common during faunachrons A and B, whereas they are virtually absent during faunachrons C and D. Instead, small metoposaurids ("*Anaschisma*") are the dominant metoposaurids during faunachrons C and D (Hunt, 1989).

Pseudopalatus and *Typothorax* continue during faunachron D, but new, unnamed genera of phytosaur and aetosaur are characteristic of this time interval. Dinosaurs are extremely abundant during faunachron D as indicated by an extensive footprint fauna from the Redonda Formation in east-central New Mexico and the Rioarribasaurus quarry in the Rock Point Formation in north-central New Mexico (Colbert, 1989; Hunt and Lucas, 1991a).

Tetrapods discriminate four time intervals based on fossils from the Chinle Group, whereas other fossils only discriminate three or less (Fig. 1). It is significant, however, that these other fossils support the biochronology based on tetrapods, particularly the palynomorphs, which locate the Carnian-Norian boundary between faunachrons B and C (Fig. 1).

The biochronology based on tetrapod fossils from the Chinle Group presented here identifies two intra-Chinle Group unconformities that delimit three depositional sequences (Fig. 2). I label these unconformities Tr-4 and Tr-5, following the scheme of Pipiringos and O'Sullivan (1978), and name the depositional sequences for the bounding Chinle Group formations in the Four Corners area of the Colorado Plateau (Fig. 2). Evidence for these widespread unconformities is fourfold:

1. Correlative rocks immediately above each unconformity overlie rocks of different ages in different areas. This probably reflects differential erosion associated with each unconformity.
2. There is a major lithologic change associated with each unconformity. Rocks of the upper part of the Shinarump-Blue Mesa sequence are bentonitic mudstones, siltstones and pedogenic calcretes/silcretes overlain by conglomerates and sandstones at the base of the Moss Back-Owl Rock sequence. Lacustrine limestones, bentonitic mudstones/siltstones and pisolitic calcretes of the uppermost Moss Back-Owl Rock sequence are directly overlain by non-bentonitic siltstones and tabular sandstones of the Rock Point sequence. The major lithologic changes at the unconformities indicate major changes in depositional systems associated with each hiatus.

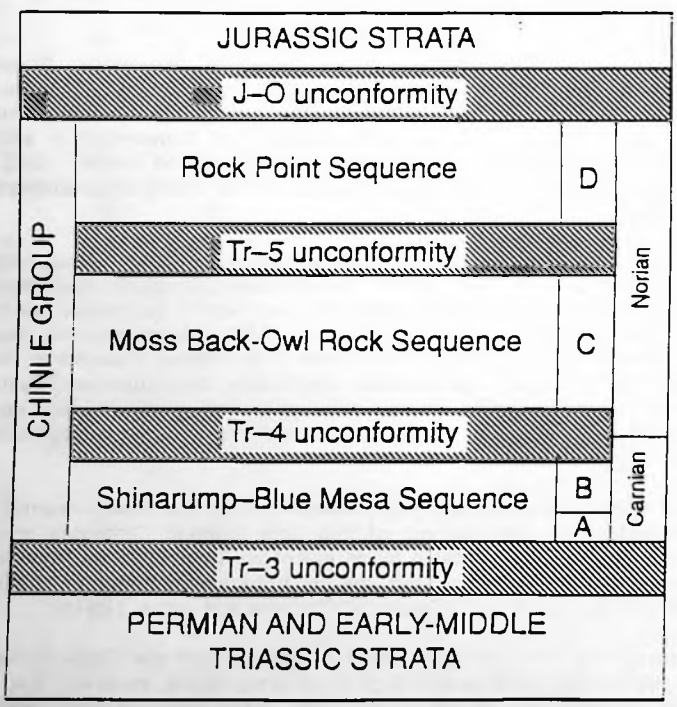

Fig. 2 Unconformities and sequences of the Chinle Group in the western United States.

3. At the Tr-4 unconformity, channeling into and reworking of underlying sediment is evident in many areas. And, under both the Tr-4 and Tr-5 unconformities, intensive subaerial weathering profiles in the Blue Mesa Member of the Petrified Forest Formation and in the Owl Rock Formation are preserved across much of the Colorado Plateau.
4. Each unconformity corresponds to a significant reorganization of the biota. Few genera of tetrapods cross an unconformity, and thus many tetrapod taxa are unique to each of the three depositional sequences, as is true of palynomorphs, megafossil plants, ostracodes and fishes. The presence of significant temporal gaps between faunachrons B and C and between C and D is consistent with this reorganization.

Marine Sequence Stratigraphy and Biochronology

In the Basin and Range Province of northwestern Nevada, Upper Triassic marine strata consist of shelfal and basinal rocks juxtaposed along the trace of the late Mesozoic Fencemaker thrust fault (Speed, 1978). Marine Upper Triassic shelfal terrane rocks of the upper part of the Star Peak Group and the lower part of the Auld Lang Syne Group, especially those exposed in the Humboldt Range and Augusta Mountains, are temporal equivalents of most of the Chinle Group. These Chinle correlative strata are the late Carnian Cane Springs Formation (upper Star Peak Group) and the Norian Grass Valley, Dun Glen, Osobb and Winnemucca Formations of the Auld Lang Syne Group (Silberling, 1961; Silberling and Wallace, 1969; Burke and Silberling, 1973; Nichols and Silberling, 1977; Oldow et al., 1990). These rocks produce ammonoids of the Dilleri, Kerri, Magnus, Rutherfordi and Columbianus Zones. Sequence boundaries (unconformities) are present at the bases of the Cane Springs and Grass Valley Formations.

Other Upper Triassic marine strata in Nevada pertain to the basinal terrane and also include correlatives of much of the Chinle Group. However, the sequence-stratigraphic correlations between Chinle Group nonmarine strata and marine strata in Nevada presented here are confined to the relatively straightforward relationship between the shelfal terrane strata and the Chinle Group.

Correlation of Nonmarine and Marine Biochronologies

I view the three unconformity-bounded Chinle Group sequences as the result of basinwide changes in base level that resulted from eustatic rises and falls of Late Triassic sea level (Lucas, 1991a, c, d; also see Embry, 1988). Thus, basal, extensive sandstone-conglomerate sheets of the Shinarump-Blue Mesa and Moss Back-Owl Rock sequences represent infilling of incised topography during the early stages of sea-level rises that followed major sea-level falls during the late Carnian and at the Carnian-Norian boundary, respectively (Fig. 3). The Tr-3 and Tr-4 unconformities thus are type 1 unconformities. The early deposits of these transgressive system tracts are followed by poorly drained floodplain and lacustrine deposits that culminate in highstand systems tracts represented by extensive, subaerially-weathered strata (paleosols) at the tops of the Shinarump-Blue Mesa and the Moss Back-Owl Rock sequences. The base of the Rock Point sequence corresponds to another fall of Late Triassic sea level that produced a type 2 unconformity followed by aggradation in response to transgression.

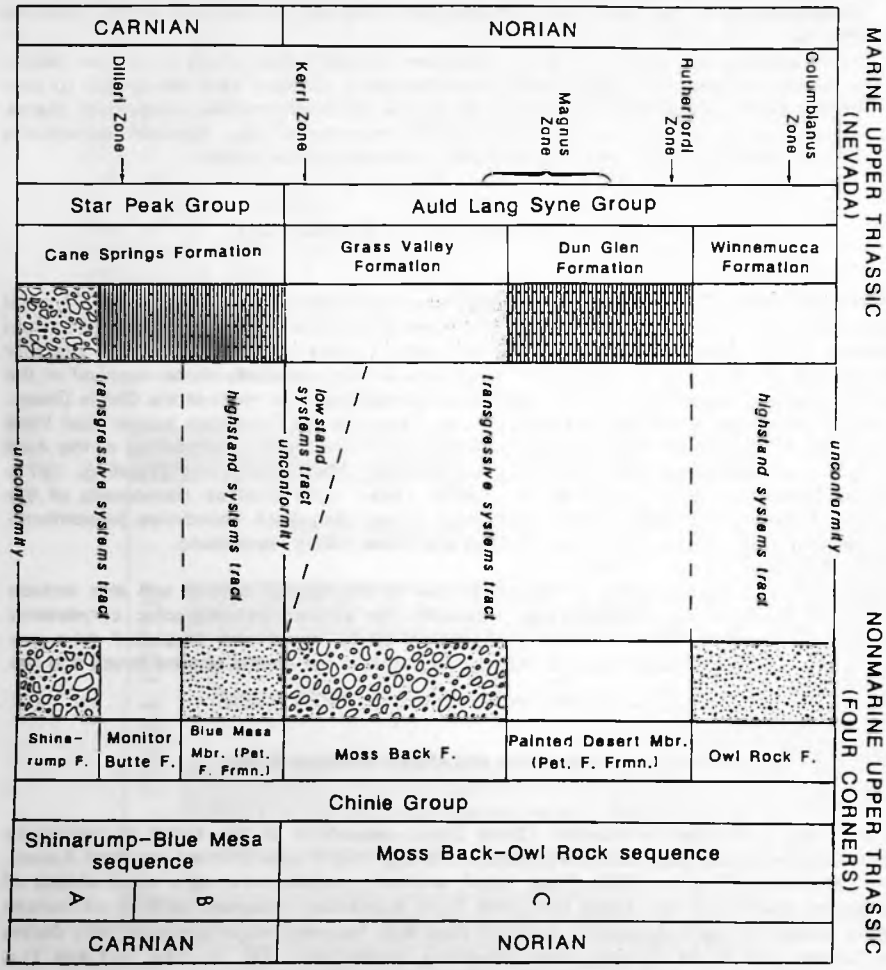

Fig. 3 Sequence stratigraphic correlation of marine, shelfal terrane rocks in Nevada (Humboldt Range) and nonmarine Chinle Group strata.

Lupe and Silberling (1985) already suggested a genetic relationship between Chinle Group strata and Upper Triassic marine strata in Nevada. However, the mechanism advocated here (eustatic changes in base level) and the chronology of the Chinle Group presented here differs from theirs. Here, the coarse clastics at the base of the Cane Springs Formation, which are strikingly similar to the Shinarump Formation of the Chinle Group, are interpreted as the initial filling of incised valleys at the base of a transgressive systems tract (Fig. 3). The basal Auld Lang Syne Group (Grass Valley and Osobb Formations) is correlated with the base of the Moss Back-Owl Rock sequence. The predominantly siliciclastic sediments of the lower portions of the Grass Valley and Osobb Formations thus are interpreted as lowstand accumulations on the shelf of sediment eroded and bypassed from the land surface during development of an incised topography (Fig. 3).

If the correlations these sequence-stratigraphic models indicate are accepted, then a close correlation of ammonoid zones (biochrons) and tetrapod faunachrons is clear (Fig. 3). Significantly, this correlation is consistent with placement of the late Carnian-Norian stages based solely on Chinle Group fossils (Fig. 1). Faunachron A encompasses the Dilleri biochron, which is consistent with the Tuvalian age assignment based on the phytosaur *Paleorhinus*. Faunachron B is equivalent to part of the time between the Dilleri and Kerri biochrons, and thus is of late Tuvalian age. Faunachron C encompasses time represented by the Kerri through Columbianus biochrons, and thus most of the upper Chinle Group is of early-middle Norian age.

Faunachron D therefore is younger than middle Norian and it may be as young as "Rhaetian" (Hunt, 1991). The Chinle Group tetrapod faunachrons span most of the Late Triassic and are a more complete record of Late Triassic time than are the tetrapod faunas of the German Keuper. Chinle Group tetrapod biochronology thus provides a significant standard for correlation of the nonmarine Upper Triassic and for the correlation of nonmarine Late Triassic biochronology with marine biochronology.

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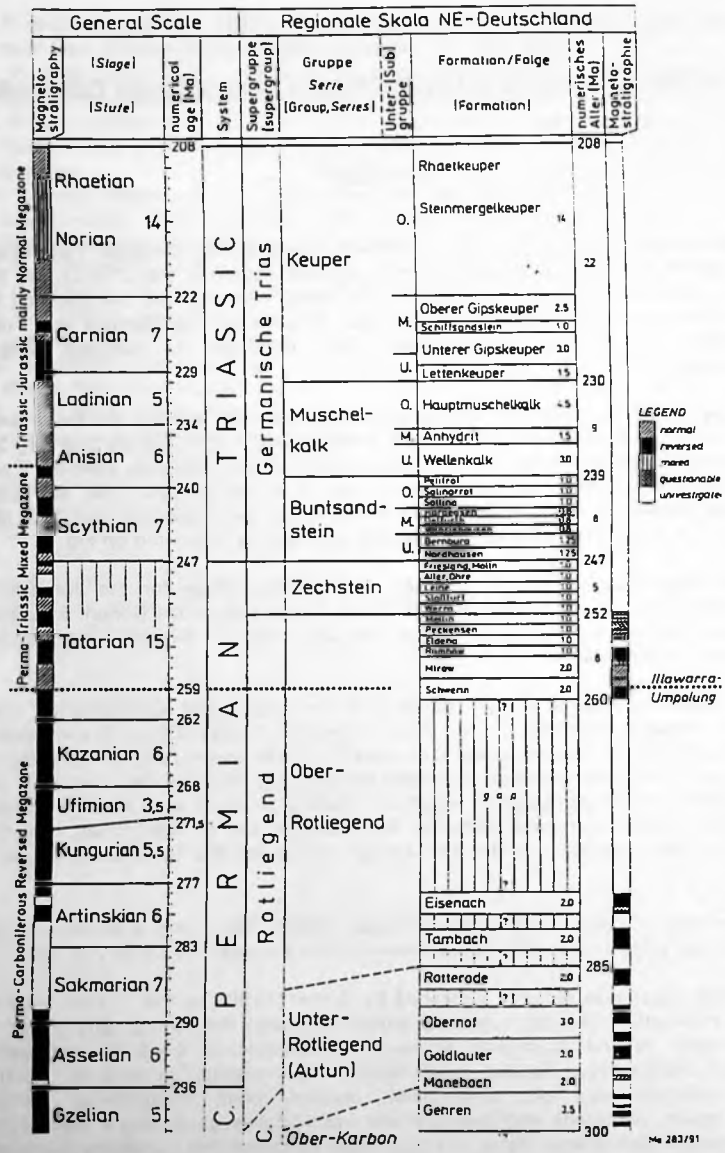

Fig. 2 The Permian and Triassic of Central Europe (after Menning, 1990)

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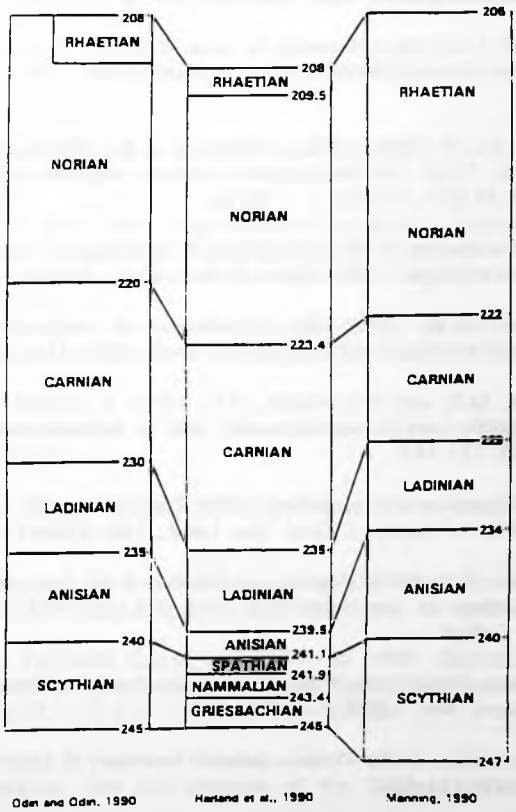


Fig. 1 Three recently published numerical time scales compared: Odin and Odin (1990), Harland et al. (1990) and Menning (1990).

BRITISH TRIASSIC PALAEONTOLOGY: SUPPLEMENT 14

G. Warrington

Since the completion of the writer's previous supplement (No. 13; ALBERTIANA, 8: 42-43) on British Triassic palaeontology, the following works relating to aspects of that subject have been published or have come to his notice:

AINSWORTH, N.R. 1989. Rhaetian, Hettangian and Sinemurian Ostracoda from the Fastnet Basin, offshore Southwest Ireland, Geol. Surv. Ire. Bull., 4: 107-150.

AINSWORTH, N.R. 1990. Uppermost Rhaetian to lower Bajocian Ostracoda from the Porcupine, Slyne, Erris and Donegal Basins, offshore west Ireland. Geol. Surv. Ire. Bull., 4: 169-200.

ANDREWS, I.J., LONG, D., RICHARDS, P.C., THOMSON, A.R., BROWN, S., CHESHER, J.A. and MCCORMAC, M. 1990. United Kingdom offshore regional report: the geology of the Moray Firth. H.M.S.O., London, x + 96 pp.

BENTON, M.J. 1990. The species of *Rhynchosaurus*, a rhynchosaur (Reptilia, Diapsida) from the Middle Triassic of England. Phil. Trans. R. Soc. Lond., B.328: 213-306.

BOWN, P.R. and LORD, A.R. 1990. The occurrence of calcareous nannofossils in the Triassic/Jurassic boundary interval. Cahiers Unic. Catho. Lyon, Sér. Sci., 3: 127-136.

BRANDON, A., SUMBLER, M.G. and IVIMY-COOK, H.C. 1990. A revised lithostratigraphy for the Lower and Middle Lias (Lower Jurassic) east of Nottingham, England. Proc. Yorks. Geol. Soc., 48: 121-141.

COPE, J.C.W. 1990. Discussion on correlation of the Triassic-Jurassic boundary in England and Austria; reply by A. Hallam. J. Geol. Soc. Lond., 148: 420-422.

FISHER, M.J. and MUDGE, D.C. 1990. Triassic. In: Glennie, K.W. (ed.) 1990, Introduction to the Petroleum Geology of the North Sea. (3rd ed.), pp. 191-218. Blackwell Scientific Publications, Oxford.

FRASER, N.C. and UNWIN, D.M. 1990. Pterosaur remains from the Upper Triassic of Britain. N. Jb. Geol. Paläont. Mh., 1990, H. 5: 272-282.

HALLAM, A. 1990. Correlation of the Triassic-Jurassic boundary in England and Austria. J. Geol. Soc. Lond., 147: 421-424.

HALLAM, A. 1990. Bivalvia. Cahiers Univ. Catho. Lyon, Sér. Sci., 3: 55-60.

LORD, A.R. and BOOMER, I.D. 1990. The occurrence of ostracods in the Triassic/Jurassic boundary interval. Cahiers Univ. Catho. Lyon, Sér. Sci., 3: 119-126.

MAZIN, J.-M. 1989. La denture et la région palatine des Placodontia (Reptilia, Trias). Implications phylogénétiques. Geobios, 22: 725-734.

MCGOWAN, C. 1989. *Leptopterygius tenuirostris* and other long-snouted ichthyosaurs from the English Lower Lias. Palaeontology, 32: 409-427.

MCGOWAN, C. 1990. Problematic ichthyosaurs from southwest England: a question of authenticity. J. Vert. Paleo., 10: 72-79.

MILNER, A.R., GARDINER, B.G., FRASER, N.C. and TAYLOR, M.A. 1990. Vertebrates from the Middle Triassic Otter Sandstone Formation of Devon. Palaeontology, 33: 873-892.

POULSEN, N.E. 1990. Jurassic dinoflagellate stratigraphy of the Danish Sub-basin and in Poland. Palyno-Nytt, 13: 14-15.

SIMMS, M.J. and RUFFELL, A.H. 1990. Climatic and biotic change in the late Triassic. J. Geol. Soc. Lond., 147: 321-327.

SMITH, A.B. 1990. Echinoid evolution from the Triassic to Lower Liassic. Cahiers Univ. Catho. Lyon, Sér. Sci., 3: 79-117.

SMITH, S.A. and EDWARDS, R.A. 1991. Regional sedimentological variations in Lower Triassic fluvial conglomerates (Budleigh Salterton Pebble Beds), southwest England: some implications for palaeogeography and basin evolution. Geol. J., 26: 65-83.

WARRINGTON, G. and IVIMEY-COOK, H.C. 1990. Biostratigraphy of the Late Triassic and Early Jurassic: a review of type sections in southern Britain. Cahiers Univ. Catho. Lyon, Sér. Sci., 3: 207-213.

WARRINGTON, G. and SCRIVENER, R.C. 1990. The Permian of Devon, England. Rev. Palaeobot. Palynol., 66: 263-272.

WILSON, A.A. 1990. The Mercia Mudstone Group (Trias) of the East Irish Sea Basin. Proc. Yorks. Geol. Soc., 48: 1-22.

WILSON, A.A. 1990. Geology of the country around Blackpool. Mem. Br. Geol. Surv., 1:50,000 geol. sheet 66 (England and Wales). H.M.S.O., London, viii + 82 pp.

WILSON, D., DAVIES, J.R., FLETCHER, C.J.N. and SMITH, M. 1990. Geology of the South Wales Coalfield, Part VI, the country around Bridgend. Mem. Br. Geol. Surv., 1:50,000 geol. sheets 261 and 262. H.M.S.O., London, viii + 62 pp.

This contribution is published with the approval of the Director, British Geological Survey (N.E.R.C.).

SEQUENCE STRATIGRAPHIC CONCEPT OF THE GERMANIC TRIASSIC

T. Aigner and G.H. Bachmann

The concept of sequence stratigraphy allows a systematic subdivision of sedimentary successions in a hierarchy of genetic units related to relative sea-level changes. Sequence stratigraphy is not only applicable in seismostratigraphy, but it is also a promising approach for the study and genetic interpretation of outcrop sections.

The long since established detailed lithostratigraphic subdivision of the German Triassic is ideal for sequence-stratigraphic analysis. The cycles recognized can, without any problem, be interpreted in terms of sequence stratigraphy. The basic stratigraphic units are the parasequences, i.e. 1-5 m thick cycles showing a shallowing-upward trend. A number of successive parasequences form a systems tract. A sequence consists of three systems tracts, viz. the Lowstand Systems Tract, the Transgressive Systems Tract and the Highstand Systems Tract. These are separated from each other by sequence boundaries. These latter are frequently erosional unconformities.

Fig. 1 shows the preliminary sequence stratigraphic framework of the Germanic Triassic. All together thirteen cycles are recognized. Important sequence boundaries were determined at the base of the Solling Sandstein, the Muschelkalk Salinar, the Lettenkeuper-Hauptsandstein, the Schilfsandstein and the Middle Stubensandstein.

The sequence-stratigraphic approach leads to a different interpretation for some of the units. The Schilfsandstein is not longer regarded as a deltaic deposit but it is interpreted as a fluvial infill of eroded valleys which were formed during a lowstand period. Also the Muschelkalk salt was deposited during a lowstand period.

Sequence stratigraphy offers a new conceptual approach for the interpretation of the basin development of the Germanic Triassic. It furthermore allows new possibilities for correlations with the Alpine Triassic.

Translated from the abstract of a paper presented at the Muschelkalk Symposium, 12-20 August 1991, Schöntal an der Jagst. Reprinted with permission of the authors.

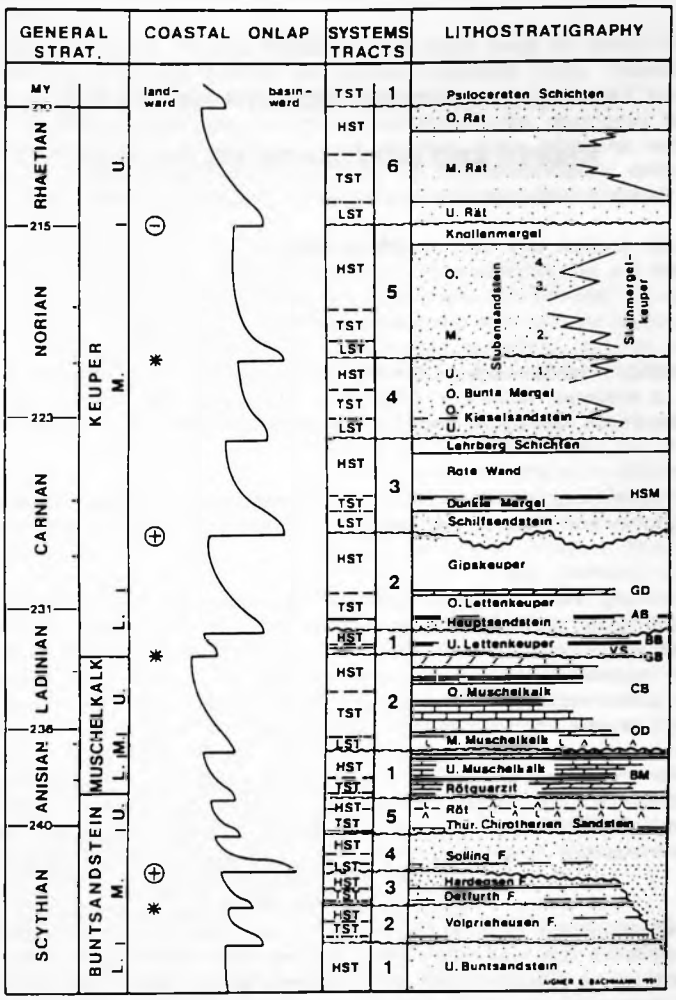


Fig. 1 Sequence stratigraphy of the Germanic Triassic. Chronostratigraphy and coastal onlap (modified) after Haq et al. (1988). Contrary to the opinion of Haq et al., a regressive trend is recognizable in the Middle Keuper.
* = additional sequence boundary; +/- = better/less well developed sequence; boundary; HST = highstand systems tract; --- = maximum flooding surface (mfs); TST = transgressive systems tract; -.- = transgressive surface (ts); LST = lowstand systems tract; ~ ~ ~ = sequence boundary
BM = Buchi-Mergel (mfs); OD = Obere Dolomite (ts); CB = Cycloides-Bank (mfs); GB = Grenzbonebed (LST); VS = Vitriolschiefer (LST, TST); BB = Blaubank (mfs); AB = ALBERTI-Bank (ts); GD = Grenzdolomit (mfs); HSM = Hauptsteinmergel (mfs)

IS THERE ANYTHING MORE TO SAY ABOUT KEUPER AND BUNTSANDSTEIN FLORAS?

Hans Kerp

A review of:

Detlef MADER, 1990. Palaeoecology of the Flora in Buntsandstein and Keuper in the Triassic of Middle Europe. 2 Volumes, lxxxviii + 1582 pp., 71 figures, 890 photos on 103 plates, 63 tables. G. Fischer-Verlag, Stuttgart, New York; ISBN 3-437-30650-2, US-ISBN 1-56081-302-4; DM 370.-

This extremely voluminous work deals on the palaeoecology of Buntsandstein and Keuper floras. Buntsandstein and Keuper are important terrestrial fluvial sedimentary sequences in Middle Europe.

Five chapters, forming Volume I, are devoted to Buntsandstein floras. Volume II consists of chapter six which deals on Keuper floras and an index of 212 pages. In Volume I special emphasis is given to *Pleuromeia sternbergii*, of which a remarkable in-situ preserved assemblage of sub-vertically standing stems was discovered by the author near Lammersdorf (Eifel, Germany). The palaeoecology of *Pleuromeia sternbergii* and *Pleuromeia*-like lycopods, the palaeophytogeogeography and the palaeophytosociology of the Buntsandstein flora are treated. Much attention is given to interdisciplinary sedimentological, pedological and palaeobotanical research, a field which is too often ignored. Comparisons with other localities with in-situ preserved lycopods, like the Upper Carboniferous of Joggins (Nova Scotia) are made. The second volume, in which the same approach is followed concentrates on *Voltzia* and *Equisetites*. Much attention is given to the ecological adaptations of Buntsandstein and Keuper plants.

The text is subdivided into a large number of individual sections, each with their own heading. Although the text looks very well-organized at first instance, more serious reading soon reveals that it contains many duplications. The same statements are made again and again. Another problem is that statements are often rather vague. Data which should be presented coherently are often scattered throughout the book. The author's argumentation is not always very clear. This often may simply be a matter of formulating, but in other cases the reasoning is too circumstantial. Ecological interpretations of Buntsandstein lycopods for example, are partly based on the occurrence and distribution of stomata in Carboniferous relatives. However, no direct evidence for the stomatal distribution of Buntsandstein lycopods is presented. Such generalizations should be treated very carefully.

Despite the fact that hundreds of pages are devoted to *Pleuromeia sternbergii*, its representation is still fragmentary. The spores are only very briefly mentioned and not illustrated. Yet, dispersed megaspores and microspores of *Pleuromeia* have been reported from Early Triassic palynological assemblages throughout the world. They may considerably help us reconstructing

the areal extent of the taxon. Typical Buntsandstein floras such as those from the Vosges (France) described by Grauvogel-Stamm are underrepresented. Little attention is given to Buntsandstein conifers. Don't they deserve more attention in a standard text like this one intends to be? The author's application of phytosociological units, analogous to those used in modern vegetation science, is debatable. I have at least some problems with the units he distinguishes in the Permian, particularly because his phytosociological units are based on associations sometimes entirely consisting of allochthonously deposited material.

The Keuper volume deals on the German Keuper floras. Also this volume concentrates on a restricted number of taxa. Cycadophytes are only briefly mentioned, as are the Bennettitales. Cuticular analysis is referred to only marginally, although this method is essential for the classification of the individual members of these groups and may provide important information on their ecology. Nothing is to be found on anatomically preserved material, although Kelber (1990), who is cited by the author, illustrated permineralized *Equisetites* specimens.

The title of this work is a little bit confusing. On one hand this work offers much more than the title suggests, especially with respect to the sedimentology and palaeosols, but on the other hand some obvious topics are missing. It has to made clear that the term **Middle Europe** should be read as Germanic Basin. Important, very rich and more or less coeval floras like those of Lunz and Neuewelt near Basel are not included. The authors states that their geographical, palaeoenvironmental and palaeoclimatic setting might have been different. This is certainly true for Lunz which is Tethyan, but Neuewelt near Basel is part of the Germanic Basin. Anyhow, I intend to include Switzerland and Austria in Middle Europe.

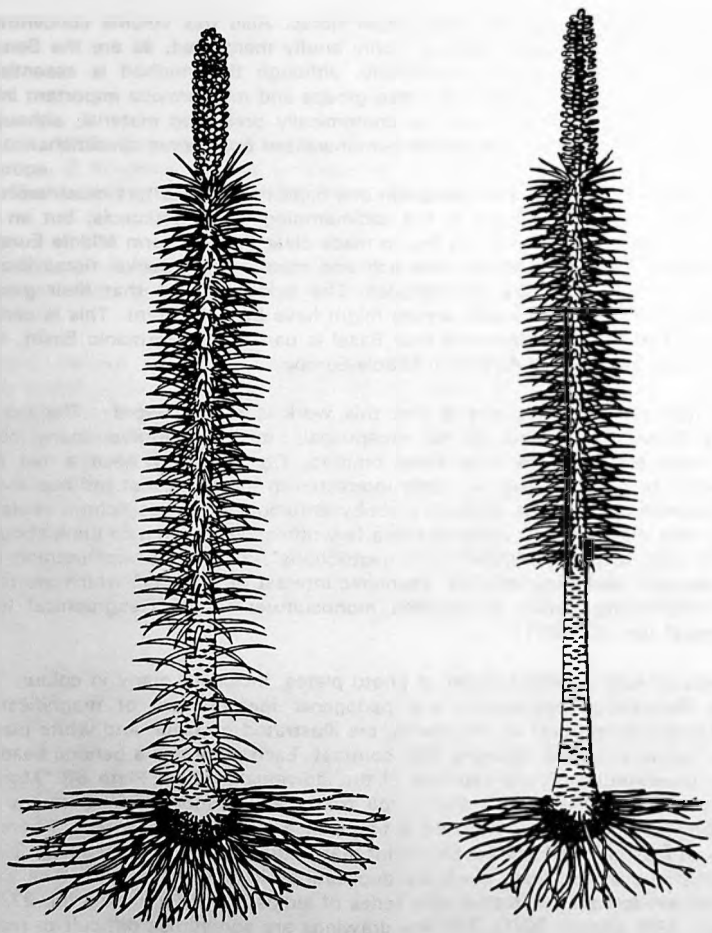
My main, but very serious, complaint is that this work is far too wordy. The text is often difficult to read. Phrases of six lines are not exceptional; I encountered even many much longer ones! Many things simply could have been omitted. Do we really need a ten page long curriculum vitae of the author? Are we really interested in the facts that red has always been the writer's favourite colour, that he was a hobby entomologist in his school years, that the winter of 1975 was very mild? To mention just a few other topics, what to think about sections on "Impact of editorial and administrative restrictions", "Research competition and non-scientific occupations" and "Scientific vs. economic interest of projects" which are to be found just between "Pioneering nature of lycopod monocultures" and "Geographical location of investigation areas" (pp. 859-861).

The two volumes include a large number of photo plates, including many in colour. The colour plates, mostly illustrating sedimentary and pedogenic features are of magnificent quality. Virtually all megafossils, at least all the plants, are illustrated on black and white plates. These halftones are often very greyish showing little contrast. Each plate has a general heading. These are not always consistent with the captions of the individual figures. Plate 66 "Morphology of stem, cone and root of *Pleuromeia sternbergii* from Lammersdorf (Eifel/Germany FRG) and Bernburg (Saxony/Germany GDR)" includes a figure of a leaf of *Anomopteris*. There are many more examples of individual photos which do not match the general plate heading. Just as there are many duplications in the text, there are duplications in the illustrations. The same in-situ stems from Lammersdorf are illustrated on a series of almost identical photos (pl. 27/1, pl. 32/1 and pl. 65/1; pl. 28/6 and pl. 30/1). The line drawings are sometimes difficult to read because of the overwhelming amount of information presented (e.g. fig. 16-20).

Despite all the criticism, this work should doubtlessly be regarded as a very important contribution. The author presents an overwhelming amount of new and very valuable

information and his interdisciplinary approach opens a new direction. However, a scientific editor could have done a good job. If presented more clearly and less fragmentary, the text could have been reduced to at least half of its present length, thus making this book much more accessible and cheaper. Therefore I would like to end this review with an old German proverb:

In der Beschränkung zeigt sich der Meister!



Reconstructions of *Pleuromeia sternbergii* (from Fuchs, Grauvogel-Stamm and Mader, 1991)

INTERNATIONAL SUBCOMMISSION ON TRIASSIC STRATIGRAPHY

SYMPOSIUM ON TRIASSIC STRATIGRAPHY

Lausanne, Switzerland - October 20-23, 1991

The symposium will consist of one day field trip followed by two days of scientific sessions, half a day for the working groups and half a day for the meeting of the International Subcommission on Triassic Stratigraphy. The symposium will be held at Lausanne University Campus in Dorigny, close to Lake Geneva.

Program

October 20:	pre-symposium field trip: The classic Briançonnais facies (middle Triassic shallow water limestone) in the Swiss Prealpes.
October 21:	
morning	Biochronological methods of stratigraphic subdivision of the Triassic System by different fossil groups (about fifteen communications announced)
afternoon	Presentation of the unitary association method with new computer program written by Jean Savary
October 22:	
morning	Stage and substage boundaries in terms of standard chronostratigraphy (fifteen communications announced)
afternoon	Integrated stratigraphy: tectonic, sedimentological and eustatic approaches. Paleogeographical and paleobiological implications. Multidisciplinary methods (geochemistry, sedimentology, paleoecology, magnetostratigraphy) (twelve communications announced)
October 23:	
morning	Subcommission meeting
afternoon	working groups meeting

A volume of *Mémoires de Géologie, Lausanne* will be devoted to the symposium.

Organizing Committee:	A. Baud, Lausanne - M. Gaetani, Milano - J. Guex, Lausanne - J. Marcoux, Paris - H. Rieber, Zürich - G. Stampfli, Lausanne
Information:	Dr. Aymon Baud, Musée de Géologie, UNIL-BFSH2, CH-1015 Lausanne, Switzerland; tel. 21/692.48.20; Fax. 21/692.48.99

THE NONMARINE TRIASSIC

International Symposium and Field Trip

October 17-24, 1993

New Mexico Museum of Natural History, Albuquerque, New Mexico, U.S.A.

A three-day international symposium followed by a four-day fieldtrip devoted to all aspects of the nonmarine Triassic will be held in Fall, 1993 in Albuquerque, New Mexico. This symposium, to which contributions are invited, will focus on Triassic nonmarine chronology, paleontology, sedimentation, paleoclimatology and paleogeography/paleobiogeography. Short articles of presentations will be published in conjunction with the symposium. A post-symposium, edited volume of longer articles is planned.

The four-day fieldtrip will follow the symposium and will leave Albuquerque to examine classic Lower, Middle and Upper Triassic (Moenkopi and Chinle) strata on the Colorado Plateau, including outcrops in Monument Valley, the Petrified Forest National Park and the southern rim of the Grand Canyon.

The symposium will follow immediately the annual meeting of the Society of Vertebrate Paleontology, which will be held October 13-16, 1993 in Albuquerque. Also, the STS has been invited to hold a meeting in conjunction with the symposium.

If you are interested in attending or receiving more information on the Nonmarine Triassic Symposium, please write to:

Spencer G. Lucas
New Mexico Museum of Natural History
1801 Mountain Road NW
Albuquerque, New Mexico 87104
U.S.A.

ANNOTATED TRIASSIC LITERATURE

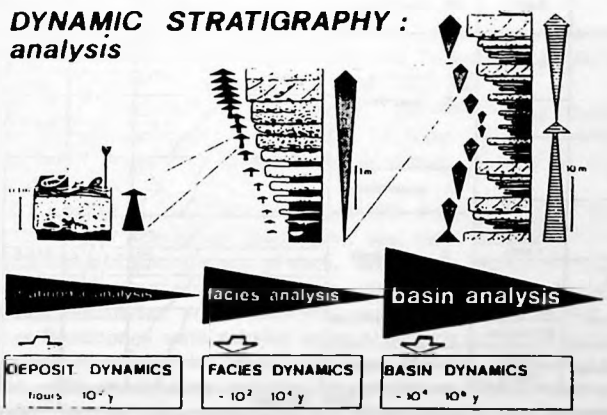
Hans Kerp

ADAMOLI, L., BIGOZZI, A., CIARAPICA, G., CIRILLI, S., PASSERI, L., ROMANO, A., DURANTI, F. and VENTURI, F., 1990. Upper Triassic bituminous facies and Hettangian pelagic facies in the Gran Sasso range. Boll. Soc. Geol. It., 109: 219-230.

Facies variations from shallow-water carbonate platforms to euxinic or pelagic basins are recognized in the Late Triassic-Early Liassic sequences of the Gran Sasso range (central Apennines). The Late Triassic-Early Liassic basinal facies of the eastern Gran Sasso range can be related with the Emma basin of the Adriatic off-shore. The Middle Liassic pelagic facies, that are widespread on the whole range, are clearly connected with the birth of the Umbria-Marche basin.

AIGNER, T., BACHMANN, G.H. and HAGDORN, H., 1990. Zyklische Stratigraphie und Ablagerungsbedingungen von Hauptmuschelkalk, Lettenkeuper und Gipskeuper in Nordost-Württemberg (Exkursion E am 10. April 1990), Jber. Mitt. oberrhein. geol. Ver., N.F., 72: 125-143.

The Muschelkalk, Lettenkeuper and Gipskeuper succession consists of 1 to 5 m thick transgressive/regressive cycles. These thin cycles form part of higher order cycles. The first transgressive maximum is to found in the "Tonhorizonte" (Postspinosus to Enodis Zone). The strongest regression is observed in the Lettenkeuper-Hauptsandstein. After a less well developed marine maximum in the Grenzdolomite of the Lettenkeuper, a gradual change to strongly regressive terrestrial sedimentation occurs, finally resulting in the deposition of the Schilfsandstein. The development of small cycles allows an interpretation of the depositional environment.



Methodological approach for the analysis of stratigraphic cycles (Aigner et al., 1990)

Al-Ameri, K., 1990. Palynofloral evidence for Middle Triassic age, palaeoenvironments and sedimentary provenance of sediments in borehole 5/8, western Iraqi Desert. Rev. Palaeobot. Palynol., 65(1/4): 267-274.

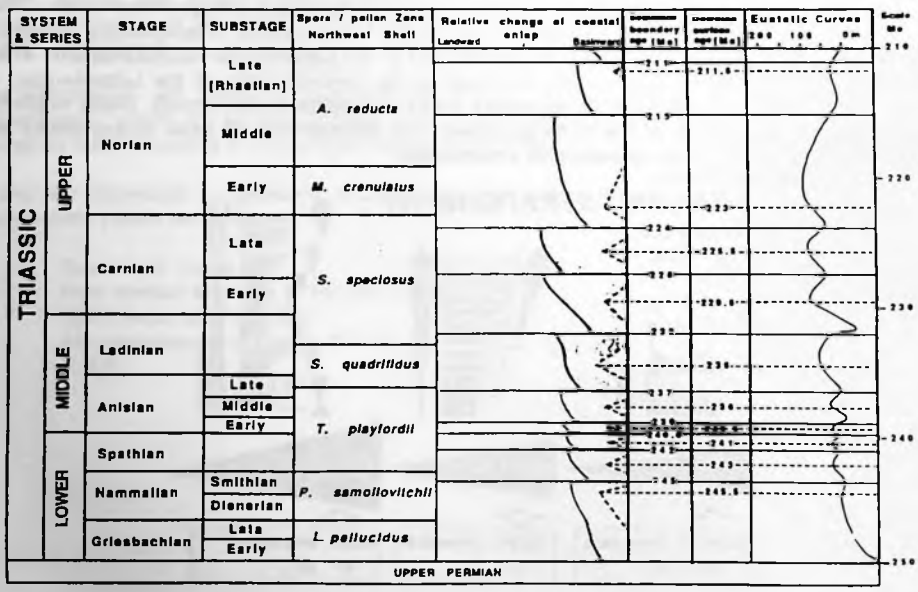
Palynological studies on rock samples from the upper part of the Ga'ara Formation and the lowest part of the Mullusa Formation in the Western Iraqi Desert revealed well preserved miospores and bisaccate pollen suggestive of a Middle Triassic age for the Ga'ara Formation. Reworked, more thermally mature spores of Early Carboniferous age are also present and indicate a westerly sediment source.

Bakken, K., 1990. A new stratigraphically important spore assigned to the genus *Rogalskaisporites* Danzé-Corsin and Laveine (1963) from the Late Triassic of the Barents Sea. Rev. Palaeobot. Palynol., 63(1/2): 153-162.

A new Late Triassic miospore is described from borehole samples from the Barents Sea. *Rogalskaisporites barentzii* nov. sp. is regarded a stratigraphically important taxon which has correlative potential as a Norian marker species in the Barents Sea.

Balme, B.E., 1990. Australian Phanerozoic timescales: 9. Triassic biostratigraphic charts and explanatory notes. Bureau of Mineral Resources, Australia, Record 1989/37. 28 pp.

A review of the current Australian biochronology. Most papers published since 1978, when an earlier correlation chart for the Australian Triassic was published by Banks, have dealt with vertebrates or palynology. Important new amphibian and reptilian records have been reported from the Lower Triassic of Tasmania and Bowen Basins, new fish have been described from the Sydney Basin and a good deal of palynological



Australian Triassic palynologically based zones in relation to sequence boundaries and eustatic sea-level changes. Global cycles modified from Haq et al. (1987). (Balme, 1990)

data have become available, principally from the sedimentary basins of Queensland. The various biostratigraphically important groups are discussed and chapters on radiometric datings and sequence stratigraphy are included. Zonations and correlations are presented on 14 enclosures.

BAUD, A., BRANDNER, R. and DONOFRIO, D.A., 1991. The Sefid Kuh Limestone - A late Lower Triassic carbonate ramp. In: RUTTNER, A.W. (Ed.), The Triassic of Aghdarband (AqDarband), NE-Iran and its pre-Triassic frame. Abh. Geol. B.-A., 38: 111-123.

After the worldwide drastic Permo-Triassic event, a thick sequence of shallow-water carbonates, i.e. the Sefid Kuh Formation, was formed before the late Early Triassic. For the first time dasycladacean algae were found there, together with foraminifers which are typical of the Lower Triassic. A carbonate ramp is formed by several parasequences, each of them shallowing upwards. The Sefid Kuh Formation as a whole is the product of a transgression-regression cycle (Spathian to ?Aegean/ Bithynian), which is probably of eustatic nature.

BAUD, A., STAMPFLI, G. and STEEN, D., 1991. The Triassic Aghdarband Group: volcanism and geological evolution. In: RUTTNER, A.W. (Ed.), The Triassic of Aghdarband (AqDarband), NE-Iran and its pre-Triassic frame. Abh. Geol. B.-A., 38: 125-137.

During the Late Palaeozoic, the area of Kopet Dagh had been accreted to the Turan plate as were the Band-i-Turkestan, the N Hindu Kush and the N Pamir. During Permian time, parts of these accreted terranes were uplifted, eroded and mainly this southern areas covered by red continental deposits. The Paleotethys active margin migrated to the south and a new volcano-plutonic arc was emplaced south of the Hercynian collage, just north of the new Paleotethys subduction zone. During Triassic time, an arcuate marine volcano-sedimentary belt is traceable from the S Caucasus through the Kopet Dagh to the N Pamir. A Cimmerian deformed segment of this back arc basin is now outcropping in the erosional window of Aghdarband. Lithologically, the Triassic Aghdarband group is subdivided into four formations, ranging in age from latest Early Triassic to late Norian.

BOERSMA, M. and VAN KONIJNENBURG-VAN CITTERT, J.H.A., 1991. Late Triassic plant megafossils from Aghdarband (NE-Iran). In: RUTTNER, A.W. (Ed.), The Triassic of Aghdarband (AqDarband), NE-Iran and its pre-Triassic frame. Abh. Geol. B.-A., 38: 223-252.

Plant megafossils, including two new species, considered to be indicative for a Norian-Rhaetian age are described and figured. The base of the Ghal'eh Qabri Shales is probably Rhaetian, while the Aghdarband Coal Bed is probably Norian.

BONI, M., IANNACE, A., KÖSTER, J. and PARENTE, M., 1990. Anoxic facies in the Upper Triassic of Picentini Mountains (Southern Apennines, Italy). Boll. Soc. Geol. It., 109: 171-185.

The petrography and microfacies of dark, laminated, organic-rich dolomites from the Upper Triassic of southern Italy were studied. The most recurring facies are homogeneous mudstones and mudstones with very regular, thin algal laminations; wackestones/floatstones with micritic or algal intraclasts are less common. Halite and anhydrite molds in organic-rich levels indicate a shallow, subtidal, intraplatform basinal environment, with mesohaline and anoxic conditions. Three main dolomite types are distinguished. Two of these dolomites are stochoimetric to Ca-depleted according to X-rays data. Geochemical analysis point to a prevailing algal origin of the organic fraction. The early destructurized organic matter underwent then a thermal evolution until reaching the oil window. The diagenetic evolution is reconstructed.

Bucek, S., Jendrejáková, O., Papsová, J. and Puskárová, K., 1991. Contribution to the biostratigraphy of the Veterlín and Havranica units in the Biele hory Mts. (Malé Karpathy Mts, West Carpathians). Geologogicke' Pra'ce, 92: 29-51. (in Czech with extended English summary)

Assemblages of conodonts, foraminifers and dasycladacean algae characterize the Middle and Upper Triassic sequences of the Veterlín and Havranica units in the Biele hory (Malé Karpathy Mts.). The species spectrum of so far known microfossils has been complemented by many further taxa and enabled the precision of stratigraphy of some lithostratigraphic units (Zámostie Formation, Reifling Formation, Wetterstein (?Tisovec) limestone). The Veterlín unit is a typical example of the transition of basinal facies into reef carbonates; the Havranica unit is characterized by mostly lagoonal facies of the same or related depositional area.

Busson, G. and Cornée, A., 1987. Données sur les paléoclimats deduites de la sédimentation continentale du Mesozoique saharien. Mus. Nat. Hist. Nat., Lab. de Géol., Paris, Publ. Occ., 1989/18, 87 p.

The authors attempt an overall study of the Mesozoic continental terrains in the northern part of the Saharan Algerian-Tunisian platform based on outcrop and borehole data. It includes a review of the lithological and palaeobiological characteristics of these series together with an interpretation in terms of basin geology. During the Triassic-Liassic there was considerable development of evaporites and redbeds.

Busson, G. and Cornée, A., 1988. Enseignements généraux de l'extrême constance de la séquence argile-halite du Carnien de bassins distants et isolés d'Europe du Nord-Ouest. Eclogae geol. Helv., 81: 441-455.

In very distant basins separated by probably emergent ridges (Jura, Bresse, Champagne and southern North Sea Basin), beds and groups of beds constitutive of Carnian salt series show a nearly perfectly similar development with a nearly constant thickness. For the clay interbeds, these features seem incompatible with a spreading by bottom processes. Spreading as interstratal flow is suggested, at a level where turbid waters coming from adjacent lands spread over brines of equivalent density. Because of the isopacity of salt beds a crystallization resulting from bottom processes is unlikely, as differences in basin bottom morphologies would have resulted in great thickness variations. Salt deposition has been determined only by the time during which evaporation acted upon water/atmosphere interface. Under these conditions, salt deposition was originally extended to the whole basin area and the present lack of halite in peripheral areas mainly results from solution. On the whole, during this halite/clay deposition, transport of clays and saturation/crystallization of halite have been processes primarily occurring in the surface or intermediate water layer. As a result these alternations can be considered as remarkable records of climatic phases during which arid stages enhanced flooding of thallasocratic elements and humid stages enhanced spreading of geocratic elements. An alternative hypothesis to interpret such constant sequences consists in a model with synchronous deposition of clays and halite. This model is disproved.

Busson, G. and Cornée, A., 1989. Quelques données sur les antécédents climatiques du Sahara: la signification des couches détriques rouges et des évaporites du Trias et du Lias-Dogger. Bull. Soc. Géol. France, (8), T. V, No. 1: 3-11.

The Triassic and Lias-Dogger of the Algero-Tunisian Sahara are analyzed to understand the role of climate controlling depositional environments. These very widespread and thick saline beds of the "Salifère principal" (Upper Triassic) in the northern and central

part of the studied area provide evidence of hyper-arid conditions. If not continuous, such conditions were at least periodic. The authors conclude that there was a fundamental discontinuity of sedimentary stages through time and that the specific character of this sedimentary setting is different from those known today.

CALLAWAY, J.M. and MASSARE, J.A., 1990. Geographic and stratigraphic distribution of the Triassic Ichtyosauria (Reptilia, Diapsida). N. Jb. Geol. Paläont. Abh., 178: 37-58.

Geographic and stratigraphic data are given for all known Triassic ichtyosaurian material. Ichtyosaurs are recognized from the Smithian through the Rhaetian. Their fossils are widely distributed in the Northern Hemisphere, but extremely rare south of the Equator. The species diversity of Triassic Ichtyosauria is as high as that of the Jurassic, while the number of genera exceeds that of the Jurassic and Cretaceous combined.

CATALANO, R., DI STEFANO, P., GULLO, M. and KOZUR, H., 1990. *Pseudofurnishius* (Conodonta) in pelagic Late Ladinian - Early Carnian sediments of western Sicily and its stratigraphic and paleogeographic significance. Boll. Soc. Geol. It., 109: 91-101.

Rich occurrences of *Pseudofurnishius* were found in fully pelagic Middle Longobardian-Early Cordevolian beds of the Torrente San Calogero Section in western Sicily. The whole *Pseudofurnishius* line, including five successive forms, was observed. The age of all *Pseudofurnishius* species could be well established. *Pseudofurnishius* is ecologically very tolerant and occurs in pelagic, carbonate platform and restricted basin facies. It is geographically restricted to the southernmost pelagic trough of the Tethys and adjacent areas from Spain through North Africa to Jordan and in the Dinarids, Southern Alps, southern Turkey. The rich occurrence of *Pseudofurnishius* at the southern, eastern and northern margin of Apulia shows the affinity of Apulia to Africa.

CIARAPICA, G., 1990. Central and Northern Apennines during the Triassic: a review. Boll. Soc. It., 109: 39-50.

Some important paleogeographic units can be recognised in the Northern and Central Apennines: (1) a Middle Triassic marine basin on the west, (2) two Late Triassic restricted basins, i.e. the NS-oriented La Spezia Basin on the west and the Mt. Camicia Basin on the east which is connected with the Emma Basin in the Adriatic Sea, (3) a Late Triassic evaporitic-carbonate platform in between, and (4) carbonate marginal facies interposed between the evaporitic platform and the basin. The birth of the Jurassic Umbria-Marche Basin was therefore preceded by a Triassic rifting phase (probably accompanied by strike-slip movements) which determined the existence of two Triassic basins with restricted conditions.

CIARAPICA, G., CIRILLI, S., MARTINI, R., PANZANELLI FRATONI, R., ZANINETTI, L. and SALVINI-BONNARD, G., 1990. Reworked foraminifera in the Triassic Monte Facito Formation *auctt.*, Lagonegro Basin (Southern Apennines, Italy). Boll. Soc. Geol. It., 109: 143-149.

Two Upper Permian fusulina zones are reworked in the lower part of the Triassic Monte Facito Formation, Lagonegro Basin, southern Apennines: the *Neoschwagerina craticulifera* subzone of Middle Murghabian age and *Neoschwagerina margaritae* subzone of Late Murghabian age. The discovery of *Meandrospira pusilla*, in the turbiditic lower part of the Monte Facito Formation, shows that also Lower Triassic microfaunas have been reworked, as is also indicated by the presence of particular palynomorphs.

Ciarapica, G., Cirilli, S., Martini, R., Rettori, R., Zaninetti, L. and **Salvini-Bonardo, G.**, Carbonate buildups and associated facies in the Monte Facito Formation (Southern Apennines). Boll. Soc. Geol. It., 109: 151-164.

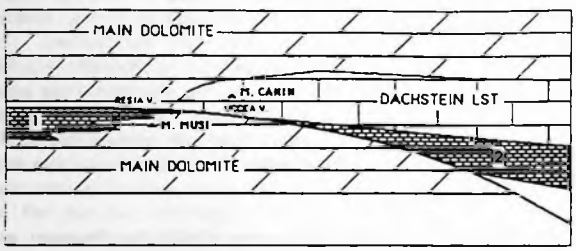
Carbonate buildups and associated facies of the upper part of the Monte Facito Formation (Ladinian) are described. The growth of the carbonate complex was locally interrupted by terrigenous deposition. The drowning of the buildups was caused by an increase of subsidence connected with block-faulting.

Ciarapica, G., Cirilli, S., Panzanelli Fratoni, R., Passeri, L. and **Zaninetti, L.**, 1990. The Monte Facito Formation (Southern Apennines). Boll. Soc. Geol. It., 109: 135-142.

The Monte Facito Formation (Early Triassic-Late Ladinian) is divided into four members (A, B, C and D). This paper presents a characterization of these units and their sedimentological interpretation.

Ciarapica, G. and **Passeri, L.**, The Dachstein Limestone of the Mt. Canin (Julian Alps) and its paleogeographic setting. Boll. Soc. It., 109: 239-247.

The lithological sequence, sedimentary cycles, dolomitization pattern and depositional environment of the Mt. Canin range and its micropaleontological content are briefly described. The Val Resia tectonic line seems due to a dextral tear fault.



Schematic distribution of the Norian-Rhaetian facies in the Julian Alps: 1 - Euxinic facies of the Tagliamento River Basin; 2 - Pelagic facies of the Slovenia Basin. (Ciaparica and Passeri, 1990)

Cirilli, S., Montanari, L. and **Panzanelli Fratoni, R.**, 1990. Palynomorphs from the Lercara Formation (Sicily): new biostratigraphic data. Boll. Soc. Geol. It., 109: 123-133.

This paper presents the preliminary results of a palynological study of the Lercara Formation, eastern Sicani Mountains, western Sicily. The associations consist of a mixture of Permian and Middle Triassic palynomorphs. The later taxa indicate a Ladinian-?Early Carnian age. The marly intervals at the base of the Late Triassic Cherty Limestone contain a Carnian assemblage without reworking of older elements.

Cope, J., 1991. Discussion on correlation of the Triassic-Jurassic boundary in England and Austria, with a reply by **A. Hallam**. J. Geol. Soc. Lond., 148: 420-422.

Cope debates the boundary proposed by Hallam (ibid., 147: 421-424) because it would be a lithostratigraphical boundary at which there is no accurate biostratigraphical control. Cope considers the first appearance of *Psiloceras planorbis* to be isochronous and therefore to be the most reliable basis for biostratigraphy and correlation. According to Cope the conodont *Misikella posthernsteini* from the Pre-Planorbis Beds is unlikely to be reworked. The ranges of various bivalves are

considered to be not significant, at least not for the definition of the Triassic-Jurassic boundary.

Hallam is strongly in favour of using all the available data. He agrees that ammonites are by far the best means for fixing the boundary. They must be used when present, but in determining a global stratotype choice must be restricted to a fully marine sequence containing Triassic as well as Jurassic ammonites. The Triassic Penarth Group in Great Britain was deposited in lagoonal or marginal marine conditions, with a restricted fauna virtually lacking ammonites. The Blue Lias clearly marks a major marine transgression. The appearance of *Psiloceras planorbis* could have been under facies control, which Hallam considers a poor recommendation for fixing an international stratotype. It is argues that for a fully marine sequence like Kendelbach with both Triassic and Jurassic ammonites but with an ammonite-free interval in between, it is more reasonable to fix the boundary at the horizon of the greatest organic turnover rather than at the first Jurassic ammonite. This turnover, based on conodont, brachiopod, bivalve, coccolith and palynomorph occurrences, should be place at the Grenzmergel. The base of the Blue Lias, also marking a significant lithostratigraphical change, is considered to be precisely correlative with the Grenzmergel. Possible reworking of conodonts in the British sections is discussed. George et al.'s (1969) recommendation to place the base of the Jurassic at distinctive black shale at the base of the Blue Lias in the classic Somerset section is confirmed by the presence of a newly discovered erosion/condensation horizon.

CORNET, B., 1989. Late Triassic angiosperm-like pollen from the Richmond Rift Basin of Virginia, U.S.A. Palaeontographica Abt. B, 213(1-3): 37-87.

Fluvio-lacustrine Newark Supergroup sediments from the Richmond Basin are dated palynologically as early Carnian to late middle Carnian. This paper focuses on pre-Cretaceous angiosperm-like pollen that is, according to the author, often disregarded or dismissed as contamination. The material is studied light-microscopically, by SEM and TEM. Seven new genera and thirteen new species are described. Most of the species are placed in the newly defined Crinopolles Group. The morphological and evolutionary implications of Triassic angiosperm-like pollen are discussed. This study highlights the Triassic as the Period to search for evidence of the earliest phases of angiosperm evolution.

CORNET, B. and OLSEN, P.E., 1990. Early to Middle Carnian (Triassic) flora and fauna of the Richmond and Taylorsville Basins, Virginia and Maryland, U.S.A. Virginia Museum of Natural History, Guidebook 1, Martinsville, 1990, 87 pp.

The coal measures and associated shales and sandstones from the Newark Supergroup in the Richmond and Taylorsville basins provide the best documented Late Triassic wetland flora from eastern North America. This flora contains diverse ferns, giant sphenopsids, lycopods, possible ginkgophytes, diverse Bennettitales and Cycadales, and conifers. Insects and mammal-like reptiles also have been collected from these basins. This volume provides a comprehensive overview of the regional geology, the sedimentology, flora and fauna of the Richmond and Taylorsville basins, while also giving information on the megaflora of the Deep Run basin, which underlies just northeast of the Richmond basin. Together, the flora and fauna provide a view of equatorial conditions during the Carnian, a time when floral diversity was highest for any Newark Supergroup assemblage. Megaplant taxa are illustrated on twenty plates reproduced from the classical Fontaine monograph (1883). In addition, photographs of newly collected material are presented. This guidebook includes an excursion road log.

Courel, L., Adloff, M.-C., Doubinger, J. and Lacombe, P., 1990. La transgression triassique en France centrale: témoin d'un haut niveau marin ladinien; données nouvelles du sondage de Sancerre-Couy (Cher - France). Bull. Soc. géol. France, (8), VI, No. 5: 723-729.

The discovery of a palynological association, dated as late Ladinian in the "Grès infra-anhydritique Formation" in the Sancerre-Couy borehole cores, allows to date the Triassic series in the southern part of the Paris Basin. Palynological assemblages are characterized by a high percentage of wind-transported pollen reflecting the presence of xerophilous shrub vegetation. There is a good correlation between the palynological assemblage and the sea level high stand deposits, transgressive over many Variscan massives of Western Europe. These deposits always occur immediately underneath the first evaporitic Carnian units. This synchronism, despite variable local tectonic conditions, suggests a fluctuating sea level which may have extended over a wide continental area. The suggested Upper Ladinian high stand of the sea level could likely be compared to the 232-235 transgressive fluctuation proposed by Haq et al. (1987).

Cuif, J.P. and Ezzoubair, F., Diversité des Cératoporellides triasiques. Geobios, 24: 257-266.

In Carnian faunas from the Dolomites (Italy) and in the lower Norian of the Lycian Taurus (Turkey) several species of calcifying Demospongia have been identified as Ceratoporellids. Some of them have initially been described as hydrozoans. Ceratoporellidids were important constituents of Late Triassic shallow-water faunas, in association with scleractinian corals and algae.

Dagys, A.S. and Dagys, A.A., 1990. In favour of the Rhaetian. Geologiya i Geofisika, 1990, No. 5: 35-44. Akademia Nauk SSSR, Novosibirsk. (in Russian with English summary)

The up-to-date state of the Rhaetian problem is discussed. The Rhaetian is supposed to be kept as a proper stage, its lower boundary being in the basement of the Cochloceras suessi Zone. The paleontologic substantiation is given for the new lower boundary and Rhaetian volume, the correlation of stratigraphic schemes of terminal Triassic of various world regions is given.

Dagys, A.S., Dagys, A.A. and Ermakova, S.P., 1989. Upper Palaeozoic and Triassic of Siberia - Biostratigraphy of the Upper Olenekian. in: Dagys, A.S. and Dybatolov, V.N. Upper Paleozoic and Triassic of Siberia. Akademia Nauk USSR, Siberian Branch, Inst. of Geology and Geophysics, Novosibirsk, No. 732: 39-49. (in Russian)

A contribution to the knowledge of Olenekian ammonoids of Siberia.

Dagys, A.S. and Dybatolov, V.N., 1990. The Triassic of Siberia. Akademia Nauk USSR, Siberian Branch, Inst. Geology and Geophysics, Novosibirsk, No. 767, 102 pp. (in Russian)

A volume with nine contributions on plant megafossils, bivalves, ammonoids and conodonts.

Dam, G. and Christiansen, F.G., 1990. Organic geochemistry and source potential of the lacustrine shales of the Upper Triassic-Lower Jurassic Kap Stewart Formation, East Greenland. Marine and Petroleum Geology, 7: 428-443.

The Upper Triassic-Lower Jurassic Kap Stewart Formation (Jameson Land, East Greenland) has been studied by a combination of sedimentological and organic geochemical methods. The environmental interpretation and the source rock potential of these lacustrine deposits are discussed.

De Castro, P., 1990. Studies on the Triassic carbonates of the Salerno Province (southern Italy): the Croci d'Acerno sequence. Boll. Soc. Geol. It., 109: 187-217.

A Triassic sequence of shallow water carbonate platform sediments, exposed in the central part of the Picentini Mountains, is considered to range in age from the Norian to the Early Liassic. The presence of Rhaetian is suggested by an association of *Triasina hantkeni*, *Aulotortus sinuosus* and *Griphoporella curvata* in a thick calcareous level with large megalodonts. The Croci d'Acerno sequence can be divided into three parts, a lower Norian part, a middle Rhaetian part and an upper Early Liassic part.

De Jersey, N.J. and **Raine, J.I.**, 1990. Triassic and earliest Jurassic miospores from the Murihiku Supergroup, New Zealand. New Zealand Geol. Surv. Paleont. Bull., 62, 164 pp.

This work is the first comprehensive survey of miospore distribution in Middle Triassic to earliest Jurassic strata in New Zealand. Sampling was concentrated in sections for which marine invertebrate faunas of Malakovian (?Smithian) to Arataurian (Sinemurian) age provide age correlations with New Zealand and international stratigraphic stages. Five miospore zones and one subzone are established, and correlations made with continental consequences of eastern Australia and Antarctica which share the same southern high latitude Triassic biogeographic province. One hundred and nine miospore taxa are treated systematically, including eight new species and six new combinations.

De Zanche, D., 1990. A review of the Triassic stratigraphy and paleogeography in the eastern Southern Alps. Boll. Soc. Geol. It., 109: 59-71.

Nine major carbonate-terrigenous and terrigenous units, deposited in basinal, lagoonal, paralic and continental environments, are recognised in the eastern Southern Alps. Four main paleogeographic-paleostructural units are distinguished. Aborted rifting, subduction, back-arc basin, transcurrence and transpression are proposed to work out a geodynamic model for the Southern Alps. Factors as tectonic control on deposition, the coincidence of tectonic phases and development of sedimentary cycles and the paleogeography are discussed.

Di Stefano, P., 1990. The Triassic of Sicily and the Southern Apennines. Boll. Soc. Geol. It., 109: 21-37.

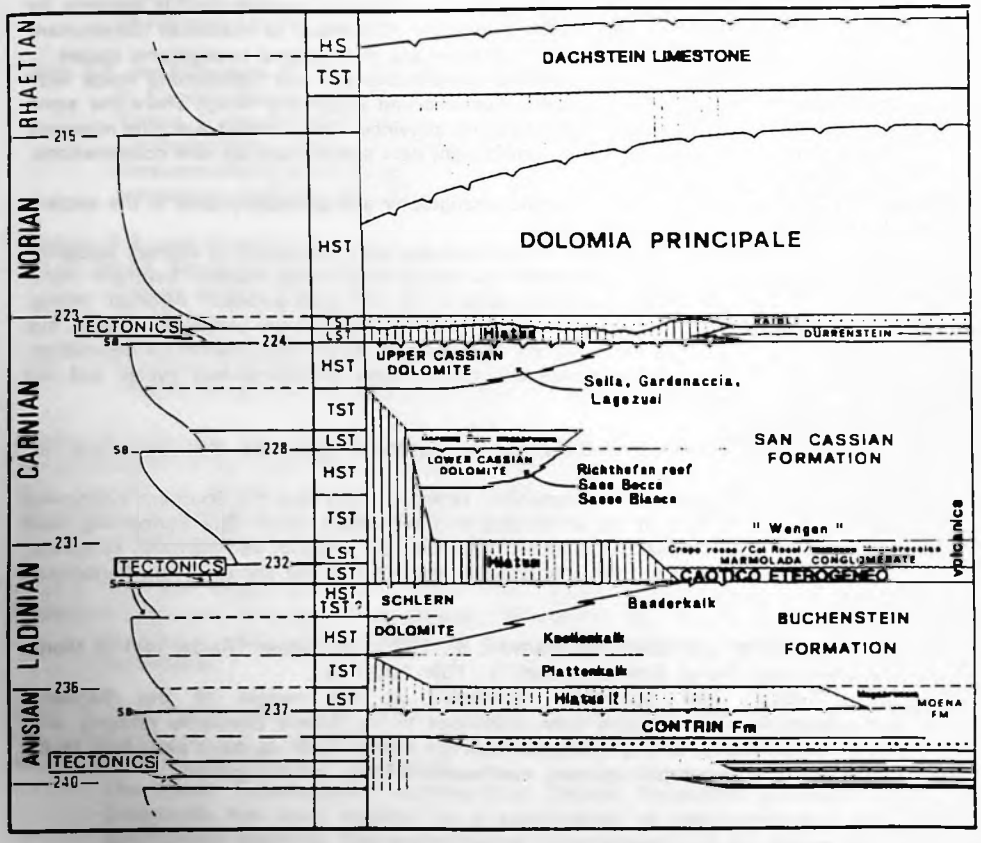
The Triassic stratigraphy and sedimentary facies of Sicily and the Southern Apennines is outlined in the light of the most recent contributions. New data concerning both Lower to Middle Triassic sequences and the pre-Triassic sedimentary substrate, stimulate new thinking on the paleotectonic evolution of this sector of the Periadriatic region.

Di Stefano, P., **Gullo, M.** and **Senowbari-Daryan, B.**, 1990. The Upper Triassic reef of Monte Genuardo (southwestern Sicily). Boll. Soc. Geol. It., 109: 103-114.

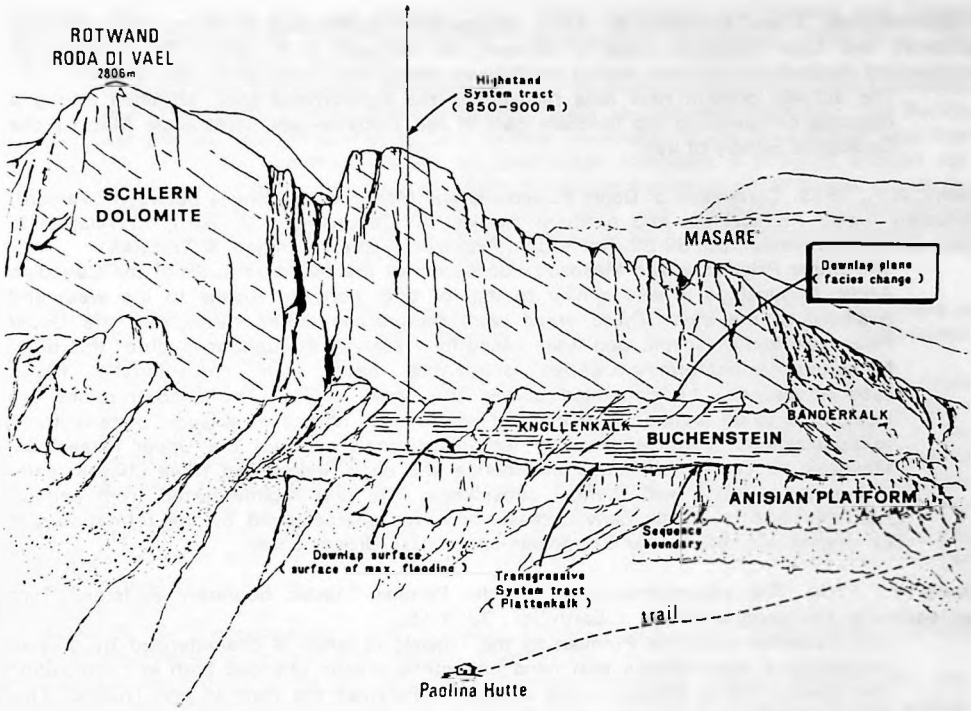
Upper Triassic reef complexes developed at the margin of the Saccense paleogeographic domain have been evidenced in the Monte Genuardo tectonic unit, southwestern Sicily. Strong analogies with the coeval reefs deposits pertaining to the Panormide paleogeographic domain, northwestern Sicily, are recognized.

Doglioni, C. Bosellini, A. and Vail, P.R., 1990. Stratal patterns: a proposal of classification and examples from the Dolomites. Basin Research, 2: 83-95.

A classification of stratal patterns is proposed from outcrop analysis of the Middle-Upper Triassic succession of the Dolomites (northern Italy). Stratal patterns are classified into two groups: stratal discontinuities and internal geometries. The stratal discontinuities are further subdivided into unconformities and synsedimentary stratal discontinuities on the basis of whether significant time is missing at the discontinuity. Internal geometries are further subdivided into planes and internal patterns.



Triassic stratigraphy of the Dolomites and correlation with eustatic cycles of Haq et al. (1987) (Doglioni et al., 1990)



Sequence stratigraphy at the southern end of the Catinaccio (Rosengarten). Note the downlap plane and overlying prograding system. (Doglioni et al., 1990)

DONOFRIO, D.A., 1991. Radiolaria and Porifera (spicula) from the Upper Triassic of Aghdarband (NE-Iran). In: RUTTNER, A.W. (Ed.), The Triassic of Aghdarband (AqDarband), NE-Iran and its pre-Triassic frame. Abh. Geol. B.-A., 38: 205-222.

A new monotypic radiolarian genus and a new poriferan species are described. The possibility is discussed whether radiolarians and poriferans are suitable as reliable time markers. The particular association of radiolarians suggests an early Late Triassic (late Cordevolian) age. The entire spicule assemblage emphasizes an Upper Triassic character.

DOUBINGER, J., LÓPEZ-GÓMEZ, J. and ARCHE, A., 1990. Pollen and spores from the Permian and Triassic sediments of the Southeastern Iberian ranges, Cueva de Hiero (Cuenca) to Chelva-Manzanera (Valencia-Teruel). Rev. Palaeobot. Palynol., 66(1/2): 25-45.

Pollen and spore assemblages have been recovered from the Permian and Triassic sediments of the southeastern Iberian ranges. The different assemblages are of Thuringian, Anisian, Ladinian and Carnian ages and were recovered from different levels of the Buntsandstein, Muschelkalk and Keuper facies.

Eftekharnezhad, J. and Behroozi, A., 1991. Geodynamic significance of recent discoveries of ophiolites and Late Paleozoic rocks in NE-Iran. In: Ruttner, A.W. (Ed.), The Triassic of Aghdarband (AqDarband), NE-Iran and its pre-Triassic frame. Abh. Geol. B.-A., 38: 89-100.

The authors present new data relevant to the Aghdarband area, obtained during a mapping campaign in the northern part of the Torbat-e-Jam Quadrangle Map by the Geological Survey of Iran.

Embry, A.F., 1989. Correlation of Upper Palaeozoic and Mesozoic sequences between Svalbard, Canadian Arctic Archipelago, and northern Alaska. in: Collinson, J.D. (ed.), Correlation in hydrocarbon exploration, pp. 89-98. Norwegian Petroleum Society; Graham & Trotman.

The Upper Palaeozoic and Mesozoic succession of the Sverdrup Basin of the Canadian Arctic Archipelago is very similar to that of both northern Alaska to the west and Svalbard to the east. These areas were tectonically linked throughout the Upper Palaeozoic and Mesozoic, and were joined by a seaway throughout much of this time. Numerous unconformity-bounded sequences each with characteristic facies associations, can be correlated across the entire region. The unconformities are interpreted to be tectonic in origin and are possibly related to episodic plate-tectonic re-organizations. Two sequentional tectonic regimes affected the Upper Palaeozoic-Mesozoic succession of Arctic Euramerica and each regime had three phases: early rifting, main rifting and thermal subsidence. The first regime lasted from earliest Carboniferous to middle Early Jurassic and was characterized by the formation and development of the former Caledonian-Ellesmerian Orogenic Belt.

Eshet, Y., 1990. The palynostratigraphy of the Permian-Triassic boundary in Israel: Two approaches to biostratigraphy. Isr. J. Earth Sci., 39: 1-15.

The transition from the Permian to the Triassic in Israel is characterized by diverse palynological assemblages that have undergone drastic changes both in composition and variety. These enable a clear distinction between the Permian and Triassic. This paper presents two possible approaches to the problem of the Permian-Triassic (P-T) boundary in Israel: (1) the "stratigraphical" approach, and, (2) the "ecological" approach. In some boreholes the boundary is found in a thin layer of red clay. From a classical stratigraphic point of view, the extinctions at the boundary, as well as the inconsistency in the lithostratigraphic position of the P-T boundary in various boreholes, indicate that a hiatus may occur between the Permian and Triassic. This indication is further supported by the dominance of terrestrial organic matter, which suggests possible erosional processes at the boundary time-interval. In addition, the P-T boundary horizon was found to contain almost only fungal spores with no in situ pollen and spores. This may indicate a strong ecological stress at the boundary times that led to the extinction of almost all land vegetation except for the more ecologically resistive fungi. This ecological evidence suggests that extinctions at the end of the Permian might be ecologically driven and not only the result of some missing strata that created a hiatus.

Eshet, Y., 1990. Paleozoic-Mesozoic palynology of Israel. I. Palynological aspects of the Permo-Triassic succession in the subsurface of Israel. Geol. Surv. Isr. Bull. , 81: 1-57.

A palynostratigraphic study of the Permo-Triassic sequence in the subsurface of Israel resulted in the identification of seven interval zones. Five zones were established for the Triassic, viz. for the Scythian, Anisian, Ladinian, Carnian and Norian-Rhaetian. The paleoclimatic model used in this study indicates a mixture of arid and humid niches during the Middle Triassic, and arid conditions in the Late Triassic (Carnian).

FARABEE, M.J., TAYLOR, E.L. and TAYLOR, T.N., 1990. Correlation of Permian and Triassic palynological assemblages from the central Transantarctic Mountains, Antarctica. Rev. Palaeobot. Palynol., 65(1/4): 257-265.

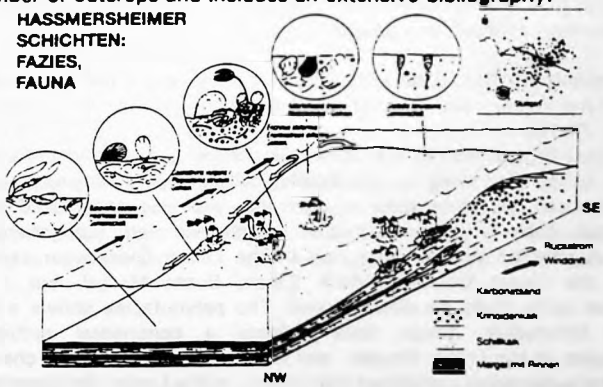
Samples from the Buckley Formation and the overlying Fremouw and Falla Formations from the central Transantarctic Mountains were studied palynologically. The Buckley assemblages are interpreted as Late Permian (Australian Stage 5). Silicified peat from the Fremouw Formation yielded an assemblage indicating a possible Anisian age. Shales and shaley coals from the Falla Formation contained assemblages correlative with possible Norian sequences in Australia and Tasmania. Permian-Triassic palynofloras in Antarctica show greater similarity with Australian assemblages than with those from other Gondwana continents.

FUCHS, G. GRAUVOGEL-STAMM, L. and MADER, D., 1991. Une remarquable flora à *Pleuromeia* et *Anomopteris* in situ du Buntsandstein moyen (Trias inférieur) de l'Eifel (R.F. Allemagne). Morphologie, paléoécologie et paléogéographie. Palaeontographica, B 222: 89-120.

A remarkable flora with *Pleuromeia sternbergii* and *Anomopteris* sp.and has been found in situ in the top of the Middle Buntsandstein of the North Eifel. The former taxon is represented by partly leaf-bearing trunks. A heterophylly is observed and a new reconstruction is proposed. Sedimentological, taphonomical and palaeobotanical analyses indicate that the plants grew on the periphery of a pond which temporarily dried up. The Lammersdorf *Pleuromeia* flora was not related to the proximity of the sea. The distribution and diversity of *Pleuromeia* are discussed. Though abundant and widespread this taxon seems to be restricted to the Scythian (Olenekian) and may extend to the Anisian.

HAGDORN, H. (Ed., in cooperation with T. SIMON and J. SZULC), 1991. Muschelkalk - A field guide. Goldschneck-Verlag Werner K. Weidert, Korb; 80 pp.

Excursion guide of the Muschelkalk Conference, held from 12 to 20 August 1991. The guide includes an introductory chapter on the German Muschelkalk giving special attention to basin development, biostratigraphy and lithostratigraphy. The outcrops visited during a six-day field trip in various parts of Germany and Poland are described by regional specialists. This well illustrated excursion guide is more than just a listing of a number of outcrops and includes an extensive bibliography.



Facies model and fossil community distribution on the Upper Muschelkalk carbonate ramp of southwest Germany during the Atavus Zone. (Hagdorn, 1991)

Hallam, A., 1990. Correlation of the Triassic-Jurassic boundary in England and Austria. J. Geol. Soc. Lond., 147: 421-424.

An attempt is made to fix the Triassic-Jurassic boundary at the classic locality of St Audries Bay, Somerset by reference to biostratigraphy in conjunction with lithostratigraphy, utilizing comparison with the more fully marine sequence of the Kendelbach gorge in Austria. The boundary is placed at the base of the Blue Lias Formation.

Hankel, O., 1991. Early Triassic plant microfossils from the Kavee Quarry section of the Lower Mariakani Formation, Kenia. Rev. Palaeobot. Palynol., 68: 127-145.

This paper deals on plant microfossils from an outcrop in the Karoo Sequence of the Mombassa Basin of Kenya. The overall appearance of the assemblage is like that of the microflora recorded recently from a borehole in the Lower Mariakani Formation. A comparison with Gondwana palynofloras from outside Africa shows that a close correspondence exists with Lower Triassic assemblages of the *Protohaploxypinus samoilovichii* Zone of eastern Australia, the *Kraeuselisporites saeptatus* Zone of western Australia, the Kathwai and Mittiwali microflora of Pakistan, the upper part of Zone II A from Malagasy, and the Purnea microflora of India. The cited assemblages of western Australia and Pakistan have been recovered from strata which have been dated by marine faunas as Griesbachian to Smithian in age.

Hauschke, N. and Heunisch, C., 1989. Sedimentologische und palynologische Aspekte einer zyklisch entwickelten lakustrischen Sequenz im höheren Teil des Unteren Gipskeupers (KM 1, Obere Trias) Nordwestdeutschlands. Lippische Mitt. Gesch. Landesk., 58: 233-256.

Sedimentological and palynological studies were performed on a sequence in the upper part of the Lower Gipskeuper (km 1, Upper Triassic; Vahlhausen section, Lippisches Keupergebiet, NW-Germany) which has a distinctive facies development. In contrast to typical Lower Gipskeuper facies which is characterized by red colours and lack of primary sedimentary structures, the studied sequence shows fine horizontal lamination and is completely grey-coloured. Noteworthy is a cyclic succession of six sedimentary cycles. Each cycle consists of three facies types. The spectrum of palynomorphs is restricted to terrestrial microfloral components of Carnian age. All observations point to deposition in a lacustrine environment. Probably the cyclic evolution of the facies reflects lake level changes in a perennial lake.

Hauschke, N. and Heunisch, C., 1990. Lithologie und Palynologie der Bohrung USB 3 (Horn - Bad Meinberg, Ostwestfalen): ein Beitrag zur Faziesentwicklung im Keuper. N. Jb. Geol. Paläont. Abh., 181: 79-105.

Ditch samples from a well in the Lower Gipskeuper (km 1) and the uppermost part of the Lower Keuper (ku) were studied lithologically and palynologically. Lithostratigraphic units which can be recognized in outcrops, are also recognized in the well log. Palynological data suggest that the Ladinian/Carnian (Longobardian/Cordevolian) boundary is situated in the upper part of the Lower Gipskeuper sequence, probably within in the Upper Coloured Marls (Obere Bunte Mergel, km 1 OBM 1). Four palynofacies units could be distinguished. The palynofacies shows a good correlation with the lithofacies. These data indicate a continental setting, with fluvial characteristics in the Lower Keuper, and predominantly lacustrine characteristics, with evidence for hypersaline conditions and aridity, in the Lower Gipskeuper.

HELMSLEY, A.T. and SCOTT, A.C., 1989. The ultrastructure of four Australian Triassic megaspores. Pollen et Spores, 31: 133-154.

A study of the ultrastructure of four species of Early Triassic (Rewan Group) megaspores from the Bowen Basin, Queensland of Australia,

HERBST, R., 1988. La flora Triasica del Gruppo El Tranquillo, Provincia de Santa Cruz (Patagonia). Parte II. Filicopsida. Ameghiniana (rev. Asoc. Paleontol. Argent.), 25: 365-379.

The filicopsida of the Triassic flora of the El Tranquillo Group are described. A new Marattialean genus and species, *Tranquilia jalfinii* is established and a new species of *Todites*, *T. baldonii* are described. The Marattiales and Osmundales constitute the majority of the El Tranquilo fern flora.

HOCHULI, P.A., COLIN, J.P. and VIGRAN, J.O., 1989. Triassic biostratigraphy of the Barents Sea area. in: COLLINSON, J.D. (ed.), Correlation in hydrocarbon exploration. pp. 131-153. Norwegian Petroleum Society. Graham & Trotman Ltd.

A succession of sixteen palynological assemblages is recognized in the Triassic (Griesbachian-Rhaetian) sequences of the Barents Sea area. This study is based largely upon the study of material from outcrops in Spitsbergen and Bjørnøya and from boreholes in the Barents Sea. Early and Middle Triassic assemblages occur in ammonite-dated beds. Almost no independent dating of Late Triassic beds exist in Svalbard, and the age of the Late Triassic assemblages are based upon palynological ranges known in the Germanic and Alpine realms. Long-distance correlation using palynomorphs is limited by climatic and environmental factors. Assemblages from the Boreal realm differ considerably from those from the Germanic and Alpine realms.

Assemblages from independently dated sections show that some palynomorphs have different ranges in the Arctic, whereas the ranges of others correspond in both areas. Some species seem to appear first and to have evolved in the Boreal realm.

Ten microfaunal assemblages consisting of foraminifera, ostracods and other microfossils are recognized in the Early and Middle Triassic sequences. These assemblages correspond to changes in environment and biofacies but can be used for regional correlations. Conodonts found in these associations allow correlation with the standard conodont zonation of the Triassic.

HOLSER, W.T., SCHÖNLAUB, H.-P., ATTREP, M. jr., BOECKELMAN, K., KLEIN, P., MAGARITZ, M., ORTH, C.J., FENNINGER, A., JENNY, C., KRALIK, M., MAURITSCH, H., PAK, E., SCHRAMM, J.M., STATTEGGER, K. and SCHMÖLLER, R., 1989. A unique geochemical record at the Permian-Triassic boundary. Nature, 337: 39-44.

A 330-metre core drilled trough the marine Permian/Triassic boundary in the Carnic Alps of Austria allows closely correlated studies of geochemistry, petrography and palaeontology across the boundary. The isotope shifts and metal concentrations are extended, multiple and complex, and do not resemble those seen at the Cretaceous/Tertiary boundary. Both the carbon isotope shifts and the chemical events (including an iridium anomaly) may have causes related to a major regression of the sea.

Hunt, A.P. and Lucas, S.G., 1990. Paleontology and biochronology of the Petrified Forest Member of the Upper Triassic Chinle Formation near San Ysidoro, Sandoval County, New Mexico. New Mexico J. Sci., 30(1): 17-26.

Fossil plants, invertebrates and vertebrate remains from the Petrified Forest Member of the Chinle Formation near San Ysidoro, Sandoval County, New Mexico occur at two stratigraphic levels. These fossils and the stratigraphy are discussed.

Hunt, A.P. and Lucas, S.G., 1990. Re-evaluation of *"Typothorax" meadei*, a Late Triassic aetosaur from the United States. Paläont. Z., 64(3/4): 317-328.

Aetosaur specimens from Howard County, Texas, named *Typothorax meadei* represent a new monotypic genus here named *Longosuchus*. The genus is found in mid-late Carnian strata in Texas, New Mexico and North Carolina. Aetosaurs can be used to distinguish three successive biochrons in Late Triassic strata of the American Southwest.

Hunt, A.P. and Lucas, S.G., 1991. *Rioarribasaurus*, a new name for a Late Triassic dinosaur from New Mexico (USA). Paläont. Z., 65: 191-198.

The generic name *Coelophysis* Cope is regarded as a nomen dubium. Because important material lacks a valid name, a new genus and species are established.

Johannessen, E.P. and Embry, A.F., 1989. Sequence correlation: Upper Triassic to Lower Jurassic succession, Canadian and Norwegian Arctic. in: Collinson, J.D. (ed.), Correlation in hydrocarbon exploration. pp. 155-170. Norwegian Petroleum Society. Graham & Trotman.

Upper Jurassic to Lower Jurassic (Norian-Pliensbachian) clastic strata are widespread in both the Canadian Arctic Islands and the Barents Sea-Svalbard region. In the Sverdrup Basin of Arctic Canada the stratigraphy of the succession is well established. In the Barents Sea region it is less well known.

Application of the principles of sequence stratigraphy to the succession in the Sverdrup Basin reveals that the number of recognizable sequences varies over the basin. This reflects the marked lateral differences in sedimentation and subsidence rates. Four sequences (Norian, late Norian-Rhaetian, Hettangian-Sinemurian and Pliensbachian) are delineated in the marine-dominated strata of the western Sverdrup Basin where sedimentation and subsidence rates were moderate. In the east, where sedimentation and subsidence rates were much higher, the Rhaetian/Hettangian sequence boundary is unrecognizable in a thick succession of coastal plain deposits. Thus a maximum of only three sequences can be distinguished in that area. On the flanks of the basin only one to three sequences can be recognized due to low sedimentation (condensation of section) or low subsidence (truncation of section).

In the Barents Sea-Svalbard region only three or less sequences are recognized in the Norian-Pliensbachian succession of known areas due to subsidence and sedimentation effects. The general palaeogeography of the Canadian-Norwegian Arctic for the Norian-Sinemurian interval was marked by centres of high sediment influx separated by semi-starved platforms.

Kilani-Mazraoui, F., Razgalla-Gargouri, S. and Mannai-Tayech, B., 1990. The Permo-Triassic of southern Tunisia - Biostratigraphy and palaeoenvironment. Rev. Palaeobot. Palynol., 66: 273-291.

The ages given to Permo-Triassic sediments of southern Tunisia often prove to be inaccurate. Combined palynological and micropalaeontological evidence allow the recognition of the Permo-Triassic boundary, the proposal of a biostratigraphic model of

the different Triassic units and the reconstruction of the palaeoenvironmental history. An important stratigraphic unconformity is marked by the absence of part of both the Upper Permian and Lower Scythian, a widespread phenomenon which is now reported for the first time for Tunisia. The Upper Scythian is characterized by carbonate sediments containing a marine fauna and a palynoflora. The Anisian-Carnian deposits consist of clastic sediments indicating an important continental input into the area. Palynofloras indicate a lagoonal to sebkha environment.

KIETZKE, K. and LUCAS, S.G., 1991. Ostracoda from the Upper Triassic (Carnian) Tecovas Formation near Kalgary, Crosby County, Texas. Texas J. Sci., 43(2): 191-197.

Three ostracod species are reported from the Tecovas Formation near Kalgary, Crosby County, Texas. This fauna closely resembles the ostracod faunas from the Bluewater Creek Member of the Chinle Formation in New Mexico and the Monitor Butte Member of the Chinle Formation in Utah and is of late Carnian age.

KLOTZ, W., 1990. Zyklische Gliederung des Unteren Muschelkalks ("Wellenkalk") auf der Basis von Sedimentations-Diskontinuitäten. Zbl. Geol. Paläont. Teil I, 1989, H. 9/10: 1359-1367.

Sedimentary discontinuities within the Lower Muschelkalk are used for stratigraphical profiling. There always exists a fundamental lithological change within the roofbed cycles. The lithological development records the continuous facial change of less differentiated subtidal carbonatic mud environments to sediments of more differentiated biogenetic-sedimentary carbonate felling systems.

KLOTZ, W., 1990. Zementation und differentielle Kompaktion im Unteren Muschelkalk ("Wellenkalk"). Zbl. Geol. Paläont. Teil I, 1990, H. 11: 1603-1610.

A diagenetic model of cementation and varying compaction is presented for the sediments of the Lower Muschelkalk. Observed and evaluated macroscopical phenomena within the stratigraphic record show a diagenetical rearrangement of the mobile carbonate, which is always oriented towards the top of the layer. As a result it could be stated that the fine-bedded "Wellenkalk" is no intertidal alternated stratification, but a diagenetic change of more homogeneous primary fabrics.

KRISTAN-TOLLMANN, E., 1991. Echinoderms from the Middle Triassic Sina Formation (Aghdarband Group) in NE-Iran. In: RUTTNER, A.W. (Ed.), The Triassic of Aghdarband (AqDarband), NE-Iran and its pre-Triassic frame. Abh. Geol. B.-A., 38: 175-194.

An echinoderm fauna collected in the Shale Member of the Sina Formation of the Aghdarband Group is described. Almost all fauna components are in the category of guide fossils of the Upper Ladinian/Lower Carnian; they occur over the entire Tethys realm.

KRISTAN-TOLLMANN, E., 1991. Ostracods from the Middle Triassic Sina Formation (Aghdarband Group) in NE-Iran. In: RUTTNER, A.W. (Ed.), The Triassic of Aghdarband (AqDarband), NE-Iran and its pre-Triassic frame. Abh. Geol. B.-A., 38: 195-200.

Three species of ostracods are described from the uppermost Ladinian of the Sina Formation (Aghdarband Group). One species is already known from the uppermost Ladinian of Hungary, the other two are new.

KRYSTYN, L. and TATZREITER, F., 1991. Middle Triassic ammonoids from Aghdarband (NE-Iran) and their paleobiogeographical significance. In: RUTTNER, A.W. (Ed.), The Triassic of Aghdarband (AqDarband), NE-Iran and its pre-Triassic frame. Abh. Geol. B.-A., 38: 139-163.

Two ammonite faunas from the Middle Triassic of Aghdarband are described and evaluated palaeobiogeographically. The lower one, consisting of ten genera with 11 species (including several new ones), is of Early Anisian (Bithynian) age. The upper fauna represents the topmost Ladinian (Longobardian 3) and is characterized by the predominance of the genus *Romanites*. Because the absence of fossils a gap is postulated comprising the Upper Anisian and Lower Ladinian. The two ammonite faunas show significantly diverging palaeobiogeographical relations. The lower fauna has a fairly restricted geographical distribution, while the upper fauna occurs all over the Tethys realm.

LERVIK, K.S., SPENCER, A.M. and WARRINGTON, G., 1989 Outline of Triassic stratigraphy and structure in the central and northern North Sea. in: COLLINSON, J.D. (ed.), Correlation in hydrocarbon exploration. pp. 173-189. Norwegian Petroleum Society. Graham & Trotman.

The Triassic extends over 300,000 km^2 in the central and northern North Sea, and reaches thicknesses of 4-6 km. However, complete sequences are scarce. The Triassic normally rests on Upper Permian strata or it overlies the crystalline basement. It is overlain conformably by Jurassic rocks. However, successive erosion, doming and rifting locally caused a major unconformity.

Ages ranging from late Triassic to late Permian are assigned to redbed sequences in the central and northern North Sea on the basis of downhole appearances of age-significant palynomorphs. Several correlations could be established. Major fault, graben and block structures in the north-west and east were active in Triassic times but were mostly not reactivated during the later Mesozoic rifting episode.

LITWIN, R.J., TRAVERSE, A. and ASH, S.R., 1991. Preliminary palynological zonation of the Chinle Formation, southwestern U.S.A., and its correlation to the Newark Supergroup. Rev. Palaeobot. Palynol., 68: 269-287.

Three informal palynological assemblage zones can be distinguished in samples from Chinle Formation outcrops in Utah, Arizona and New Mexico. The oldest zone (Zone I) is in the Temple Mountain Member in southeastern Utah; the middle (Zone II) is in the Shinarump, Moss Back, Monitor Butte and (lower part of the) Petrified Forest Members (Utah, Arizona and New Mexico); the youngest zone (Zone III) is in the upper Petrified Forest Member and the siltstone member in Arizona and Utah and the siltstone member in northcentral New Mexico. Present palynological evidence suggests that Chinle deposition on the Colorado Plateau began locally in late Carnian time and continued at least into the early part of Norian time of the Late Triassic period. Because the upper boundary of the Chinle Formation is an unconformity and the overlying formations are palynologically barren, the length of time represented by this stratigraphic hiatus is not known with certainty. Current palynological evidence suggests, however, that the unconformity at the top of the Chinle cannot be older than early Norian nor younger than Hettangian.

Zones I, II and II can now be recognized in the palynomorph assemblage sequences from the Eastern Mesozoic basins, which modifies earlier palynological zonations for the lower portions of the Newark Supergroup. This is based on our identification of palynomorphs not previously known from portions of the Newark Supergroup. and the discovery that specific biomarker taxa combinations are the same for both the western and eastern palynomorph sequences.

LUALDI, C., 1990. An outline on the Triassic in the Ligurian Alps. Boll. Soc. Geol. It., 109: 51-58.

The sedimentary evolution of the Triassic layers in the Briançonnais and Prepiedmont domain of the Ligurian Alps (NW Italy) are briefly summarized. Special attention is given to the Middle Triassic of the M.Carmo-Rialto Unit.

LUCAS, S.G., 1991. Correlation of Triassic strata of the Colorado Plateau and southern High Plains, New Mexico. New Mexico Bureau of Mines & Mineral Resources Bull., 137: 47-56.

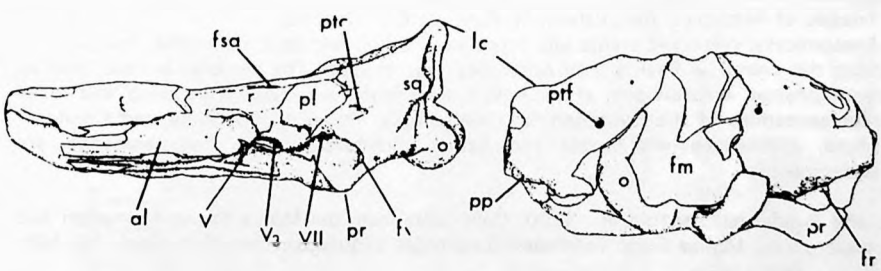
Recent studies have identified the Moenkopi Formation (Anton Chico Member) as the oldest Triassic strata in eastern New Mexico. The stratigraphy of the nonmarine redbeds of the Moenkopi, Chinle and Dockum Formations largely rests on vertebrate fossils and palynology. This paper presents a correlation of these Triassic strata from the Colorado Plateau and those recently recognized in the Rio Grande Rift of north-central New Mexico. This correlation suggests continuity of Triassic deposition across a broad region of the Southwest. In this paper the stratigraphy and palaeontology are reviewed and an alternative palaeogeography, as mandated by this review, is given. A short field guide is included.

LUCAS, S.G. and HAYDEN, S.N., 1991. Type section of the Permian Bernal Formation and the Permian-Triassic boundary in north-central New Mexico. New Mexico Geology, 13(1): 9-15.

The term Bernal Formation has been widely used throughout northern and southern New Mexico. However, in recent years it became clear that many outcrops originally assigned to the Bernal Formation should be identified as the Triassic Moenkopi Formation. The authors give a description and sedimentological interpretation of the type section and the formations development elsewhere in north-central New Mexico. The authors conclude that the term Bernal Formation should be abandoned in favour of the Artesia Formation. The Permian-Triassic boundary in north-central New Mexico is a profound disconformity between Upper Permian (Guadalupian) strata of the Artesia Group and the overlying Middle Triassic (Anisian) Moenkopi Formation.

LUCAS, S.G. and HUNT, A.P., 1990. The oldest mammal. New Mexico J. Sci., 30(1): 41-49.

The oldest mammals are thought to be latest Triassic (Rhaetian), about 205-210 my, from Western Europe. This paper describes the braincase of *Adilobasileus cromptoni*, a new genus and species of mammal from West Texas that is at least 10 million years older. This specimen pushes back mammalian origins.



Holotype of Adelobasileus cromptoni; lateral and posterior views. (Lucas and Hunt, 1990)

Lucas, S.G., Hunt, A.P. and Huber, Ph., 1990. Triassic stratigraphy in the Sangre de Christo Mountains, New Mexico. New Mexico Geol. Soc. Guidebook, 41st Field Conf., Southern Angre de Christo Mountains, New Mexico, 1990, pp. 305-318.

Triassic strata exposed in the Sangre de Christo Mountains of Colfax, Taos, Mora and San Miguel Counties, New Mexico, pertain to eight Formations. This paper gives an overview of the stratigraphy of this area, including a correlation with Triassic strata of east-central New Mexico. The measured reference sections are described in detail.

Mader, D., 1990. Palaeoecology of the Flora in Buntsandstein and Keuper in the Triassic of Middle Europe. Vol. 1: Buntsandstein, Vol. 2: Keuper and Index. lxxxviii + 1582 pp. G Fischer Verlag, Stuttgart, New York.

See the review on p. 26 of the present issue of Albertiana.

Masetti, D., Neri, C. and Boselini, A., 1991. Deep-water asymmetric cycles and progradation of carbonate platforms governed by high-frequency eustatic oscillations (Triassic of the Dolomites, Italy). Geology, 19: 336-339.

The basinal San Cassiano Formation (Triassic, Dolomites, Italy) is interfingered with clinostratified megabreccia slope deposits of coeval carbonate platforms, and to a large extent is composed of metre-scale thickening, coarsening-upward cycles. These asymmetrical cycles, often representing bundles of five coarsening-upward sequences, are interpreted as platform-basin interactions governed by fourth- and fifth-order eustatic oscillations. According to this model, progradation of Triassic platforms of the Dolomites occurred mainly during fourth-order sea-level lowstands.

Mehrotra, N.C. and Sarjeant, W.A.S., 1990. Late Triassic palynomorphs from the Andaman Andaman Islands: a reply to A. Kumar. Modern Geology, 14: 255-264.

A reply on Kumar's comments on an earlier paper by the authors. It is concluded that the spore, pollen and dinoflagellate cyst assemblages are not reworked, nor contaminated in the laboratory. The presence of Late Triassic sediments in the Andaman Islands can be attributed to either the presence of inlier of the Port Meadow Formation within the Baratangs or to exotic blocks. However, detailed investigations are needed to confirm which of the two options is correct. In plate reconstructions, a placement for the Andaman Islands close to Australia and relatively distant from India should be considered necessary.

Meyer-Berthaud, B. and Taylor, T.N., 1991. A probable conifer with podocarpacean affinities from the Triassic of Antarctica. Rev. Palaeobot. Palynol., 67: 179-198.

Anatomically preserved stems and roots from a silicified peat of Middle Triassic age from the Fremouw Peak site in Antarctica was studied. The material is described as *Nothophytum krauselii* gen. et sp. nov. Comparisons are made with living and fossil representatives of the Cycadophyta, Ginkgophyta, Pteridospermophyta and Coniferophyta. Similarities with fossil and extant members of the Podocarpaceae are underscored.

Mieto, P. and Panzanelli Fratoni, R., 1990. Conodonts from the Monte Facito Formation and from the base of the Monte Sirino Formation (Lagonegro sequence). Boll. Soc. Geol. It., 109: 165-169.

Based on conodonts the top of Member C of the Monte Facito Formation can be dated as Late Fassanian, the resedimented carbonate bodies of Member D as Early Longobardian and the base of the Monte Sirino Formation as Late Longobardian. The

Ammonitico Rosso facies of the Monte Facito sequence has yielded a conodont association of either Early or Late Fassanian age.

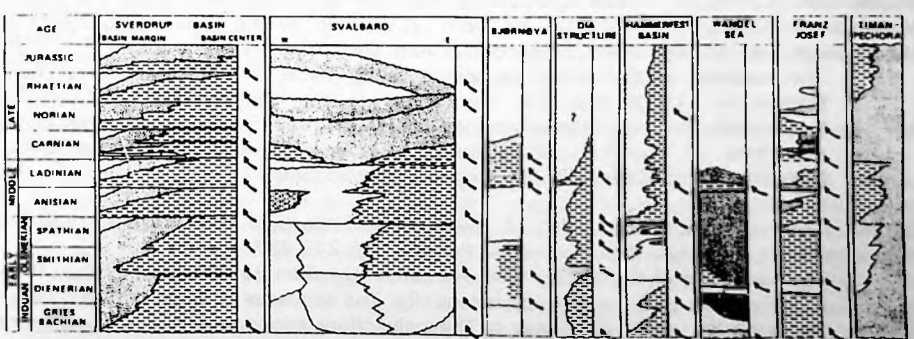
MONTANARI, L. and PANZANELLI FRATONI, R., 1990. A comparison between the Lercara Formation (Sicily) and the Monte Facito Formation (Southern Apennines). Boll. Soc. Geol. It., 109: 115-121.

Recent biostratigraphic studies on the Lercara Formation and the Monte Facito Formation demonstrate that the two formations show more differences then similarities. The former is dated as Ladinian-?Early Carnian, while the later is dated as Early Triassic-Late Ladinian. The Lercara Formation is partly deep marine, while the Monte Facito Formation is characterized by shallow-water build-ups and by Rosso Ammonitico facies and radiolarites representing the drowning of the build-ups. These evident differences can be explained paleogeographically.

MØRK, A., EMBRY, A.F. and WEITSCHAT, W., 1989. Triassic transgressive-regressive cycles in the Sverdrup Basin, Svalbard and the Barents Shelf. in: COLLINSON, J.D. (ed.), Correlation in hydrocarbon exploration. pp. 113-130. Norwegian Petroleum Society. Graham & Trotman.

Nine transgressive-regressive (T-R) cycles have recently been recognized in the Triassic succession of the Sverdrup Basin, Arctic Canada. The transgressions which initiated the cycles are dated as earliest Griesbachian, earliest Smithian, late Smithian, earliest Anisian, early Ladinian, earliest Carnian, mid-Carnian, earliest Norian, latest Norian and earliest Jurassic. Interregional correlation of these transgressive episodes depends on the accuracy of biostratigraphic dating. Ammonoids appear to be the best tool for such correlation. Unfortunately the Triassic succession of Svalbard and the Barents Shelf does not supply the same biostratigraphic resolution as the Sverdrup Basin, mainly because of several hiatuses. At Svalbard many of the transgressions recognized in the Sverdrup Basin appear to be present, but uncertainties exist for the Upper Triassic. At Bjørnøya four T-R cycles have been delineated (and two more are indicated to be present) from the base of the Triassic to the lowermost Upper Jurassic. In the Dia-structure (central Barents Sea) five transgressive reported from the Sverdrup Basin in the Lower and Middle Triassic occur. Many wells have been drilled but only few are currently available. Biostratigraphic data are still insufficient to confirm or deny the presence on the Barents Shelf of all the Triassic transgressive episodes.

However, current data indicate that most, if not all, of the Triassic transgressive events recognized in the Sverdrup Basin are present in the Svalbard-Barents Sea area.



Triassic stratigraphy of the different areas studied. (Mørk et al., 1989)

The regional nature of the T-R cycles suggests that the main variable for the origin of the cycles is either eustatic sea-level change (Vail model) or change in horizontal lithospheric stresses due to episodic plate re-organization (Cloetingh model).

Mørk, A., Vigran, J.O. and Hochuli, P.A., Geology and palynology of the Triassic succession of Bjørnøya. Polar Research, 8: 141-163.

The Triassic succession of Bjørnøya comprises the Lower Triassic Urd Formation of the Sassendalen Group, and the Middle and Upper Triassic Skuld Formation of the Kapp Toscana Group. These units are separated by a condensed ?Middle Triassic sequence represented by a phosphatic remanié conglomerate bed.

Palynology indicates a Dienerian age of the oldest beds of the Urd Formation; ammonoid faunas in the middle and upper part of the formation are of Smithian age. The palynofacies indicates a shallow marine depositional environment.

The lower part of the Skuld Formation can be dated as late Ladinian while a Carnian age is indicated for the upper part. Sedimentary structures, a sparse marine fauna and microplankton indicate deposition in a shallow marine environment.

Nakazawa, K., Suzuki, H., Kumon, F. and Winsnes, T.S., 1990. Scientific results of the Japanese geological expedition to Svalbard, 1986. in: Tatsumi, T. (ed.), The Japanese scientific expeditions to Svalbard, 1983-1988. pp. 181-214. Kyoikusha, Tokyo.

This paper presents the results of an expedition to Svalbard, with special attention to Permian-Triassic biostratigraphy, sedimentary environments and palaeomagnetism. The Permian-Triassic relation is concluded to be a paraconformity, as in the Tethys. The time gap at the boundary includes the Dorashamian Stage and most probably the early Griesbachian. The Permian-Triassic boundary clays seem to be a product of weathering due to groundwater circulation, although the chemical analysis has not been carried out yet. The faunal changes at the boundary are considered to be mainly related to eustatic sea-level changes.

Two Lower Triassic ammonoid zones and four Middle Triassic ammonoid zones or beds were confirmed. *Otoceras boreale*, the index fossil of the Lower Griesbachian in Arctic Canada, occurs in Svalbard in association with *Claraia stachei*. The *Otoceras* Zone in Svalbard is considered to be a little higher than that of the type locality, and may be correlated with the Upper Griesbachian Stage.

Oberhauser, R., 1991., Triassic foraminifers from the Faqir Marl Bed of the Sina Formation (Aghdarband Group, NE-Iran). In: Ruttner, A.W. (Ed.), The Triassic of Aghdarband (AqDarband), NE-Iran and its pre-Triassic frame. Abh. Geol. B.-A., 38: 201-204.

The revision of ammonites causes a dating back of the foraminiferal fauna of Oberhauser (1960) from the Cordevolian to the Langobardian. Isolated Triassic foraminifers give only little information. However, they contribute to the knowledge of the state of evolution of bilocular Ammodiscidae and multilocular calcareous Nodosinellidae and Nodosariidae early in Mesozoic time.

Ottone, E.G. and Garcia, G.B., 1991. A Lower Triassic miospore assemblage from the Puesto Viejo Formation, Argentina. Rev. Palaeobot. Palynol., 68: 217-232.

The basal part of the Puesto Viejo Formation near San Rafael City, Mendoza Province, Argentina has been studied palynologically. The sequence is dated as Early Triassic on the basis of vertebrate remains. The palynoflora supports this age assignment and suggests that the parent palynoflora consisted of a fairly low number of hydrophyllous plants growing under humid temperature conditions.

OUYANG, S. and UTTING, J., 1990. Palynology of Upper Permian and Lower Triassic rocks, Meishan, Chingxing County, Zhejiang Province, China. Rev. Palaeobot. Palynol., 66: 65-103.

The marine sequence exposed at Meishan, Changxing County, Zhejiang Province, China, is a candidate for the youngest Permian stage in the world, the Changsingian, and also for the Permian-Triassic boundary. Three microfloral zones have been recognized. In ascending order these are: (1) *Leiosphaeridia chanxingiensis-Micrhystridium stellatum* Assemblage Zone from the Changsing Formation (Changsingian); (2) *Vittatina-Protohaploxypinus* Assemblage Zone from the basal part of the Lower Chinglung Formation (earliest Griesbachian); and (3) *Lunatisporites-Ephedripites* Assemblage Zone from the upper part of the same formation (Griesbachian). The *Vittatina-Protohaploxypinus* Assemblage Zone occurs in "mixed" fauna bed 3 and slightly above. Age implications, problems of transitional floras, miospore reworking and paleoenvironments are discussed. Sedimentological, paleontological and geochemical elemental analyses suggest that sedimentation may have continuous across the P-T boundary at Meishan, or that any hiatus was small.

PIGG, K.B., 1990. Anatomically preserved *Dicroidium* foliage from the central Transantarctic Mountains. Rev. Palaeobot. Palynol., 66: 129-145.

The first anatomically preserved species of *Dicroidium* is described from the Triassic of the central Transantarctic Mountains.

POCOCK, S.A.J. and VASANTHY, G., 1988. *Cornetipollis reticulata*, a new pollen with angiospermid features from Upper Triassic (Carnian) sediments of Arizona (U.S.A.), with notes on *Equisetosporites*. Rev. Palaeobot. Palynol., 55: 337-356.

Two distinctly different palynomorphs have been described under the name *Equisetosporites chinleana* Daugherty 1941, one of them being reticulate and the other psilate. The new genus *Cornetipollis* is established for the former type. Both forms are studied light-microscopically and with SEM and TEM and compared with other types of early angiospermid pollen.

RADOČIĆ, R., 1990. Review of Triassic facies of the Dinarides. Boll. Soc. Geol. It., 109: 83-89.

This paper presents a review of the distribution and development of the Triassic facies in the Dinaric Domain. Late Scythian events had a local occurrence, while Late Anisian and Carnian ones are documented for the whole area. Late Anisian tectonics is responsible for the development of basinal areas and shallow-water environments, which are well-documented by the Porphyrite-Chert Fm.; the Carnian tectonics determined emersion and erosion of large sectors together with the development and diffusion of carbonate platform facies characterized by wide tidal zones.

RAU, A., (1990). Evolution of the Tuscan Domain between the Upper Carboniferous and Mid Triassic: a new hypothesis. Boll. Soc. Geol. It., 109: 231-238.

Depositional features of sedimentary-volcanic fill of the Late Paleozoic-Middle Triassic basins of the Tuscan Domain indicate that a transcurrent tectonic regime was locally active from the Late Carboniferous. This regime, closely connected with the European megashears system, produced an alternation of transtensive and transpressive conditions until the Mid Triassic at least. The prevalently tangential and transpressive conditions ended in the Late Triassic. Then divergent movements began, which were to lead to the final separation of the Adria microplate from the stable part of the rest of the European continent, which resulted in the opening of the arm of the Mesozoic Tethys. Oceanization followed in the Jurassic.

RUTTNER, A.W. (Ed.), 1991. The Triassic of Aghdarband (AqDarband), NE-Iran and its pre-Triassic frame. Abh. Geol. B.-A., 38:1-252.

In this volume includes thirteen contributions and is the result of a long-term research project which was initially focused on the Triassic coal deposit of Aghdarband (NE Iran), but which was later expanded to a larger area. The erosional window of Aghdarband is the only location where the pre-Jurassic basement of the Koped Dagh Range is exposed. Moreover, it is situated at the southern margin of the Eurasian Turan Plate ("Northern Domain" after Stöcklin, 1977), and is part of the "Cimmerian Indosinian Foldbelt" (Stöcklin, 1980, 1983), and the "Cimmerides" (Sengör, 1985) respectively. On these grounds Aghdarband has now a key position in discussions concerning the geodynamics of the Middle East. Most of the contributions deal on the Triassic. This project was supported by IGCP Project No. 73/1/4 (Triassic of the Tethys Realm).

RUTTNER, A.W. (with contributions by R. BRANDNER and E. KIRCHNER), 1991. Geology of the Aghdarband Area (Kopet Dagh, NE-Iran). In: RUTTNER, A.W. (Ed.), The Triassic of Aghdarband (AqDarband), NE-Iran and its pre-Triassic frame. Abh. Geol. B.-A., 38: 7-79.

This paper presents a structural framework of the Aghdarband area. The different structural units are described and discussed. The Triassic of Aghdarband was deposited on southern marginal parts of the Hercynian Turan Plate. The Early Scythian Quara Gheitan Formation is interpreted to be the upper part of the "Hercynian molasse". It is assumed that a huge talus-fan existed, which reached from the Hercynian orogenic belt to the south over the southern continental margin down to the oceanic trough in Early Triassic times. The Triassic "Sea of Aghdarband", represented by four formations of the Aghdarband Group, was a northern epicontinental part of the Tethys realm. This is characterized by its intermittent existence and, periodically, by strong volcanic activity in its vicinity. The Triassic sequence is interrupted by an ephemeral phase of erosion (probably) in Late Anisian times, and by a stratigraphic gap which comprises the Late Carnian and, probably, also the Early Norian. Thus three periods of Triassic sedimentation can be distinguished: (1) Late Scythian-Early Anisian, (2) Ladinian-Early Carnian, and (3) Late Norian-Early Rhaetian. The data of other contributors to this project are discussed and a synthesis is given.

The structure of the Triassic rocks is a combination of compressional folding with side-slip faulting. Generally, the results obtained favour a geodynamic model, which puts the Elborz Mountains and Central Iran not very distantly from the southern margin of the Turan Plate during the Triassic.

SADEDDIN, W., 1990. *Pseudofurnishius priscus* n.sp. (Conodonta) and its stratigraphical significance for the Ladinian (Middle Triassic) in Jordan. N. Jb. Geol. Paläont. Abh., 178: 369-382.

Triassic sequences are mainly exposed in north-central Jordan. After studying several sections, Middle Triassic ages have been determined and a new conodont species has been established. The phylomorphogenetic development of *Pseudofurnishius* and its stratigraphical significance for the Middle Triassic in Jordan are discussed.

SIBLÍK, M., 1990. New *Schwagerispira* (Brachiopoda) from the Carnian of the Slovak Karst (SE Slovakia). Západne Karpaty, Sér. Paleont., 14: 103-108. Geol. Úst. D. Stúra, Bratislava.

A new retzioid brachiopod *Schwagerispira bystrickyi* n.sp. is described from the Carnian of the Slovak Karst and its relationships to some similar species are discussed.

SIBLÍK, M., 1990. Carnian terebratulid brachiopods from the Slovak Karst (SE Slovakia). Knibovnicka Zemního plynu a nafty, sv. 9b: 109-145.

A further part of a series of contributions on the rich Upper Carnian brachiopod from the Slovak Karst area. This paper deals on the terebratulid brachiopods and includes descriptions of twelve taxa, including two new species and two new subspecies.

SIBLÍK, M., 1991. Triassic brachiopods from Aghdarband (NE-Iran). In: RUTTNER, A.W. (Ed.), The Triassic of Aghdarband (AqDarband), NE-Iran and its pre-Triassic frame. Abh. Geol. B.-A., 38: 165-174.

Two new monospecific genera and one new species are described from the Middle Triassic of Aghdarband.

SIMMS, M.J. and RUFFELL, A., 1990. Climatic and Biotic change in the late Triassic. J. Geol. Soc. Lond., 147: 321-327.

Generally arid conditions that pervaded much of Europe and North America during the late Triassic were interrupted by a wet monsoonal climatic phase during Middle and Late Carnian times. Extensive fluviatile sandstones deposited at this time throughout the region, occur within a thick sequence of playa-like mudstones. The sandstones occasionally contain kaolinite, suggesting a humid climate. And extreme $^{13}\delta$ depletion in a shallow marine sequence of this age in Israel has been interpreted as evidence for an influx of freshwater. A widespread change form carbonates to clastics in marine sequences at this time may also be climate-related. Water-course cave systems in limestone areas exposed during the late Triassic indicate high levels of runoff during the Middle and Late Carnian.

The marine invertebrate fauna shows a significant turnover at the end of the Early Carnian. The terrestrial fauna and flora were relatively unaffected at this time but subsequently diversified prior to a major biotic turnover at the Carnian-Norian boundary. These periods of biotic change appear to be synchronous with the onset and cessation of a humid Carnian phase.

The change to a monsoonal climate during this interval has been documented over more than 90° of longitude between 5° and 50° north of the Triassic equator. It may have been caused by rising atmospheric CO_2 levels due to volcanism associated with the incipient dispersal of Pangea.

SRIVASTAVA, S.C. and JHA, N., 1990. Permian-Triassic palynofloral transition in Godvari Graben, Andhra Pradesh. The Palaeobotanist, 38: 92-97.

The transition from Permian to Triassic in the Mailaram area, Godvari Graben, occurs in a paraconformable sequence; the Permian-Triassic boundary passes within a gap of 12 m.

SRIVASTAVA, S.C. and MANIK, S.R., 1990. *Rostrumaspermum venkatachalae* gen. et sp. nov., an archegoniate seed from Triassic of Nidpur, India. The Palaeobotanist, 38: 98-104.

A new genus and species of pinaceous seed is described on the basis of carbonized material from the Triassic Nidpur Beds.

TIWARI, R.A. and RAM-AWATAR, 1990. Palyno-dating of Nidpur beds, Son Graben, Madhya Pradesh. The Palaeobotanist, 38: 105-121.

On the basis of mega- and microfossils an Early Triassic age is suggested for the Nidpur beds.

Van Bergen, P.F. and Kerp, J.H.F., 1990. Palynofacies and sedimentary environments of a Triassic section in southern Germany. in: Fermont, W.J.J. and Weegink, J.W. (eds.), International Symposium on Organic Petrology, Meded. Rijks Geol. Dienst, 45: 23-37.

Palynofacies analysis of core-samples from the Triassic from a well in Franken (Germany) has resulted in a better understanding of the different depositional environments of the uppermost Muschelkalk, Lower Keuper and lowermost Middle Keuper (Fassanian-late Langobardian). The composition of palynological organic matter assemblages reflects a multitude of environments, varying from delta plain to open marine.

Vörös, A., Horváth, F. and Galácz, A., 1990. Triassic evolution of the Periadriatic margin in Hungary. Boll. Soc. Geol. It., 109: 73-81.

The Transdanubian Range and North Hungarian Mesozoic complexes used to be an integral part of the Periadriatic belt, and were situated in the proximity of the South Alpine realm.

The Triassic begins with a marine transgression in Transdanubia and formation of an extensive carbonate platform. Disintegration of the carbonate platform in the western part of the Bakony Mts. occurred in the late Anisian and basinal development prevailed until the late Carnian. During the Late Triassic the whole range as characterized by the deposition of shallow water Hauptdolomite and Dachsteinkalk. In northern Hungary a uniform carbonate platform collapsed in the late Anisian and crustal extension led to the formation of a narrow oceanic trough flanked by two continental margins.

The tectonic evolution of the region during the Triassic can be explained in terms of activity of a sinistral transcurrent fault zone. A set of local basins with different timing and amount of extension are "en echelon" transtensional features along this fault which bordered the Periadriatic area to the north.

Wang Ziqiang, 1991. Advances on the Permo-Triassic lycopods in North China. I. An *Isoetes* from the Mid-Triassic in northern Shaanxi Province. Palaeontographica B 222: 1-30.

A distinctive monospecific taphocoenosis is the basis for a whole-plant reconstruction of a new lycopod *Isoetes ermayinensis*. The evolutionary history of the Isoetaceae is discussed. Based on the new material the author's conclusion differs from the traditional hypothesis in which *Isoetes* is derived from other Triassic lycopods represented by *Pleuromeia* in the post-Triassic.

Warth, M., 1990. Die Muschelfauna des südwestdeutschen Schilfsandsteins (Obere Trias, Karn, Mittlerer Keuper) und ihre stratigraphische Verbreitung. N. Jb. Paläont. Abh., 181: 107-115.

From the Schilfsandstein of southwest Germany the following species of bivalves are documented: *Modiolus dorsocurvatus* Linck 1968, *Unio keuperinus* Berger 1854, *Unionites equisetitis* Linck 1968, *Anodontophora* cf. *ovalis* (Zeller 1907) and *"Anodonta" lettica*. Some of these species are also found in other horizons of the Keuper. Most of the bivalves of this stage seem to be endemic species, their roots being seeked in the faunas of the Bunter and of the Muschelkalk. The environment of deposition of the Schilfsandstein must have been an extensive continental basin filled with lakes of changing salt concentrations and with slowly flowing rivers.

WHITE, J.F. and TAYLOR, T.N., 1991. Fungal sporocarps from Triassic peat deposits in Antarctica. Rev. Palaeobot. Palynol., 67: 229-236.

Several different fossil fungi are described from silicified peat deposits from the Fremouw Peak locality of the Transantarctic Mountains. The structures of these fossils are interpreted and potential relationships discussed.

YAROSHENKO, O.P. and BASH IMAM, I., 1990. Palynoflora and stratigraphy of the Middle and Upper Triassic of Siberia. in: ACHMATIEV, M.A. (ed.), 1989. Paleofloristics and startigraphy of the Phanerozoic. Geol. Inst. Akad. USSR, Moscou, pp. 32-65. (in Russian)

Palynological assemblages from North Syria were studied. They can be dated as Anisian, Ladinian, Carnian and Norian. Characteristic forms are illustrated on six plates.

YIN HONGFU, 1990. Paleogeographical distribution and stratigraphical range of the Lower Triassic *Claraia, Pseudoclaraia* and *Eumorphotis* (Bivalvia). J. China Univ. Earth Sci., 1(1): 98-110.

On the basis of a worldwide review of *Claraia, Pseudoclaraia* and *Eumorphotis,* especially their important species, two range zones are recognized: (1) the *Pseudoclaraia wangi* Range Zone (Upper Griesbachian), and (2) the *Claraia stachei - C. aurita - Eumorphotis multiformis* Acme Zone (Upper Griesbachian to Lower Smithian). This result revises both the traditional Chinese concept regarding these fossils as limited to the Lower Scythian and the viewpoint of some Eurasian researchers who consider *Eumorphotis multiformis* to be Upper Scythian.

The paleogeographical distribution of the three genera is controlled primarily by temperature (latitude) and secondarily by physiographic separations. Four realms and five provinces can be recognised. The Eastern Asian province of the Tethys realm is suggested as the source area of these fossils. The striking contrast between the composition of the species along the southern and northern margins of the Tethys, together with other distributional characters, supports plate tectonic models.

ZAPPATERA, E., 1990. Carbonate paleogeographic sequences of the Periadriatic region. Boll. Soc. Geol. It., 109: 5-20.

A paleogeographic-oriented approach to regional basin analysis of the Periadriatic region is illustrated through a new concept in carbonate stratigraphy, the Carbonate Paleogeographic Sequence (CPS). It is based on the recognition that basic lithostratigraphic similarities exist between widely separated paleogeographic units. The CPS represents the fusion of geographically distant paleogeographic units of similar lithostratigraphies into a single mappable unit. The new concepts provides a relative predictive tool in stratigraphic and facies interpretation of areas where geologic data are scarce.

ZAVATTIERI, A.M., 1990. Stratigraphic and paleoecologic evaluation of the palynofloras of the Triassic Las Cabras Formation at the type locality Cerro Las Cabras, Mendoza, Argentina. N. Jb. Geol. Paläont. Abh., 181: 117-142.

Seven microfloristic associations are recognized in the Las Cabras Formation, comparisons with megafloras are made and a Middel Triassic age is established.

The papers listed above have come to the compiler's notice since the publication of the last issue of ALBERTIANA. Authors are kindly requested to send reprints or copies of the title page (with full reference and an abstract, preferably in English, French or German) of their recently published papers to the editor of ALBERTIANA.

ADDRESSES OF CONTRIBUTORS

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T. Aigner	Institut für Geologie und Paläontologie, Universität Tübingen, Sigwartstraße 10, D-7400 Tübingen, Germany
G.H. Bachmann	c/o Preussag AG, Erdöl und Erdgas, Karl-Wiegert-Allee 4, D-3000 Hannover 61, Germany
H. Kerp	Forschungsstelle für Paläobotanik, Westfälische Wilhelms-Universität Münster, Hindenburgplatz 57-59, D-4400 Münster, Germany
S.G. Lucas	New Mexico Museum of Natural History, P.O. Box 7010, Albuquerque, New Mexico 87194, U.S.A.
C.A. McRoberts	Department of Geology, Heroy Geology Laboratory, Syracuse University, Syracuse, New York 13244-1070, U.S.A.
G.D. Stanley Jr.	Department of Geology, University of Montana, Missoula, Montana 59812, U.S.A.
H. Visscher	Laboratory of Palaeobotany and Palynology, University Utrecht, Heidelberglaan 2, 3584 CS Utrecht, The Netherlands
G. Warrington	British Geological Survey, Keyworth, Nottingham NG12 5GG, United Kingdom

The critical reader of ALBERTIANA may have noted that our Editor, Hans Kerp, apparently has two addresses: Utrecht and Münster.

This is due to the fact that, per 1 September 1991, Hans has been appointed to the Chair of Palaeobotany at the University of Münster. Congratulations on behalf of the STS !!

Since Hans will still be regularly in Utrecht, we have decided to keep the Editorial Office of ALBERTIANA, at least during the coming year, in Utrecht.

H. Visscher

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Authors should send their contributions for the next issue to the editor of ALBERTIANA **before August 1st, 1992.** The layout of contributions should preferably be in accordance with that of those in the present issue (including the citation of references). In order to facilitate the production of this newsletter and reduce typing errors, authors are kindly requested to submit their contributions on floppy disk (if possible). Files should be in plain ASCII format, WordPerfect 5.0, WordPerfect 5.1 or any other kind of word processing program which is convertible to WordPerfect 5.1. Manuscripts can be submitted on 5¼ inch or 3½ inch IBM computer disks (returnable) together with a printed hard copy.

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SECRETARY GENERAL	H. Visscher, Laboratory of Palaeobotany and Palynology, Rijksuniversiteit Utrecht, Heidelberglaan 2, 3584 CS Utrecht, The Netherlands, tel. 0031 30 532629, fax 0031 30 535096
PAST CHAIRMAN	C. Virgili, Collegio de Espana, Cité Internationale Universitaire, 7 Boulevard Jourdan, F-75014 Paris, France, tel. 0033 14 58 97 495.