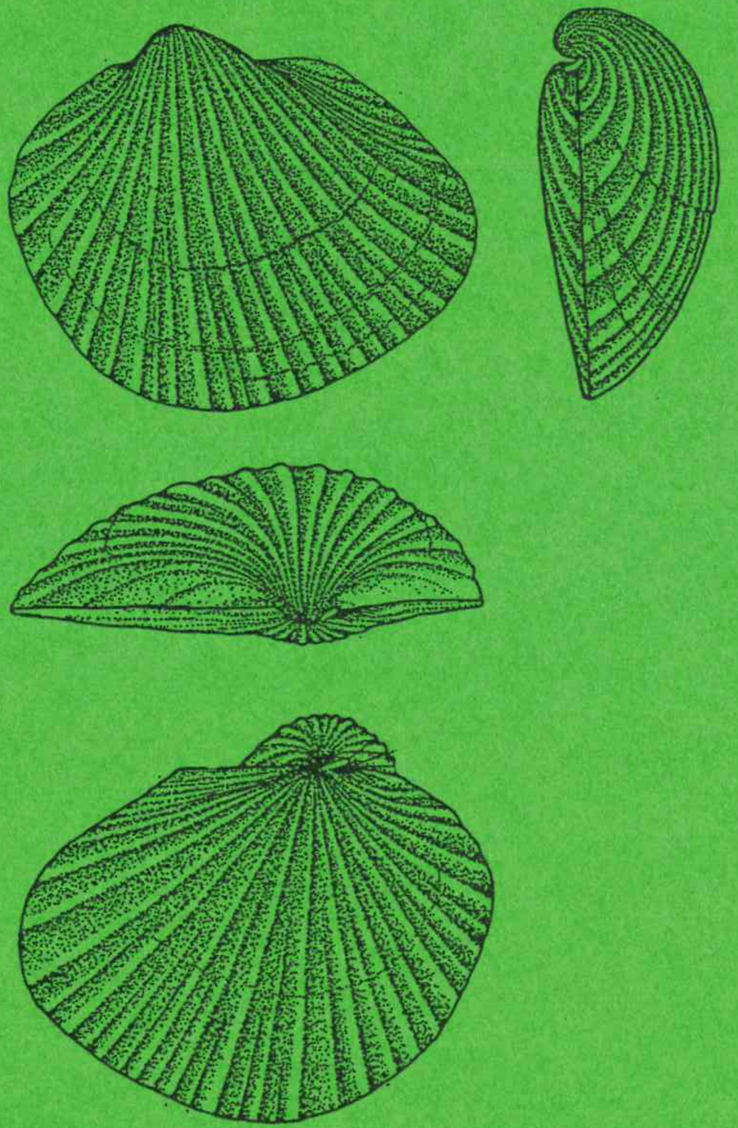
# ALBERTIANA

SUBCOMMISSION ON TRIASSIC STRATIGRAPHY





6 DECEMBER, 1987



ISSN 0169-4324

ALBERTIANA

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The primary intention 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 new 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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Front page: Reconstruction of *Monotis ochotica ochotica* (Keyserling).

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Non-members of the Subcommission on Triassic Stratigraphy can obtain ALBERTIANA at the cost of US $ 2.50 per issue (bank-cheque to Mr.A.J.Goslinga,Laboratory of Palaeobotany and Palynology, Heidelberglaan 2, 3584 CS Utrecht, The Netherlands).

# SUBCOMMISSION ON TRIASSIC STRATIGRAPHY

## REPORT 1987

H. VISSCHER

In 1987 the Subcommission on Triassic Stratigraphy once more concentrated its activities on the Permian - Triassic boundary and the subdivision of the Lower Triassic. Moreover, a new discussion on the problem of the status of the Rhaetian Stage was initiated.

In conjunction with the successfull Final Conference on Permo-Triassic events of East Tethys Region and their Intercontinental Correlations, organized in China, the chairman and secretary of the STS, together with some members and invited specialists organized a work meeting in order to evaluate the present state of affairs with regard to the principal issue in current STS discussion: the chronostratigraphical subdivision of the Lower Triassic. It was concluded that:

- There are still insufficient contributions of STS members in order to make a final choice with regard to recommended stage and substage nomenclature
- The chairman will issue a circular, in which she will once more call upon the members to give their judgement on the various concepts of chrono-stratigraphical subdivision available
- There are a number of problems with regard to the classification scheme(s) advocated by stratigraphers from the USSR; therefore Dr. Yu. Zakharov has been asked to initiate a discussion to clarify the Russian view(s) (see present issue of ALBERTIANA)

With regard to the Rhaetian problem, initiatives were taken to become familiar with - hopefully refreshing - views of authorities other than STS members. The contribution of Prof. Dr. D.V. Ager in this issue of ALBERTIANA seems a promising start of a renewed discussion.

## FINAL CONFERENCE OF IGCP-PROJECT 203: PERMO-TRIASSIC EVENTS OF EAST TETHYS REGION AND THEIR INTERCONTINENTAL CORRELATIONS (September 5-20, 1987) -REPORT

H. VISSCHER

A conference and a field-trip, both related to the discussion of the major events at the Permian-Triassic boundary, were organized in China by Prof. Dr. Yang Zunyi and his collaborators of the Wuhan College of Geology. The conference was the final meeting of IGCP-project 203.

During the scientific meeting in Beijing, about 30 papers were presented by participants from Australia, Austria, China, Denmark, India, Italy, The Netherlands, New Zealand, Poland, Spain, USA and USSR. Abstracts of papers, together with a field-trip guide, were published by the China IGCP National Committee. The principal topics of the contributions included:

- new data and interpretations on P/T mass-mortality and mass-extincition in a wide variety of faunal anf floral groups
- new evidence on the pronounced increase of volcanic activity at the P/T junction
- new data on the occurrence and origin of microspherules in P/T boundary sediments
- new data on P/T anomalies in the ratio of stable C- and O-isotopes
- new data on P/T anomalies in the content of Ir and other rare elements

Many investigators now try to recognize similarities between the Permo-Triassic and the Cretaceous-Tertiary boundary events. When discussing the cause of the P/T events, a number of Chinese contributions strongly favoured an explanation in terms of an impact of an extra-terrestrial body.

Another important issue at the conference remained the definition of the P/T boundary as well as the selection of an appropriate stratotype. These problems formed also the main theme of discussion during the field-trip to Permian-Triassic sections in the provinces Sichuan and Hubei. The programme included a visit to the Shangsi section, one of the two potential Chinese P/T boundary stratotypes. The participants had ample opportunity to study the sections in detail and to take samples for micropalaeontological, palynological, sedimentological and geochemical analysis.

From Chongqing to Wuhan the excursion took place by boat, down-stream the Changjiang (Yangtze) river. The passage through the famous Three Gorges was certainly one of the highlights of the field-trip. At Wuhan there was another day of lecturing, especially organized to inform geology students of the Wuhan College of Geology about the results of P/T research outside China.

During the final business meeting of project 203, it was decided to formulate a proposal for a new IGCP project aimed at the multidisciplinary study of Late Palaeozoic - Early Mesozoic geodynamic and biodynamic events. The principal results of project 203 will be published as a multi-author book.

In conclusion it can be stated that project 203 has been successful. The foreign participants in the conference and the field-trip were largely impressed by the current quantity and quality of P/T research in China. It would be highly unrealistic to neglect the vast amount of new information and new views available in Chinese literature. Unfortunately, however, there is still the serious drawback of the language barrier, blocking the passage to an optimal exchange of information.

As far as the activities of the STS are concerned, it may be stated that project 203 has yielded many contributions with regard to the knowledge about the P/T boundary and the Lower Triassic. Once more an IGCP project has stimulated international multidisciplinary research in the Triassic: similar to the achievements of project 4 (ALBERTIANA 1), the results will certainly have their impact on current discussions within the STS.

Prof. Yang Zunyi and his co-organizers are to be congratulated for the way in which they have stimulated Permian and Triassic research in China as well as in other parts of the world.

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In April 1988 the C.I.M.P. and the Laboratory of Palaeobotany and Palynology of the University of Utrecht will jointly organize a symposium on

CIRCUM-MEDITERRANEAN PALYNOLOGY

Of course, the Triassic will not be neglected !

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# A DEFENCE OF THE RHAETIAN STAGE

DEREK AGER

Abstract: The Rhaetian Stage at the top of the Triassic has, in recent years, been threatened with extinction by ammonite specialists. However, it is strenuously defended in many parts of the world, especially by specialists in other groups. Though the ammonites were at a low ebb in Rhaetian times, brachiopods and bivalves make the stage highly distinctive and it is here defended in terms of simple usefulness.

## INTRODUCTION

I love the Rhaetian. In recent years it has become fashionable to extinguish it within the vastness of the Norian Stage below, but to me it is a distinctive, easily recognizable and above all a useful division of the stratigraphical record at the top of the Triassic System. The authoritative work of Tozer (1984) on "The Trias and its Ammonoids" in effect ordered its elimination, but the Triassic Subcommission of the International Union of Geological Sciences (Visscher, 1984; Tozer, 1986) declared the matter still to be open and it is in that context that I make my cases for the preservation of this well-known stage.

## HISTORY

In his entertaining and definitive book on the Trias and its ammonoids, Tozer (1984) entitles his last chapter "Worldwide Reconciliation". I must admit to still being unreconciled on one point. Does this just mean that I am an arkward cuss? Perhaps I am, but I like to think that my reasons are deeper than a natural contrariness. Basically it is because I refuse to bend the knee to what has been called "the tyranny of the ammonites" in Mesozoic stratigraphy. We see it most clearly in the almost holy work of Arkell on the Jurassic of the world (1956) which is basically only concerned with ammonite correlation. All sorts of marvellous things in the Jurassic rocks, faunistically, floristically, sedimentologically and volcanologically are ignored or played down in that great book because they do not bear on the supposedly all-important matter of ammonite correlation. Similarly with Tozer on the Triassic, this fine work ignores almost everything that is not a cephalopod.

The history of the classic Rhaetian was well summarized by Pearson (1970) and need not be repeated here in detail.

The Rhaetian Stage was named by Gümbel (1861) for the uppermost Triassic rocks in the Northern Calcareous Alps of southern Germany. The section in the Kössener Schichten at Kössen in Bavaria provides a very adequate stratotype. After first accepting the Rhaetian Stage for his North American sections (1967) Tozer later classified the Kössener Schichten as the equivalent of his Upper Norian (1981, p. 413) or Servatian. To me the Kössener Schichten are chiefly noteworthy for their distinctive fauna of brachiopods which were originally well monographed by Suess (1854) and later correlated elsewhere, chiefly on their bivalves, by Oppel and Suess (1856). The ammonites, to me, are of minor importance in spite of their obvious stratigraphical value.

The correlation of the alpine Rhaetian of southern Germany and Austria with the extra-alpine Rhaetian was based on the common bivalve *Rhaetavicula contorta* (Portlock). Slavin (1961, 1963), however, suggested that the transgressive *contorta*-bearing strata of north-west Europe should be separated from the Rhaetian in a "Bavarian Stage" at the bottom of the Jurassic. In other words, the determining factor should be the event, not the palaeontology or the precedent.

It may be noted that the so-called "Rhaetic" of Britain was usually linked with the Jurassic, notably by Arkell in his classic work on the British Jurassic (1933). However, this was essentially on the basis of the transgression which marked these beds and which inaugurated the great cycle of marine sedimentation that was recorded in the British Jurassic. In other words, it was a grouping on the basis of what I have called "Event stratigraphy". On the basis of a major "happening" at the beginning of Rhaetian times over major parts of the earth's surface, one can see the attractions of the Rhaetian as a separate division of geological time to those who take what I have termed (more light-heartedly) a "Marxist" attitude to stratigraphy (Ager, 1973).

The Rhaetian has always been recognized as a separate division in Europe, above the Norian, notably in Jean Ricour's monumental work on the French Trias (1962), though he also included it as the basal stage of the Jurassic. German workers, on the other hand, usually put it at the top of the Trias.

Certainly the Rhaetian stage in Europe marks a significant and distinctive event in earth history. It is such, for example, in my present back-yard in South Wales (Ager and Edwards, 1986). Most notably it records a widespread marine transgression, albeit with the deposition of unusual and unhealthy-looking sediments.

The black, pyritous shales of the Upper Rhaetian extend at least from the British Isles to Italy and probably much farther.

In his later major work on the Jurassic of the World, Arkell (1956) rejected this "Marxist"-type approach and reallocated the Rhaetian to the Triassic, just as he pushed the Callovian down into the Middle Jurassic to the dismay of my Soviet friends (Ager, 1973, p.87). There is no reality to such arguments unless one believes in world-wide catastrophes or fanfares of heavenly trumpets at the appropriate moments in earth history.

The classic type Rhaetian of the Alps contains the ammonite *Choristoceras marshi* Mawer, which does not occur in the *contorta* beds of extra-alpine Europe. To Tozer (1967) and his followers, this one ammonite is all that matters. In western North America at this level, Tozer (1979) recognized a zone characterized by his species Choristoceras crickmayi. Hallam (1981) confirmed that this genus only occurs at this level and earlier records are erroneous. The second commonly mentioned ammonite genus, Rhabdoceras, on the other hand, does also occur in two lower zones. On this basis, and because of its small size, Tozer (1979) opted to include the Rhaetian within the Norian, and in this he was supported by Hallam (1981).

Tozer pointed out (1984, p.14) that the Norian and Rhaetian are defined at different places in the Alps and the boundary between them is not clear. But this is true of almost every division of the stratigraphical column and is bound to be so unless someone discovers a super Grand Canyon with the whole succession piled up in an unimaginable thickness, layer upon layer. Even then I would not believe that there were not immense and undetected gaps in the record. The boundary between the two stages was discussed by Pearson (1970).

In that the Rhaetian was named first (by Gümbel in 1861) it has priority over the Norian (named by Mojsisovics in 1869). That is not to say that the latter should be abandoned in favour of the former, which would be ridiculous. But at the same time there is no legalistic reason why the Rhaetian should be regarded as a synonym of the Upper Norian. That is merely a matter of names and a subjective opinion based mainly on one interpretation of the record in one part of the world. What is more, if the Rhaetian becomes the Upper Norian, what becomes of the previous Upper Norian (i.e. the zones of Cochloceras amoenum and Gnomohalorites cordilleranus in Tozer's classification)? It is a similar problem to the one we had in the Jurassic over the Aalenian and the Lower Bajocian. If we accept the former (as we now all seem to do), then we often have to explain the sense in which we use the term "Lower Bajocian", which in turn changes the meaning of "Middle Bajocian". We also have the non-standard term "Middle Cretaceous" which is used in a wide variety of meanings and confuses both the "Lower" and "Upper" divisions.

Indeed on the very topic of this paper, Hallam (1981) was forced into the awkward Germanic usage "late late Norian" when he wanted to convey the idea of Rhaetian. I cannot see what is gained by that.

So I refuse to be convinced by the succession in one particular place defined by one group of organisms and prefer to follow the example of common usage and priority. It is far better to leave things as they are to avoid confusion.

Tozer rejected the Rhaetian as a stage name on the grounds that it overlapped with the Servatian (or Upper Norian) and he preferred to use the name Servatian. This is a curious argument since Rhaetian is well-known as a stage name world-wide, whereas Servatian is not (in fact this particular Mesozoic worker had never heard the term in 35 years' work, until he read it in

Tozer's paper. A number of other leading Mesozoic specialists proved equally ignorant. It is also not included in such standard reference works as Elseviers's "Geological Time Table" (Van Eysinga, 1972) nor in "A geological time scale" (Harland et al., 1982). What is more, even Tozer himself used the term Servatian in different senses in different publications (1967, 1979).

Obviously it is unsatisfactory to treat the Rhaetian as though it were of equivalent length to the Norian as it appears in many tables (e.g. in Harland et al., 1982, where both are allocated 6 million years). This is based on the somewhat naive approach of dividing the intervals between radiometrically-fixed time markers. Nevertheless, it does not seem logical to me to argue that because the Rhaetian only lasted perhaps one million years and the Norian lasted perhaps ten, that the former should be included in the latter and so make it even longer.

## BIOSTRATIGRAPHY

It does not concern me that the Rhaetian only constitutes one ammonite zone - that of *Choristoceras crickmayi* in North America and *C. marshi* in Europe. Certainly it represents a time of trauma in ammonite history. They seem to have come close to extinction at that time, before indulging in a second frenzy of diversification in the Jurassic, though there were more ammonites around than is generally realized. In Europe we have *Choristoceras* and *Rhabdoceras* as the characteristic ammonite genera together with the more long-ranging *Arcestes* (with its various synonyms and sub-genera such as *Cladiscites*, *Stenarcestes* and *Rhaetites*) and *Megaphyllites* (which in New Zealand is accompanied by other long-ranging stocks such as *Rhacophyllites* and *Placites*, teste H. Campbell).

Genera such as *Choristoceras* and *Cycloceltites*, are entirely restricted to the Rhaetian on Tozer's authority (1980), whilst *Rhabdoceras* has been split and lumped in various ways.

Even so, as I have said before, ammonites are not everything in Mesozoic stratigraphy and it could be argued that, since the ammonites were having such a bad time and were so few in number and diversity in Rhaetian times, that we should consider using other groups, notably the brachiopods and the bivalves.

Much as I love them, I would not pretend that brachiopods are the best of fossils, for stratigraphic purposes, in Mesozoic rocks. I do not study them with that in mind as my primary purpose. Nevertheless, I have collections sent to me from all over the world (or collected personally) and I am confident that I can use them to recognize stages, sub-stages and even ammonite biozones in some cases.

I have done this, for example, in the Jurassic (Ager,1978) as have other specialists such as Dagys, Tchoumatchenko and Prosorovskaya. More recently in the Cretaceous, Surlyk (1984) has recognized no less than ten brachiopod zones in the Maastrichtian Stage of north-west Europe.

Such work is less well-known in the Trias, largely because of the absence of brachiopod-bearing beds in the most studied parts of the world, though mention must be made of excellent modern work (following the classic monographs of Bittner) such as Dagys (1974) in the Soviet Union and Pearson (1977) specifically on the Rhaetian brachiopods of Europe.
So far as the brachiopods are concerned, from the detailed information in Pearson's revision of the Rhaetian brachiopods of Europe (1977), one can say that some Rhaetian species, for example Sinucosta emrichi (Suess), Laballa suessi (Zugmayer), Zugmayerella koessensis (Zugmayer), Oxycolpella oxycolpos (Suess), Rhaetina pyriformis (Suess) and Triadithyris gregariaeformis (Zugmayer) range down into the Norian. One, Piarorhynchia cf. L. juvenis (Quenstedt), is of a distinctly Jurassic appearance. Several range right through from the Norian into the Jurassic, notably Rhaetina gregaria (Suess), Fissirhynchia fissicostata (Suess) and Zugmayerella uncinata (Schafhautl). A few are wholly confined to the Rhaetian, notably the highly distinctive Austrirhynchia cornigera (Schafhautl) with its almost ridiculously exaggerated "wings", Rhaetina ovalis Pearson and Mentzellia rhaetica Pearson. One could also mention the genus Carapezzia at this level in southern Europe and Turkey (Ager et al., 1980). There is no doubt that the strongest affinities for the Rhaetian brachiopods, both at species and at generic level, are with the Norian and earlier strata. Nevertheless, associations of Rhaetina, Austrirhynchia and Carapezzia immediately indicate this stage. However, besides what is there, one has to consider what is not there. Most notable of the absentees is Halorella, which occurs in Norian strata (s.s.) both in Europe and in the supposedly ideal sections of the western U.S.A., in Oregon and Nevada (Ager, 1968). Other distinctive Norian genera not found in the Rhaetian include Halorelloidea, Austriellula, Dimerella, Omolonella and probably Timorhynchia (see also Ager et al., 1972).

Tozer himself (1980, p.866) conceded the distinctiveness of the Rhaetian brachiopod fauna and on their basis I can recognize the Rhaetian Stage as far away as southern Turkey in one direction (Ager et al., 1980) and Nevada in the other (on the basis of material loaned by George Stanley). In New Zealand, the equivalent Otapirian is characterized by brachiopods such as several species of the spiriferinid Rostelligera.

The bivalve fauna of the Rhaetian is also distinctive. Hallam and Shaarawy (1981) list no fewer than 35 species at Kössen, of which only six occur also in the very different facies of southern Britain. They blame the lower diversity of the extra-alpine faunas, with their own distinctive elements, on lower salinity. Besides the classic case of Rhaetavicula contorta, discussed above, correlation is possible with other well-known species such as Chlamys valoniensis (Defrance) and Protocardia rhaetica (Merian).

In New Zealand, the Rhaetian/Otapirian is marked by the first appearance of Otapiria (which also occurs in the European sections) and by species of Myophoria, Monotis and Torastarte (Marwick, 1953).

## LITHOSTRATIGRAPHY

It is often said that there is a good correlation between sediment thickness and the number of ammonite zones present. On that basis, the Rhaetian, only constituting one ammonite zone, represents only about a million years of deposition. However, the thickness of Rhaetian strata alone may be said to be sufficient justification for the stage.In New Zealand, for example, it is represented by up to 1000 m of sediment. This compares well with some of the classic Mesozoic sections in Europe where zones are thinner than the zonal ammonites (which have been planed off to fit in).Tozer (1984,p.77) comments on Triassic blocks in Timor which contain nine successive ammonite faunas in less than a metre of sediment.

There is also the all-important matter of gaps in the stratigraphical record. It often seems to be tacitly assumed that if there are no sediments representing a particular time-span in a particular area, then nothing happened there. This is obvious nonsens. There are no gaps in time. In many parts of the world there is no record, either of sediments or of many groups of organisms between the Norian (s.s.) and the Sinemurian. The Hettangian, at the base of the Jurassic, is therefore hardly more defensible than the Rhaetian. Darwin long ago argued that long periods of time left virtually no record, and this is certainly true if one confines oneself to one particular part of the earth's surface.

It must be pointed out that, prior to Tozer's work, a gap had been postulated at the top of the Triassic almost everywhere in North America in the correlation charts published by the Geological Society of America (McLearn, 1953, Reeside et al., 1957). It is my inclination to expect gaps in the stratigraphical record rather than to assume continuity (Ager, 1973, chapter 3). The widespread nature of continental conditions at this level makes a gap in the marine record all the more likely. In Tozer's splendid book he says on this matter (1984, p.13): "The record is most clearly displayed in Nevada ... Despite the change in the fauna there is little or no evidence for an interruption in sedimentation. Something catastrophic nevertheless seems to have happened." But later (p.100) he writes of the same section: "There may have been a short break in sedimentation between the Triassic and Jurassic but the section ... comes closer to providing a continuous record of ammonoid faunas for this interval of time than any other."

Apart from the fact that no one can be that dogmatic about the length of a gap in a stratigraphical record which is as full of holes as a net, the critical word is "ammonoid". It is not true of other groups of organisms. Krystyn (1980), for example, continued to claim on the basis of conodonts, that the top of the Trias is missing in North America. This was strongly denied by Tozer, though it is not clear his grounds for doing so. There is not enough evidence to be sure if this is also true for the brachiopods, but so far as they are concerned, the sections seem to be far inferior to those of central Europe. In fact on the basis of brachiopods I discovered a break between the Triassic and the Jurassic in north-west Canada at a distance of several thousand miles (Ager and Westermann, 1963). What is more, I think I can recognize the Rhaetian from its brachiopods in Nevada itself, in collections made by George Stanley in the Luning Formation, which we plan to describe together.

Tozer (1984, p.13) suggested a catastrophe at the end of the Triassic to explain the supposed mass extinctions at that time. He followed McLaren (1983) in suggesting a correlation with the Manicouagan impact crater in Quebec, which was molten about 210 million years ago. I note, however, that McLaren (op.cit., p.321) does say of the supposed mass extinction at the end of the Triassic "while not pleading in any way for a catastrophe for this particular extinction...". Though I often find myself being labelled a "catastrophist" and certainly would not deny such impacts as one of the main physical processes in the Solar System, I find very little evidence for such "mass extinctions" on earth. In every case I know, there are clear signs of gradual decline in every group of organism concerned, as though they knew that the hypothetical asteroid (or dark star) was coming. Tozer himself points out the ammonoids were declining from Mid Norian times onwards. Certainly that was also true of the brachiopods. If there was a major break in the fossil record at the end of the Triassic (which I doubt) then I would far rather blame it on a gap in the record than on an extra-terrestrial intruder.

Hallam (1981) recorded a similar decline in the bivalves from a diversity peak in the Carnian to early Norian terminating in a "significant extinction episode" at the end of the period. This is blamed on the environmental effects of an eustatic lowering of sea-level rather than on external influences.

## DISCUSSION AND CONCLUSION

There are no absolute criteria for the recognition of a stage. When my research students have similar problems over palaeontological nomenclature my ultimate advice is always one of usefulness. If it is useful to have a name, be it for a family, a genus or a species, then a separate name is justified. The same applies to stratigraphical nomenclature and on that basis the Rhaetian is a useful name and should be retained on that account.

It may be thought that the battle is already lost. Because of Tozer's influence as our leading authority on Triassic ammonites, the term is no longer used in North America. It was not used by Dagys (1974) in his magnificent studies of the Triassic brachiopods of the U.S.S.R.. I was even persuaded myself by my French colleagues, most unwillingly, to let it appear as "Upper Norian (Rhaetian)" in a study of Late Triassic brachiopods from the south of Turkey (Ager et al., 1980). But I knew that they were distinctively Rhaetian!

However, I am always an optimist and I am pleased to see the Rhaetian still used in the invaluable Elsevier time table (Van Eysinga, 1972) and in many other standard works. It is still used in the correlation charts for the Trias published by the

Geological Society of London (Warrington et al., 1980) and I note therein a reference to the work of Baud and his Rhaetian being "Atypically regarded as part of the Norian Stage ... ".

I am unmoved by the lack of enthusiasm for the Rhaetian Stage in western North America. If they cannot recognize a distinctive Rhaetian Stage there, then it may equally be said that we cannot readily recognize their stages and substages such as Griesbachian, Dienerian, Smithian and Spathian in Europe. Indeed several of these, like the Rhaetian, only comprise a single ammonite zone, and by Tozer's own reasoning should be rejected.

From what I have outlined above, it is clear that we have the choice of names between Rhaetian, Upper Norian, Servatian, Bavarian and Otapirian for the strata concerned. I maintain that of all these, the Rhaetian is by far the best known and best understood internationally. As a dedicated pragmatist therefore, I think it is the one we should accept, though I must admit to a fondness for the Otapirian, if only because the type area is in the Hokonui Hills in the beautiful South Island of New Zealand, which are renowned in song and story as the home of bootleg whisky.

It is obviously misleading (as in Ager et al., 1972) to treat the Rhaetian as though it covered the same length of time as the Norian. But this is merely a convention and there is no basic reason why it should be so. As George Orwell might have said: "Some stages are more equal than others", as are some systems and any other divisions of the stratigraphical record. Should all formations be equal in thickness? On that principle, how can we justify a Silurian Period lasting only 30 million years compared with close on 90 million years for the Cambrian and the Cretaceous? What about the Palaeozoic Era lasting some 340 million years, compared with a mere 65 million for the whole of the Caenozoic? If we drop the Rhaetian, then why not drop the Quaternary (and certainly the Holocene) on the same grounds?

No, this is all nonsense. If it is useful to call a division of geological time the Rhaetian, then let us continue to do so. It is useful, so let the Rhaetian remain.

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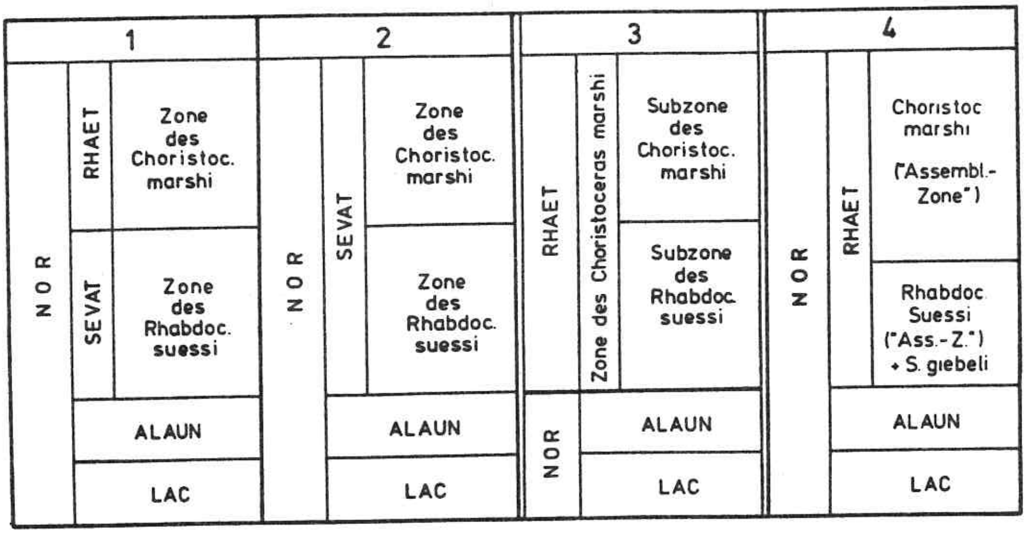
## THE RHAETIAN CONTROVERSY: 1978-1988

In 1978 the STS organized a meeting in Munich. Much attention was given to the discussion of the status of the Rhaetian in Triassic standard classification. The following four concepts were compared:




So far there is still no consensus about a definitive recommandation. Therefore, in order to renew the discussion, ALBERTIANA invites authorities other than STS members, to give their opinion on the problem.

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# THE PROBLEM OF STAGE-SUBDIVISION OF THE LOWER TRIASSIC

YURI D. ZAKHAROV

## INTRODUCTION

Many suggestions have been made regarding a stage-subdivision of the Lower Triassic (Mojsisovics, 1882; Mojsisovics et al., 1895; Lapparent, 1900; Ichikawa, 1950, 1956; Kiparisova and Popov, 1956, 1964; Arkell et al., 1957; Mutch and Waterhouse, 1965; Tozer, 1965, 1978; Vavilov and Lozovskiy, 1970; Zakharov, 1973, 1978; Kozur, 1973; Guex, 1978; Rostovcev and Dagys, 1984). Four of the suggested subdivisions have become regularly used (Table 1). In this paper these four schemes are briefly reviewed as a response to the invitation of Prof. dr. C. Virgili and Prof. dr. H. Visscher to take part in the STS-discussion on the chronostratigraphical subdivision of the Lower Triassic.

## DISCUSSION OF THE VARIANTS

Variant 1: The 1-Stage concept (Mojsisovics et al., 1895; Arkell et al., 1957)

The Lower Triassic lagoonal and marine sediments named Werfenian by Mojsisovics (1882) cannot successfully be subdivided into ammonoid zones. On the basis of new data on marine sediments in the Salt Range, Kashmir and some other territories Mojsisovics et al. (1895) established a number of Triassic Series including the Scythian. Subsequently, Arkell et al. (1957) regarded the Scythian as a stage.

The Scythian Stage is here rejected in accordance with Tozer (1978) who made clear that
(1) the type locality of this stage cannot be characterized with certainty, and
(2) the Scythian - in the concept of Mojsisovics et al. (1895) comprising the Brahmanian and Jakutian - does not correspond with the Lower Triassic as a whole but with the lower part only.

Variant 2: The 2-Stage concept (Kiparosova and Popov, 1956, 1964).

Kiparisova and Popov (1956, 1964) have proposed a subdivision of the Lower Triassic into two stages, viz. Induan and Olenekian.

The Induan Stage has been based on a section in the Salt Range, i.e. the upper part of the Upper Productus Limestone, the Lower Ceratite Limestone and the Ceratite Marl (Waagen, 1895).

The Olenekian Stage is typified by a section along the Lower Olenek river in Arctic Siberia (Mojsisovics, 1886, 1888; Kiparisova and Popov, 1964). The vulnerability of this scheme lies in the fact that the stages are typified by sections situated in different realms (Tethys and Boreal realm), thus provoking

| Stage 1 | 2 | 3 | 4 | Salt Range (Waagen, 1895; Guex, 1978 ) | Kashmir (Diener, 1895) | South Primorye (Zakharov, 1968, 1978; Zakharov et Rybalka, 1987) | Western North America (Silberling et Tozer, 1968) | Siberia (Dagys et Kazakov, 1984; Zakharov et Rybalka, 1987) | Arctic Canada (Tozer, 1967, emend.) | Most significant events |
|---|---|---|---|---|---|---|---|---|---|---|
| S C Y T H I A N | O L E N E K I A N | SPATHIAN | SPATHIAN | Tozericeras pakistanum | Prohungarites middlemissi | Subcolumbites multiformis | Subcolumbites Beds | ? ? ? | ? ? ? | |
| | | | | - - ? - - - - | - - ? - - - - | Neocolumbites insignis | Columbites Beds | - - ? - - ? - Olenekites spiniplicatus \| - ? - - ? - - Keyserlingites subrobustus; Parasibirites grambergi | - - ? - - ? - Keyserlingites subrobustus; Subolenekites pilaticus | I I I |
| | | ??? | ??? | Tirolites-Columbites | ? ? ? | Tirolites-Amphistephanites: Tirolites ussurienis Beds; Bajarunia dagysi Beds | Tirolites Beds | Dieneroceras demokidovi Beds \| ?Nordophiceras euomphalus; Bajarunia contrarium | ? ? ? | |
| | | SMITHIAN | NAMMALIAN | Anasibirites pluriformis | Anasibirites spiniger | Anasibirites nevolini | Anasibirites Beds | Wasatchites tardus | Wasatchites tardus | I I |
| | | | | Hedenstroemia himalayica | Hedenstroemia himalayica | Hedenstroemia bosphorensis | Meekoceras gracilitatis | Hedenstroemia hedenstroemi | Euflemingites romunderi | |
| | I N D U A N | DIENERIAN | | Prionolobus rotundatus | Vavilovites markhami | Gyronites subdharmus | ? ? ? | Vavilovites | Vavilovites sverdrupi | |
| | | | | Gyrorites frequens | | | Proptychites Beds | | Proptychites candidus; Pachyproptychites strigatus | |
| | | GRIESBACHIAN | GRIESBACHIAN | Ophiceras connectens | Ophiceras tibeticum | Glyptophiceras | Claraia stachei Beds | Glyptophiceras-Vishnuites domokhtovi | Ophiceras commune | I |
| | | | | ? ? ? | Ophiceras woodwardi | ussuriense - - - - ? ? ? | | Otoceras boreale | Otoceras boreale; Otoceras concavum | |

TABLE 1. Biostratigraphic units recognized in the marine Lower Triassic and some suggestions on stage division.

1 = Mojsisovics, Waagen et Diener, 1895: Arkell, Kummel et Wright, 1957

2 = Kiparisova et Popov, 1956, 1964

3 = Tozer, 1965

correlation problems.

Variant 3: The 4-Stage concept (Tozer, 1965).

In 1965 Tozer introduced four stages within the Lower Triassic, viz. Griesbachian, Dienerian, Smithian and Spathian, all stratotypes being situated in Arctic Canada.

The Smithian and Spathian of this concept seem to be unacceptable. In Siberia the *Dieneroceras demokidovi* Zone ( ?*Nordophiceras euomphalus* Beds and *Bajarunia contrarium* Beds) and in South Primorye the *Tirolites-Amphistephanites* Zone (*Bajarunia dagysi* Beds and *Tirolites ussuriensis* Beds) occur above the *Anasibirites-Wasatchites* Beds (see Table 1). Correlatives of the zones are unknown in Arctic Canada. It is not correct, therefore, to postulate the presence of approximate equivalents of the Canadian stages in the Tethys realm and some other areas (Tozer, 1978). Furthermore, there are significant difficulties with regard to the correlation of the uppermost part of the Lower Triassic in the Boreal realm and the Tethys.

Variant 4: The 3-Stage concept (Tozer, 1978; Guex, 1978)

In 1978 Tozer rejected the four-stage concept and proposed a three-stage one, in which the Lower Triassic was subdivided into (1) Griesbachian, (2) a new stage, being Dienerian + Smithian of the former concept and (3) Spathian. Guex (1978) substantiated the establishment of this new stage by naming it Nammalian, with a stratotypein the Salt Range, i.e. the Lower Ceratite Limestone, the Ceratite Marl and the Upper Ceratite Limestone. This concept is unacceptable, primarily on nomenclatural grounds. As noted by Rostovcev and Dagys (1984) the name of the middle stage in Guex's scheme is preoccupied since it was already used by Gee (1935) for the designation of some Eocene sediments in the Salt Range. Besides, all of the negative arguments given with regard to the variants 2 and 3 apply to this scheme:
- the absence of an equivalent of the *Tirolites-Amphistephanites* Zone in the middle part of the Lower Triassic of Arctic Canada and
- the location of the stage stratotypes in distant realms.

## MAJOR PHASES IN FAUNAL DEVELOPMENT

According to a number of recent publications (e.g.,Zakharov, 1968, 1971, 1974, 1978,1987; Shishkin and Ochev, 1967; Lozovskiy, 1969; Vavilov and Lozovskiy, 1970; Kozur, 1972), three major stages can be observed in the evolution of the Early Triassic fauna (see "most significant events" in Table 1). This must be taken into account when discussing a standard subdivision of the Lower Triassic.

The first phase has been extensively investigated in:
- the Himalayas (Waagen, 1895; Diener, 1897; Kummel, 1966, 1972, 1973; Kummel and Teichert, 1970; Teichert et al., 1970; Sweet, 1970a,b; Bando, 1973, 1981; Nakazawa et al., 1975; Pakistani-Japanese Research Group, 1985)
- Arctic Canada (Tozer, 1961, 1963, 1965, 1967; Silberling and

Tozer, 1968) - the Verkhoyansk region (Popov, 1958; Vavilov, 1968; Zakharov, 1971; Dagys et al., 1979).

The other two phases have been studied in:

- South Primorye (Kiparisova, 1961; Zakharov, 1968, 1978, 1987; Zakharov and Rybalka, 1987; Burij, 1979; Burij and Zharnikova, 1980; Zharnikova, 1985)
- western North America (Hyatt and Smith, 1905; Kummel and Steele, 1962; Kummel, 1969)
- Siberia (Mojsisovics, 1882; Popov, 1961; Vavilov, 1967; Arkhipov, 1974; Zakharov, 1978; Dagys et al., 1979; Dagys, 1984; Dagys and Kazakov, 1984).

The three phases are characterized as follows:

In the first stage we see, in particular, the appearance and development of the Ophiceratidae, and the appearance of the Meekoceratidae, Paranoritidae and Proptychitidae .The beginning of the stage seems to be determined by the first emergence of Otoceras.

In the second phasee we observe the appearance of, at first, Hedenstroemiidae, Ussuriidae, Prosphingitinae, Owenitidae, Dieneroceratidae, Flemingitidae, Xenoceltitidae, and then, Kashmiritidae, Sibiritidae, Palaeophyllitidae, Tirolitidae, Doricranitidae and Dinaritidae.

The third phase can be characterized by the appearance of the Megaphyllitidae, the appearance and development of the Columbitidae and Keyserlingitidae.

According to his first scheme, Tozer (1965) has accepted four phases in the evolution of Early Triassic biota, including a Griesbachian one. However, paleontologically this Griesbachian phase is not always very characteristic; in many places it is difficult to recognize.

Kiparisova and Popov (1964) and Kummel (1973) considered the Griesbachian to represent a single zone of the lowermost Triassic. The rank of the Griesbachian seems to be not higher than that of a substage.

## CONCLUDING REMARKS

Of the four concepts reviewed above only the second one, proposed by Kiparisova and Popov (1964) reflects satisfactorily the evolution of the Early Triassic biota as outlined in the foregoing. Yet the resulting scheme remains incomplete since it reflects only two stages instead of three.

Palaeogeographically, the first concept proposed by Tozer (1965) seemed the most promising one, because all stratotypes of his four stages were chosen within a single biogeographical realm. However, the middle part of the Lower Triassic in Arctic Canada, as pointed out before, does not provide a sufficiently complete palaeontological record.

With regard to the establishment of the best scheme chronostratigraphical subdivision of the Lower Triassic, in my opinion (Zakharov, 1971, 1978) and that of Rostovcev et Dagys (1984), preference should be given to stratotypes in the Tethys realm. Here one can observe a more diverse fauna as compared to the Boreal realm. Unfortunately, however, it is so far impossible to base all Lower Triassic stages on the faunal development in such Tethyan provinces as the Himalayan Salt Range, where the facies of the upper part of the Lower results in poor fauna.

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## PERMIAN/TRIASSIC NON-MARINE TRANSITION BEDS IN THE INNER ANAGARALAND (SIBERIA)

**SADOVNIKOV, G.N.**

Non-marine Permian and Triassic sediments are widely spread in Siberia. Permian/Triassic transition sequences are here much thicker than elsewhere in Europe.

The developments of the Cordaitalean flora culminates in the Cagary-ostrov assemblage (Meien, 1966):
- dominance of the so-called "sulcial" Cordaites
- presence of some species that commonly occur in the early Late Tatarian flora
- presence of Todites (with pecopteroid leaflets), Yavorskyia.

Younger volcanic beds contain quite a different flora commonly regarded as Triassic. This could be confirmed by new data (Sadovnikov, 1981). In Siberia three different eomesophytic floras can be distinguished, viz. the Korvuntchanian, the Putoranian and the Ustkelterian flora.

The Korvuntchanian megaflora contains Neokoretrophyllites, cladophleboid Todites, Acrostichides, Yavorskyia, Tatarina, Ctenopteris, Madygenia, Kirjamkenia, Sphenophyllum (rare), Arthropitys, Boweria-shaped ferns and Rhipidopsis. Cordaitales are absent.

As far as the microflora is concerned two assemblages can be observed:
- an assemblage with abundant cordaitalean pollen, associated with Palaeozoic Hymenozonotriletes, Trachytriletes, Leiotriletes, Acanthotriletes, Cordaïtina, etc..
- an assemblage with Apiculatispora, Nevesispora, Dictyophyllidites, Gnetaceapollenites, Vitreisporites, etc..

As a rule these assemblages occur separately. Sometimes, however, they occur alternately in the rock sequence (Obonitskaya, 1973).

The Putoranian flora is dominated by Mertensides and Quadrocladus. Some plants known from the Korvuntchanian flora and Boreopteris are abundant. Both mega- and microfossil remains of the Cordaitales are totally absent. The miospore assemblages are dominated by Lueckisporites.

The Ustkelterian flora consists of Tomiostrobus (close to Annalepis), Lepidopteris and especially Annalepis-like Pleuromeia. Putoranian plants are extremely rare.

Of these three the Korvuntchanian flora is undoubtedly the oldest one. In the Tunguska basin and in the Taimyr peninsula this flora is succeeded by the Putoranian flora. The relation between the Putoranian and the Ustkelterian flora is much less clear; in one sequence in the Kuznetsk basin a Tomiostrobus assemblage is found below a Putoranian flora whereas in a sequence in the Verkhoyansk range it occurs on top of a Putoranian flora. In the Middle Putoranian of the Tunguska basin a distinct Ustkelterian element, viz. Lepidopteris, occurs within a typical Putoranian flora. Since in numerous Lower Putoranian localities Ustkelterian plants are missing we can safely assume that the Lower Putoranian is older than the Ustkelterian. The latter flora had its first appearance during the Putorian.

As is shown by Novojilov (1958, 1970) and Orlova (see Sadovnikov et al., 1981), the same distribution holds for conchostraca. The Korvuntchanian fauna is dominated by Bairdestheriidae: Polygrapta, Rohdendorfium, Liograpta and Monopemphigus are abundantly present. Pseudestheria is present , too. In the upper part of the Korvuntchanian Leaiidae are rather abundant. In the Putoranian the Limnadia, mainly the Falsisca, are dominant. In the Ustkelterian we see a dominance of Cyclotunguzites, Palaeolimnadiopsis, Loxomicroglypta and Cyclestheria.

As far as ostracods are concerned Mischina (1973) observed in the Korvuntchanian a dominance of Permian Darwinula in associations with Suchonella, Tatariella and Darwinuloides. Gerdalia is rather rare. Putoranian ostracod assemblages are dominated by Gerdalia. The species of Darwinula have a Triassic appearance, except for some horizons which contain a typical Permian Darwinulida-fauna. From the Ustkelterian no ostracods have been found yet.

Siberian eomesophytic flora and accompanying non-marine faunas are considered to be more or less synchronous:
- Korvuntchanian: latest Tatarian (and may be the middle Zechstein)
- Ustkelterian : Vetlugian and Buntsandstein.

The Korvuntchanian clearly belongs to the Permian and the Ustkelterian is Triassic in age. The Putoranian is younger than Tatarian but older than Induan. Since it is more or less synchronous with the Changsingian it is here considered to be of uppermost Permian age.

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Mischina, E.M., 1973. The age of volcanic series of the Tungusskaya syncline. Soviet Geol., 8: 133-140 (in Russian).

Novojilov, N., 1958. Conchostraca du Permien et du Trias du littoral de la mer des Laptev et de la Toungouska inférieure. Ann.Serv.Inf.Geol. BRGM, 26: 15-80.

Novojilov, N., 1970. Ancient Limnadioidea, 238 pp.

Obonitskaya, E.K., 1973. The role of spore-pollen records in the subdivision of volcanogenic deposits and possible erroneous datings of the assemblages (owing to redeposition) exemplified by the Tunguska basin. Palynology of the Mesophytic. Proc. 3. Int,.Palynol.Conf., Moscow: 179-181.

Sadovnikov, G.N., 1981. Regional stratigraphic subdivisions of the Upper Permian and Lower Triassic of the Siberian Platform and adjacent regions. Soviet Geol., 6: 74-84 (in Russian).

Sadovnikov, G.N., Orlova, E.F. and Belozerov, V.P., 1981. The Permian/Triassic transition in continental sediments of Taimyr and western Verkhoyane. Proc. USSR Acad. Sci. Geol. Ser., 5: 53-64 (in Russian).

## BRITISH TRIASSIC PALAEONTOLOGY: SUPPLEMENT 11

**G. WARRINGTON**

A wide range of organisms is known from Triassic deposits in the British Isles. However, the relevant literature is widely dispersed and in some cases is obscure; recognition of these factors prompted the publication of a review paper on the subject (Warrington, G., 1976 - British Triassic palaeontology. Proc. Ussher Soc., 3(3): 341-353). Relevant publications have continued to appear since that time however, and that account has been updated with annual bibliographic supplements published in the Proceedings of the Ussher Society* from 1977 (volume 4, part 1) to 1986 (volume 6, part 3); 178 separate contributions were listed during that period.

Since the completion of the writer's previous supplement (No. 10, Proc. Ussher Soc., 6(3): 420-421; 1986) to his paper 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. and Horton, N.F., 1986. Mesozoic micropalaeontology of exploration well Elf 55/30-1 from the Fastnet Basin, offshore southwest Ireland. J. Micropalaeontol., 5(1): 19-29.

Ambrose, K., 1986. Geological notes and local details of 1 : 10.000 sheets: SP36NW (Royal Leamington Spa).British Geolological Survey, Keyworth: 1-26.

Ash, S.R., 1986. Fossil plants and the Triassic - Jurassic boundary. Pp. 21-30 in Padian, K., (q.v.).

Batten, D.J., Trewin, N.B. and Tudhope, A.W., 1986. The Triassic-Jurassic junction at Golspie, inner Moray Firth Basin. Scott. J. Geol., 22(1): 85-98.

Benton, M.J., 1986a. The late Triassic reptile Teratosaurus - a rauischian, not a dinosaur. Palaeontology, 29(2): 293-301.

Benton, M.J., 1986b. The Late Triassic tetrapod extinction events. Pp. 303-320 in Padian, K., (q.v.).

Clark, J.M. and Fastovsky, D.E., 1986. Vertebrate biostratigraphy of the Glen Canyon Group in northern Arizona. Pp. 285-301 in Padian, K., (q.v.).

Clayton, G., Sevastopulo, G. and Sleeman, A.C., 1986. Carboniferous (Dinantian and Silesian) and Permo-Triassic rocks in south County Wexford, Ireland. Geol. J., 21(4): 355-374.

Clemens, W.A., 1986. On Triassic and Jurassic mammals. Pp. 237-246, in Padian, K., (q.v.).

Crompton, A.W. and Attridge, J., 1986. Masticatory apparatus of the larger herbivores during Late Triassic and Early Jurassic times. Pp. 223-236 in Padian, K., (q.v.).

Earp, J.R. and Taylor, B.J., 1986. Geology of the country around Chester and Winsford. Mem. Br. Geol. Surv., Sheet 109 (England and Wales). HMSO, London: viii + 119.

Fraser, N.C., 1986. New Triassic sphenodontids from south-west England and a review of their classification. Palaeontology, 29(1): 165-186.

Galton, P.M., 1985. Notes on the Melanorosauridae, a family of large prosauropod dinosaurs (Saurischia: Sauropodomorpha). Geobios, 18(5): 671-676.

Galton, P.M., 1986. Herbivorous adaptions of Late Triassic and Early Jurassic dinosaurs. Pp. 203-221 in Padian, K. (q.v.).

Haubold, H., 1986. Archosaur footprints at the terrestrial Triassic-Jurassic transition. Pp. 189-201 in Padian, K., (q.v.).

Ivimey-Cook, H.C., 1985. Mesozoic and Tertiary rocks. Pp. 88-89 in Allen, P.M. and Jackson, A.A., Geology of the country around Harlech. Mem. Br. Geol. Surv., Sheet 135 with part of sheet 149 (England and Wales). HMSO, London: xii + 111.

Kjellesvig-Waering, E.N., 1986. A restudy of the Fossil Scorpionids of the World. Palaeontogr. am., 55: 1-287.

Martill, D.M. and Dawn, A., 1986. Fossil vertebrates from the exposures of the Westbury Formation (Upper Triassic) at Newark, Nottinghamshire. Mercian Geol., 10(2): 127-133.

McCune, A.R., 1986. A revision of Semionotus (Pisces: Semionotidae) from the Triassic and Jurassic of Europe. Palaeontology, 29(2): 213-233.

McCune, A.R. and Schaeffer, B., 1986. Triassic and Jurassic fishes: patterns of diversity. Pp. 171-181 in Padian, K., (q.v.).

Murry, P.A., 1986. Vertebrate paleontology of the Dockum Group, western Texas and eastern New Mexico. Pp. 109-137 in Padian, K. (q.v.).

Olsen, P.E. and Padian, K., 1986. Earliest records of *Batrachopus* from the southwestern United States, and a revision of some Early Mesozoic crocodylomorph ichnogenera. Pp. 259-273 in Padian, K., (q.v.).

Olsen, P.E. and Sues, H.-D., 1986. Correlation of continental Late Triassic and Early Jurassic sediments, and patterns of the Triassic-Jurassic tetrapod transition. Pp. 321-351 in Padian, K., (q.v.).

Padian, K. (Editor), 1986. The Beginning of the Age of Dinosaurs: Faunal change across the Triassic-Jurassic boundary. Cambridge University Press, Cambridge: xii + 378.

Parrish, J.M. and Carpenter, K., 1986. A new vertebrate fauna from the Dockum Formation (Late Triassic) of eastern New Mexico. Pp. 151-160 in Padian, K., (q.v.).

Sues, H.-D., 1986. Relationships and biostratigraphic significance of the Tritylodontidae (Synapsida) from the Kayenta Formation of northeastern Arizona. Pp. 279-284 in Padian, K., (q.v.).

Warrington, G., 1986. The Late Triassic and Early Jurassic palynomorph succession in Somerset, England. (Abstract). American Association of Stratigraphic Palynologists 19th Annual Meeting, Program and Abstracts: 38.

Warrington, G., Whittaker, A. and Scrivener, R.C., 1986. The Late Triassic succession in central and eastern Somerset. Proc. Ussher Soc., 6(3): 368-374.

Whiteside, D.T., 1986. The head skeleton of the Rhaetian sphenodontid *Diphydontosaurus avonis* gen. et sp. nov. and the modernizing of a living fossil. Phil. Trans. R. Soc., B.312 (No. 1156): 379-430.

Wright, A.D. and Benton, M.J., 1986. Trace fossils from Westbury Formation (Upper Triassic) shore-face deposits of the Needwood Basin, Staffordshire. Palaeontological Association Annual Conference (Leicester), Abstracts: 24-25.

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

*For information about the Ussher Society and its publications (Proc. Ussher Soc.) write to the Secretary of the Ussher Society, Mr. M.C. George, at the Department of Geology, University of Exeter, North Park Road, Exeter EX4 4QE (Great Britain).

## ANNOTATED TRIASSIC LITERATURE

**MIENTE BOERSMA**

Under this heading new relevant literature on the Triassic research received by the editor or the secretary general of the S.T.S. will be briefly annotated.

**Ando,H.**, 1987. Evolution and paleobiogeography of Late Triassic bivalve Monotis from Japan. In: McKenzie,K.G. (Editor, 1987), Shallow Tethys 2 - Proceedings of the international symposium on Shallow Tethys 2, Wagga Wagga, 15-17 September 1986, pp. 233-246,, 6 figs, 1 table, 40 refs. Balkema, Rotterdam.

The Late Triassic bivalve genus Monotis occurs in 22 local areas in Japan. The genus is represented by four species and a subspecies, each showing a considerably wide range of intraspecific variation.

Throughout Japan four Monotis zones can be recognized. Evolutionary lineages are emphasized.

Japanese Monotis beds are generally characterized by coarse-grained clastic sediments indicating a shallow marine environment. This habitat differs considerably from that of M.salinaria as known from the Hallstatt Limestone facies of the Tethyan province.

The japanese Monotis fauna may belong to the same faunal province as that of east Siberia. In the Sambosan Belt of the Outer Zone of southwest Japan, however, quite different Late Triassic bivalve faunas occur, including some obvious Tethyan elements.

**Baud,A.**, 1987. Stratigraphie et sėdimentologie des calcaires de Saint-Triphon (Trias, Prėalpes, Suisse et France). Mėm. Géol. Lausanne, 1987(1): 322 pp., 41 figs, 29 pls, 5 tables, 35 detailed lithological columns, 218 refs (with English abstr.). Lausanne.

In the first part the Saint-Triphon Fm, an Early Middle Triassic lithological unit, is dealt with. Emphasis is put on its mineral content. The type locality is situated in the Rhone Valley of Western Switzerland.

In the second part the palaeo-environment is described.

The third part deals with the evolution of the palaeo-environment and the benthic communities.

In the final part a general synthesis is given.

**Baudelot,S. and Taugourdeau-Lantz,J.**, 1986. Découverte d'une microflore dans les Pyrenées Catalanes attribuable au Norien-Rhétien. Rev. Paléobiol., 5(1): 5-9, 3 figs, 1 pl., 1 table, 31 refs (with English abstr.). Genève.

A rich Norian-Rhaetian palynological assemblage is described from calcareous pelites interbedded in dolomitic limestones overlying the Keuper gypsum in the Catalan Pyrenees.

**Boersma,M. and Broekmeyer,L.M.**, 1986. Index of figured plant megafossils - Triassic 1976-1980. Rev. Palaeobot. Palynol., 49: 235-344, 159 refs. Amsterdam.

The fifth volume of the reference work "Index of Figured Plant Megafossils" deals with Triassic plant megafossils figured from 1976 through 1980. The publication holds information on 290 genera and 946 species among which 47 new genera, 350 new species and 9 new taxa of infraspecific rank.

**Chaloner,W.G. and Turner,S.**, 1987. An enigmatic Triassic lycopod axis from Australia. Rev. Palaeobot. Palynol., 51: 51-58, 1 fig., 1 pl., 33 refs. Amsterdam.

Cidarophyton rewanense gen. et sp. nov. is described from the Arcadia Fm, Rewan Group in central Queensland, Australia. The specimen is interpreted as representing a lycopod cone axis comparable to that of Skilliostrobus. Other possible interpretations (e.g. that it represents an unbranched rhizophore) are considered and comparison is made with other fossil lycopods.

**Chen,Y., Duan,S. and Zhang,Y.**, 1985. A preliminary study of Late Triassic plants from Qinghe of Yanbian district, Sichuan province. Acta Bot. Sinica, 27(3): 318-325, 2 pls, 2 tables, 11 refs (in Chinese with English abstr.). Beijing.

A rich flora (46 genera, 144 species) is described from Qinghe (Yanbian district, Sichuan). Five new species are described and figured. On the basis of biostratigraphic comparison with floras in China, Vietnam, Japan and East Greenland the flora has been given a middle Keuper-Rhaetian age.

**Cheng,Z.**, 1986. Vertebrates. In: Institute of Geology, Chinese Academy of Geological Sciences; Institute of Geology, Xinjiang Bureau of Geology and Mineral Resources (Editors), Permian and Triassic strata and fossil assemblages in the Dalongkou area of Jimsar, Xinjiang. Geol. Mem., 2(3): 207-218, pls 58-63, tables 9-12. Geol. Publ. House, Beijing,

Vertebrate remains have been found in the lower part of the Triassic sequence only. One new species has been described and figured.

**Dobruskina,I.A.**, 1987. Phytogeography of Eurasia during the Early Triassic. Palaeogeogr. Palaeoclimatol. Palaeoecol., 58: 75-86, 3 figs, 2 tables, 47 refs. Amsterdam.

New data provided by Chinese and Soviet palaeontologists and stratigraphers allow correlation between the Triassic plant-bearing beds of Siberia, China and western Europe. The Early Triassic floras of these regions were much more connected than hitherto supposed.

The western European and Chinese floras with xeromorphic plants belonged to the united European-Sinian palaeofloristic area which was once part of the Laurasian kingdom. The floras of the Tunguska and Kuznetsk basins, Taimyr and Verkhoyansk belonged to the Siberian area where a more humid climate allowed luxuriant growth of ferns.Thus the ferns were different in the Siberian and European-Sinian areas, whereas the conifers and lycopods were very similar. The maritime areas were rich in lycopods; conifers and ferns were abundant in the intracontinental parts of Eurasia.

The lower part of the Triassic may be considered as a transitional period from the Palaeophytic to the Mesophytic. Its peculiarity is reflected in the composition of the fossil floras as well as in their distribution. The lower Triassic differs from the Palaeozoic (which shows a degree of isolation and differentiation of the phytochoria) as well as from the Mesozoic (characterized by the homogeneity of its floras) by the vast expansion of lycopods through all the phytochoria. Already by the Middle Triassic the general plan of the phytochoria becomes similar to the recent one.

**Duan,S.**, 1987. A comparison between the Upper Triassic floras of China and the Rhaeto-Liassic floras of Europe and East Greenland. Lethaia, 20: 177-184, 4 figs, 1 table, 21 refs. Oslo.

A survey is given of the Upper Triassic floras of China. They are compared with Rhaeto-Liassic floras in Sweden, Germany and East Greenland. It is concluded that comparable floral assemblages, e.g. the Thaumatopteris schenkii assemblage-zone, occur considerably earlier in China than in Europe and East Greenland.

**Geyer,G. and Kelber,K.-P.**, 1987. Flügelreste und Lebensspuren von Insekten aus dem Unteren Keuper Mainfrankens. Neues Jahrb. Geol. Paläontol. Abh., 174(3): 331-355, 19 figs, 46 refs (with English abstr.). Stuttgart.

Insect remains are described and figured from the Lower Keuper of Mainfranken (German Federal Republic) including 1 new genus and 2 new species. Specimens originally described and figured by SANDBERGER are here refigured and redescribed.

Apart from the descriptive part emphasis is put on insect-plant interactions.

**Gou,Y., Hou,Y. and Wen,S.**, 1987. Mesozoic Tethys in China. In: McKenzie,K.G. (Editor, 1987), Shallow Tethys 2 - Proceedings of the international symposium on Shallow Tethys 2, Wagga Wagga, 15-17 September 1986, pp. 187-197, 1 fig., 1 table, 59 refs. Balkema, Rotterdam.

In the last few decades large-scale scientific investigations and regional geological surveys have been carried out in China, especially on the Qinghai-Xizang Plateau. The results of these investigations show that in the Mesozoic the Eastern Tethys controlled the variability of marine lithofacies and biofacies on the present Chinese territory. Two marine mesozoic biotic types are proposed. The consequences of the regression of the Eastern Tethys are discussed.

**Gupta,V.J. and Brookfield,M.E.**, 1986. Preliminary observations on a possibly complete Permian-Triassic boundary section at Pahlgam, Kashmir, India. Newsl. Stratigr., 17(1): 29-35, 2 figs, 6 refs. Berlin.

New sections described from Pahlgam, Kashmir, possibly represent the thickest and most complete Permian-Triassic sequence from Kashmir. The Pahlgam sections do not show signs of sedimentary breaks and appear to have been deposited in a rapidly subsiding deltaic environment, possibly within a Late Permian graben.

Faunas are relatively abundant. Preliminary evaluations suggest that much of the Late Permian is present.

The paper deals with lithostratigraphical description of the sections and their faunal content.

**Hirsch,F.**, 1987. The Gondwanian Triassic and Jurassic Tethys shelf: Sephardic and Ethiopian faunal realms. In: McKenzie,K.G. (Editor, 1987), Shallow Tethys 2 -Proceedings of the international symposium on Shallow Tethys 2, Wagga Wagga, 15-17 September 1986, pp. 215-232, 5 figs, 3 tables, 32 refs on Triassic. Balkema, Rotterdam.

The faunal differentiation of neritic and nektonic taxa between Eurasia and Gondwana increases as the Tethys-rifting progrades through the Triassic and Jurassic. The zoogeographic distribution of taxa supports the relative unity of the African-Arabian and Apulian terrains. In the late Early Triassic the shallow Paleozoic Tethys was replaced by the Mesozoic Tethyan Seaway.

With regard to facies the "Southern" and "Northern" shelf regions are often similar. They differ, however, regarding their faunal assemblages, the Middle Triassic "Sephardic" vs. "Germanotype" provinces.

The ("Sephardic") Iberian Platform became connected with Eurasia during Jurassic times.

**Institute of Geology, Chinese Academy of Geological Sciences and Institute of Geology, Xinjiang Bureau of Geology and Mineral Resources** (Editors, 1986). Permian and Triassic strata and fossil assemblages in the Dalongkou area of Jimsar, Xinjiang. Geol. Mem.,2(3): 262 pp., 15 figs, 64 pls, 12 tables (in Chinese with English abstr.). Geol. Publ. House, Beijing.

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|---|---|
| See: Li,P., Zhang,Z. and Wu,S. | Stratigraphy |
| Zhou,T. and Zhou,H. | Fossil plants |
| Qu,L. and Wang,Z. | Triassic sporo-pollen assemblage |
| Yang,J. and Sun,S. | Megaspores |
| Li,Y. | Ostracods |
| Cheng,Z. | Vertebrates |

**Kimura,T.**, 1985. Notes on the present status of the Late Triassic floras in East and Southeast Asia. Memoria 3. Congr. latinoam. Paleontol.: 5-9, 1 fig., 65 refs. Mexico City.

Short note on the present knowledge on Late Triassic floras in East and Southeast Asia. In fig.1 the fossil plant bearing localities are indicated in a phytogeographical context.

**Kimura,.T. and Kim,B.K.**, 1985. Outline of the Late Triassic Daedong flora in the Korean Peninsula. Memoria 3. Congr. latinoam. Paleontol.: 1-4, 1 fig., 1 table, 12 refs. Mexico City.

Short note on the rich Late Triassic Daedong flora. See also Albertiana 4: 32. In the table (pp.2-3) a list is given of the fossil plant remains and their occurrence in the Daedong Supergroup.

**Kristan-Tollmann,E.**, 1987. Triassic of the Tethys and its relations with the Triassic of the Pacific Realm. In: McKenzie,K.G. (Editor, 1987), Shallow Tethys 2 - Proceedings of the international symposium on Shallow Tethys 2, Wagga Wagga, 15-17 September 1986, pp. 169-186, 2 figs, 7 pls, 1 table, 103 refs. Balkema, Rotterdam.

A general introduction is given on the Triassic Tethys. The sequence of formations and facies types as occurring in the Northern Calcareous Alps are taken as a typical example of a carbonate reef complex of the shallow Tethys.

Many formations of this classical area are found in several sections throughout the Tethys. Whole sequences, even, may regularly be found in far away parts of the Tethys.

The results are summarized as follows: - a great similarity can be observed throughout the Tethys realm with regard to the fauna; this holds for several groups of megafossils - the Tethyan faunal assemblages are closely related to those of the Pacific realm. Examples are given from both western and eastern parts of the Pacific area. - the mechanism of the faunal distribution, larval stages included, by westward oriented sea currents is discussed.

**Li,P., Zhang,Z. and Wu,S.**, 1986. Stratigraphy. In: Institute of Geology, Chinese Academy of Geological Sciences; Institute of Geology, Xinjiang Bureau of Geology and Mineral Resources (Editors, 1986), Permian and Triassic strata and fossil assemblages in the Dalongkou area of Jimsar, Xinjiang. Geol. Mem., 2(3): 2-38, figs 1-9, tables 1-4. Geol. Publ. House, Beijing.

The following lithstratigraphical units are used:

| | | | |
|---|---|---|---|
| Upper Triassic (T3) | Xiaoquangou Group | Haojiagou Fm | (T3hj) |
| | | Huangshanji | (T3hs) |
| Middle-Upper Triassic (T2-3) | | Karamay Fm | (T2-3k) |
| Lower Triassic (T1) | Cangfanggou Group | Shaofanggou Fm | (T1sh) |
| | | Jiucaiyuan Fm | (T1j) |
| Upper Permian (P2) | | Guodikeng Fm | (P2g) |
| | | Wutonggou Fm | (P2w) |
| | | Quanzijie Fm | (P2q) |

**Li,Y.**, 1986. Ostracods. In: Institute of Geology, Chinese Academy of Geological Sciences; Institute of Geology, Xinjiang Bureau of Geology and Mineral Resources (Editors), Permian and Triassic strata and fossil assemblages in the Dalongkou area of Jimsar, Xinjiang. Geol. Mem., 2(3): 200-206, pls 55-56. Geol. Publ. House, Beijing.

Ostracods have been found in the Jiucaiyuan Fm. The presence of monotonous and small-bodied *Darwinula*, including *D.triassina* and *D.rotundata*, is characteristic of the ostracod assemblage. Ten new species have been described and figured.

**McKenzie,K.G.** (Editor, 1987). Shallow Tethys 2 - Proceedings of the international symposium on Shallow Tethys 2, Wagga Wagga, 15-17 September 1986, 562 pp., numerous figs, pls, tables and refs. Balkema, Rotterdam.

A fine book on a highly interesting topic. The plates are of high quality. Since the Tethys not only existed in Triassic times I will refrain from reviewing all the papers. The relevant ones will be treated separately.

See: Ando,H.
Gou, Y. et al.
Hirsch,F.
Kristan-Tollmann,E.
Yeates,A.N. et al.

Copies can be ordered from:

A.A.Balkema Publishers
P.O.Box 1675
3000 BR Rotterdam, The Netherlands.
Price Hfl. 121,90 /$ 58.50 /ú 37

**Mader,D.**, 1985. Entstehung des germanischen Buntsandsteins. Carolinea, 43: 5-60, 64 figs, 4 tables, 53 refs (with English abstr.). Karlsruhe.

In this richly and beautifully illustrated paper an overview is given of the author's opinion concerning the genesis of the german Buntsandstein including an extensive bibliography of his works.

**Martin,J.M. and Braga,J.C.**, 1987. Alpujarride carbonate deposits (southern Spain) - marine sedimentation in a Triassic Atlantic. Palaeogeogr. Palaeoclimatol. Palaeoecol., 59(4): 243-260, 13 figs, 66 refs. Amsterdam.

In the Betic Cordillera, the westernmost of the Alpine Chains, the Alpujarride Complex is the only one in which the Middle-Upper Triassic is represented predominantly by carbonate marine facies. The correlation of various stratigraphic columns, together with the position of the facies belts at different levels, reveal that these carbonate deposits could only have originated in a basin which opened westwards to the sea. In contrast to previous hypotheses, the Triassic Alpujarride basin is thought to have opened towards an Atlantic in the west and not towards the Tethys in the east.

Although some connection clearly existed between the Alpujarride and Tethys basins during the Middle Triassic, when the extension of the Alpujarride carbonate deposits was at its greatest, the Upper Triassic saw a separation of the Alpujarride basin from the Tethys, which is reflected in the very specific peculiarities in the endemic flora and differences in the types of bioconstructions which evolved in this and in coetaneous basins.

Thus the Alpujarride carbonate deposits originated in an early Atlantic and were tectonically emplaced in the western Mediterranean by transform movements and later by overthrust.

**Mogucheva,N.K. and Dobruskina,I.A.**, 1986. Male conifer cones from the Korvunchanskian flora. In: Yanshin,A.L. and Dagis,A.S.

(Editors), Biostratigraphy of the Mesozoic of Siberia and the Far East, pp.72-77, 2 pls, 11 refs (in Russian). "Nauka", Novosibirsk.

From the Lower Triassic Korvunchanskian flora of the Tungusk Basin two new male conifer cones are described and figured, viz. Willsiostrobus cylindricus Mogucheva and Darneya inopinata Mogucheva.

**Oostendorp,C.**, 1987. The bryophytes of the Palaeozoic and the Mesozoic. Bryophytorum Bibliotheca, 34: 5-112, 49 pls, 7 tables, 148 refs. Berlin/Stuttgart.

An overview is given of the knowledge on fossil bryophytes up to 1980. Genera and species are described and figured in alphabetical order. 16 Mosses and moss-like remains have been recorded from the Triassic. On 49 plates photocopies are given of illustrations in literature.

**Qu,L. and Wang,Z.**, 1986. Triassic sporo-pollen assemblages. In: Institute of Geology, Chinese Academy of Geological Sciences; Institute of Geology, Xinjiang Bureau of Geology and Mineral Resources (Editors), Permian and Triassic strata and fossil assemblages in the Dalongkou area of Jimsar, Xinjiang. Geol. Mem., 2(3): 111-173, fig. 13, pls 31-40, table 7. Geol. Publ. House, Beijing.

Sporo-pollen assemblages have been found in all the Triassic Formations. 22 New species have been described and figured; four new combinations have been made.

**Sadovnikov,G.N.**, 1985. Cordaites-like leaves from Norian-Rhaetian sediments of the Elburz. Paleontol. Zh., 1985(4): 125-127, 1 fig., 9 refs (in Russian). Moscow.

A new Cordaites-like leaf - Desmiophyllum barnardii - is described and figured from Norian-Rhaetian sediments of the Elburz Mountains (Iran).

**Sadovnikov,G.N.**, 1986. Microstructures of some Late Triassic Arthrophytes from Iran. Paleontol. Zh., 1986(3): 94-102, 4 figs, pl.9, 8 refs (in Russian). Moscow.

A new diagnosis is given of the genus Neocalamites. Three new species of Radicites are described and figured. A new organ genus, Calamoderma is introduced, comprising two new species.

**Salaj,J., Borza,K. and Samuel,O.**, 1983. Triassic foraminifers of the West Carpathians, 213 pp., 23 figs, 157 pls, 306(!) refs (with Czech summary - pp. 177-200 -). Geol. Ustav Dionyza Stura, Bratislava.

This book has been published on the occasion of the 18th European Colloquium on Micropaleontology in Bratislava, September 1983.

It holds chapters on
- tectonics, lithostratigraphy and microbiostratigraphy of the West Carpathians
- the classification of Triassic foraminifers and
- the systematic description of Triassic foraminifers in the West Carpathians.

About 300 species belonging to 100 genera (30 new taxa) have been described and figured. A list of the fossils dealt with (pp. 201-213) facilitates quick consultation.

**Siblik,M.**, 1986. Carnian rhynchonellid brachiopods from the Slovak Karst area. Zapadne Karpaty, ser. Paleontol., 11: 7-34, 19 figs, 4 pls, 27 refs (with Czech summary). Bratislava.

The paper is the second part of a study on the Carnian rhynchonellids from the Slovak Karst. Two new genera, five new species and four new taxa of infraspecific rank have been described and figured.

**Smoot,E.L., Taylor,T.N. and Delevoryas,T.**, 1985. Structurally preserved plants from Antarctica. 1. Antarcticycas, gen. nov., a Triassic cycad stem from the Beardmore Glacier area. Am. J. Bot., 72(9): 1410-1423, 20 figs, 53 refs. Columbus, Ohio.

Silicified stems with typical cycadalean anatomy are described from the Fremouw Fm (Triassic) in the Transantarctic Mountains of Antarctica. They are attributed to the new genus and species Antarcticycas schopfii. The anatomy is compared with that of other fossil and extant cycadalean stems.

**Sopeña,A., Virgili,C., Arche,A., Ramos,A. and Hernando,S.**, 1986?. El Triasico. In: Libro Jubilar J.M.Rios - Geologia de España. II: 47-62, 8 figs, 56 refs. Madrid.

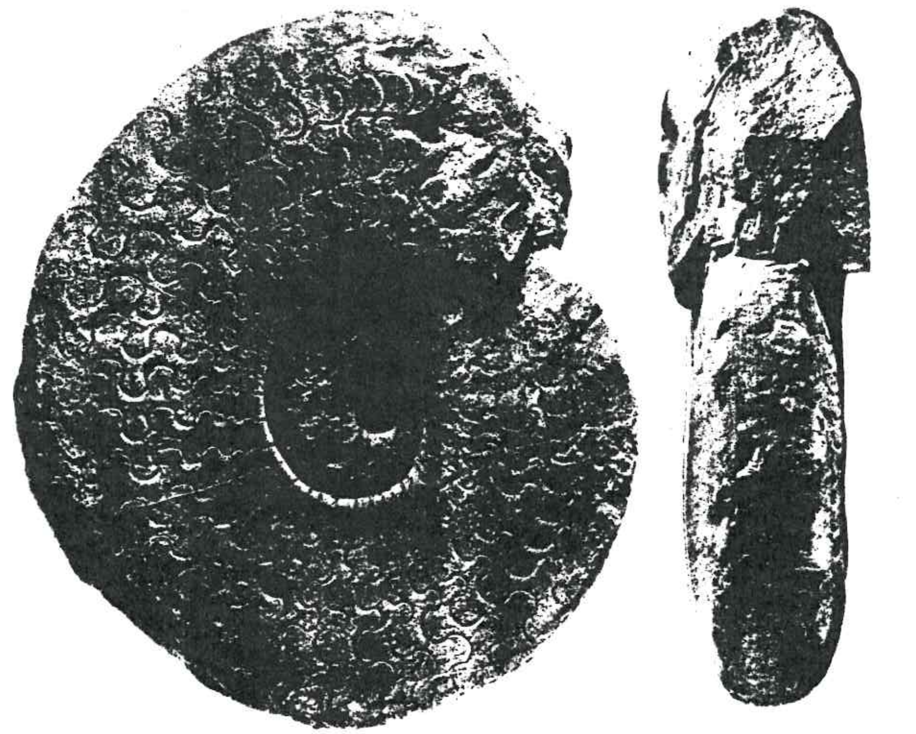
An overview is given of the Triassic sediments of Spain. The following regions are dealt with:
- Los Catalanides
- Cordillera Ibérica
- Zona Cantabrica
- Interior y bordes del Macizo Ibérico.

The lithostratigraphical units recognized in the regions are correlated. See fig.III.3.12.

**Urlichs,M. and Mundlos,R.**, 1987. Revision der Gattung Ceratites De Haan 1825 (Ammonoidea, Mitteltrias).I. Stuttgarter Beitr.

Naturkd., B, 128: 1-36, 16 figs, 70 refs (with English abstr.). Stuttgart.

Ceratites De Haan 1825 and its subgenera have been redefined. Beautiful pictures are given of still available type specimens. A lectotype of Ceratites (Ceratites) nodosus (Schlotheim) is proposed. The latter species and its close allies have been revised. A new name - Ceratites (Discoceratites) weyeri -is proposed for Ceratites (Discoceratites) intermedius, the type species of Ceratites (Discoceratites).



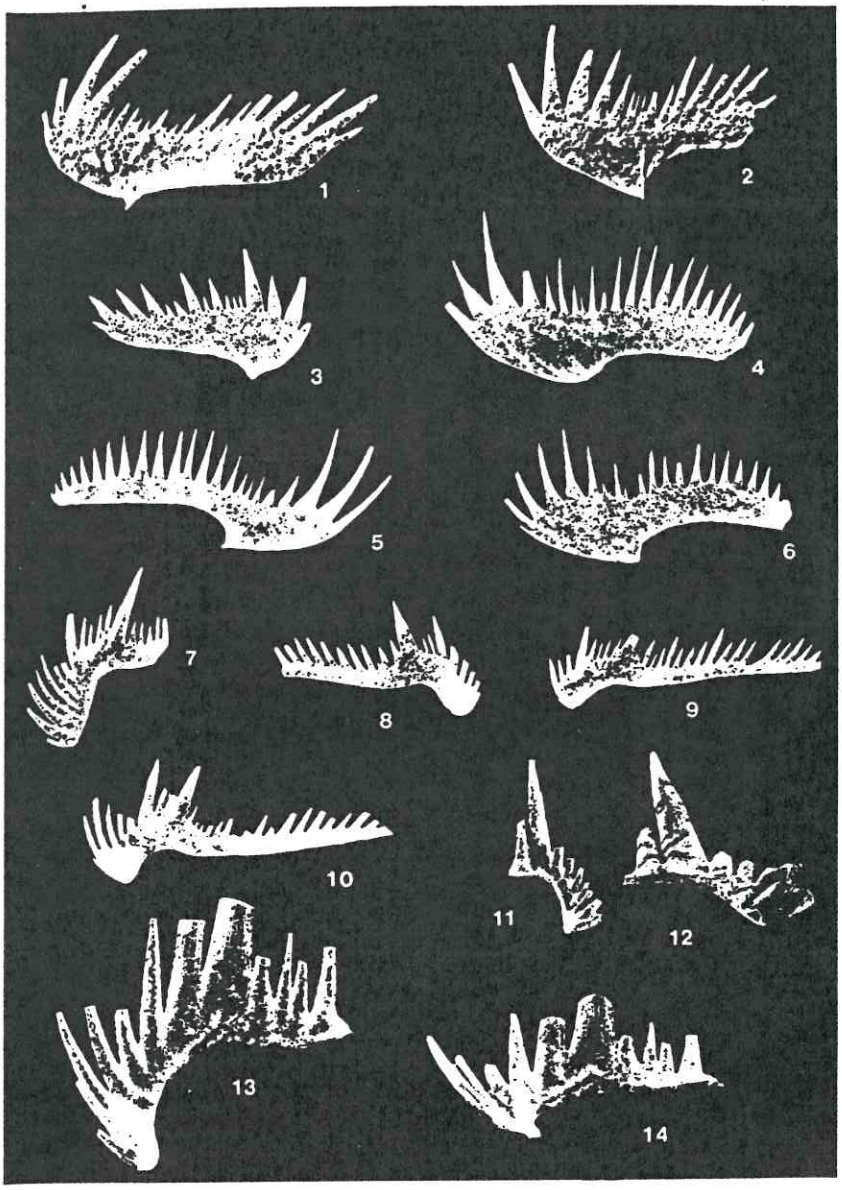
*Ceratites (Gymnoceratites) enodis* (QUENSTEDT), Holotypus. Original zu QUENSTEDT (1845: Taf. 3, Fig. 15). Oberer Muschelkalk, *enodis/laevigatus*-Zone (Unterladin); Neinstedt am Harz. IGPT: ohne Nummer. a: Lateralansicht, b: Frontalansicht. — x 1.

**Vrielynck,B.**, 1987. Conodontes du Trias périméditerranéen - Systématique, stratigraphie. Doc. Lab. Géol. Lyon, 97: 301 pp., 57 figs, 15 pls, 426 (!) refs (with English abstr.). Villeurbanne.

The material for this publication has been obtained from 12 localities in Greece and Italy. The outcrops were directly or indirectly stratigraphically controlled by ammonoids and/or bivalves. The study includes a new conception for the classification of conodont-elements . 18 Genera and 57 species could be recognized. The stratigraphic range of some of the species has been changed.

Docum. Lab. Géol. Lyon N° 97

Pl. 13 B. Vrielynck




**Yang,J. and Sun,S.**, 1986. Megaspores. In: Institute of Geology, Chinese Academy of Geological Sciences; Institute of Geology, Xinjiang Bureau of Geology and Mineral Resources (Editors), Permian and Triassic strata and fossil assemblages in the Dalongkou area of Jimsar, Xinjiang. Geol. Mem., 2(3): 174-196, fig. 14, pls 41-54, table 8. Geol. Publ. House, Beijing.

Megaspores have been found in all the investigated Triassic Formations, except for the Huangshanjie Fm. Five new species have been described and figured from the Triassic.

**Yang,Z., Yin,H., Wu,S., Yang,F., Ding,M., Xu,G. et al.**, 1987. Permian-Triassic boundary stratigraphy and fauna of South China. Geol. Mem., 2(6): 379 pp., 76 figs., 37 pls., 60 tables, 289 refs. (in Chinese with English abstr. - pp. 295-347 -). Geol. Publ. House, Beijing.

The book is composed of the following chapters:
- Permian-Triassic boundary stratotype and reference sections
- Subdivision and correlation of the Permian-Triassic strata and correlation of the Permian-Triassic boundary in South China
- Late Permian (Changxingian)- Early Triassic (Dayean) litho-paleogeographic features of South China and the Permian-Triassic contact relationships
- Alteration of marine biotas at the turn of Paleozoic and Mesozoic.

Furthermore, there are, apart from a postscript, appendices on (a) 24 Permian-Triassic sections from South China and (b) systematic descriptions of non-fusulinid foraminifers, fusulinids, brachiopods, bivalvia, ammonoids and conodonts. Eight new genera and 51 new species have been described and figured.

Finally, seven stratigraphical columns/range charts have been added under separate cover.

Useful for non-chinese readers are
- the latin-chinese index of genera and species
- the extensive English summary including description of new taxa, and
- the translation in English of the captions of figures and tables.

**Table 3—4 Formation names of Lower Triassic in South China**

| | | | | | | |
|---|---|---|---|---|---|---|
| E. yunnan | Guanling | Yongningzhen 4 \| 3 \| 2 | 1 | Fexianguan 4 \| 3 \| 2 | 1 | U. Xuanwei |
| Sichuan & Guizhou | Leikoupo | Jialingjian 4 \| 3 \| 2 | 1 | Yelang 4 \| 3 \| 2 | 1 | Dalong / Changxing |
| W. Hubei | Badong | Jialingjiang | | Daye | | Changxing |
| Guangxi | Pingerguan | U. Loulou | | L. Loulou | | Changxing |
| Anhui | L. Huangmaqing | Biandanshan | Helongshan | Yinkeng | | Chaoxiaon |
| Jiangsu | L. Huangmaqing | U. Qinglong | | L. Qinglong | | Chaoxian |
| Fujian | | Xiwei | | Xikou | | Yanshi |
| Stage | Anisian | Spathian | Smithian | Dienerian | Griesbachian | Changxingian |
| Epoch | M. Triassic | Lower Triassic | | | | Upper Permian |

**Ye,M., Liu,X., Huang,G., Chen,L., Peng,S., Xu,A. and Zhang,B.,** 1986. Late Triassic and Early-Middle Jurassic fossil plants from northeastern Sichuan, 141 pp., 2 figs, 56 pls, 6 tables, 40 refs (in Chinese with English abstr. - pp. 127-132 -). Anhui Sci. Technol. Publ. House, Nanjing.

171 Species belonging to 78 genera are described and figured, including 8 new species. The major part of the plant material comes from the Hsuchiaho and Zhenzhuchong Formations.

The Zhenzhuchong flora is very similar to Early Jurassic floras of South China. Moreover, many forms are identical or closely comparable with those from the Thaumatopteris zone of Sweden.

The Hsuchiaho (= Xujiahe) Formation is subdivided in 7 Members. The seventh (uppermost) Member has tentatively been given a Norian-Rhaetian age; the underlying Members are regarded as having a Norian age.

**Yeates, A.N., Bradshaw, M.T., Dickins, J.M.,Brakel,A.T.,Exon,N.F., Langford, R.P., Mulholland, S.M., Totterdell, J.M. and Yeung,M.,** 1987. The Westralian Superbasin: an australian link with Tethys. In: McKenzie,K.G. (Editor, 1987), Shallow Tethys 2 - Proceedings of the international symposium on Shallow Tethys 2, Wagga Wagga, 15-17 September 1986, pp. 199-213, 12 figs, 73 refs. Balkema, Rotterdam.

A comparison of onshore regional geological syntheses in Western Australia with results of offshore petroleum exploration activities substantiates Teichert's concept of one gigantic submerged basin of coherent geological character extending along the west coast of Australia. It is suggested that its Permian to Cretaceous fill be formalized as the Westralian Superbasin.

The geographical extension of the superbasin is described.

Sedimentological differences are observed between the superbasin and adjoining, largely onshore basins. Northeasterly trends and thick Mesozoic sediments are characteristic of the Westralian Superbasin.

The superbasin's ca. 10 km-thick Permian to Cretaceous sequence is distributed amongst numerous depocentres, grabens and structural highs. A hierarchy of these structural elements is proposed and discussed.

Relics of continental basement along parts of its western edge, and an absence of widespread deepwater facies suggest that the Westralian Superbasin was epicontinental until late Mesozoic times, straddling Australia and formerly adjacent parts of Gondwanaland. Facies relations and faunal elements suggest that its shallow seas were periodically linked to Tethys.

The superbasin sequence begins with poorly known extensive Permian sedimentary rocks. The better known Mesozoic sediments comprise several cycles of shallow marine and non-marine deposition, with subsidence in many places being controlled by growth faulting, until development of the modern continental margin. There is an overall progressive change from fluvio-deltaic sedimentation to limited marine transgression until the earliest Jurassic.

**Zhou,T. and Zhou,H.**, 1986. Fossil plants. In: Institute of Geology, Chinese Academy of Geological Sciences; Institute of Geology, Xinjiang Bureau of Geology and Mineral Resources (Editors), Permian and Triassic strata and fossil assemblages in the Dalongkou area of Jimsar, Xinjiang. Geol. Mem., 2(3): 39-69, fig. 10, pls. 5-20, tables 5-6. Geol. Publ. House, Beijing.

Plant megafossils have been found in all the investigated Triassic Formations, except for the Shaofanggou Fm.

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Contributions for the next issue of ALBERTIANA should reach the Editor or the Secretary General before December 1st., 1988.

The lay-out of contributions should be preferably comparable to that of the contributions in the present issue of ALBERTIANA.

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The production and distribution of ALBERTIANA is sponsored by the "Special Services" of the Laboratory of Palaeobotany and Palynology of the State University of Utrecht.

In the light of the Laboratory's role as one of the few training centres for stratigraphical palynology in Europe, and as a result of the expanding need for accurate palynostratigraphical data, the Laboratory of Palaeobotany and Palynology has become engaged in a wide range of services which assist universities, government agencies and companies in their geological research.

It is not the objective of the programme of Special Services to supplant the work of professional consultants. However, palynological information is frequently required from stratigraphical intervals and/or geographical areas where palynological consultants are not yet operating on a routine basis. Material from such areas may be accepted for detailed analysis by the Laboratory of Palaeobotany and Palynology. The funds raised from the special services will be exclusively used to support the various educational activities of the Laboratory."

The assistance by members of the scientific, technical and administrative staff of the Laboratory, and by research-students is gratefully acknowledged.

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## SUBCOMMISSION ON TRIASSIC STRATIGRAPHY

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