INTERNATIONAL SUBCOMMISSION ON JURASSIC STRATIGRAPHY

Newsletter N° 21

Lyon, June 1993

A SUBCOMMISSION OF THE INTERNATIONAL
UNION OF GEOLOGICAL SCIENCES (I.U.G.S.)

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Chairman : **Raymond Enay**
Secretary : **Charles Mangold**

A SUBCOMMISSION OF THE INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (I.U.G.S.)

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SOMMAIRE

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1. INFORMATIONS

The chairman and the Secretary of the ISJS have to apologize for being late to perform and deliver the Newsletter n° 21. Normally it would have to be ready one year ago ! It is not only by negligence but also by lack of time and means. So you will find the reports on the 3rd International Symposium on Jurassic Stratigraphy in Poitiers and those on Subcommission and Working Groups activities.

Since the Poitiers Symposium, activities of Jurassic workers, at least within the scope of the Subcommission, seem to be few, except the Joint-Meeting of the Oxfordian and Kimmeridgian Working Groups in Warszawa, September 7-12, 1992 of which the report is given.

Other informations are given on ICS subcommissions whose activities concern ISJS Subcommission, e. g. Subcommission on Geochronology and Subcommission on Stratigraphic Classification. The latter finished to revise the International Stratigraphic Guide, and the new chairman proposed to rewrite the ICS Guidelines for the establishment of GSSP (Global Stratotype Section and Points).

And so we come again to the activity of the "Stage Boundary Working Groups". We insist again on the necessity to progress towards proposals by our subcommission. That is the main purpose – if not the only one – of the ICS as it was call to mind again during the Commission plenary session at the International Geological Congress in Kyoto. There, it has been requested that " ICS should accelerate boundary definitions (D. KALJO) or even have all stage boundaries defined until year 2000 (G. JENKINS)".

Concerning Jurassic we made progresses (cf. reports by the working groups convenors) but they are quite different for individual stage and, for a few one, almost nothing. We hope the new convenors will be more successfull. Surely, it is not possible – nor desirable – that all the stages would be ready at the same time, but it is important :

1) that the ISJS would be able to present formalized proposals before long ;
2) that all the WG get involve really on the way leading to proposal.

Activity of each WG is on the one convernors guidance. But they are requested to not overlook the Guidelines for the establishment of GSSP, first reminded by the past Chairman A. ZEISS and recently in Newsletter n° 20. We do not want call them again. We prefer to enclose, for your information, copy of a proposal for the global stratotype section and Point (GSSP) for the Frasnian-Famennian boundary «from the Subcommission on Devonian Stratigraphy.

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2. 3rd INTERNATIONAL SYMPOSIUM ON JURASSIC STRATIGRAPHY
Poitiers, Sept. 1991

2.1. REPORT ON THE MEETING

Elie Cariou & Pierre Hantzpergue

The 3rd International Symposium on Jurassic Stratigraphy took place at Poitiers in September 1991, held under the aegis on the International Subcommission on Jurassic Stratigraphy (of IUGS), whose chairman is currently Professor Raymond Enay of the University Claude-Bernard Lyon I. It followed those held previously at Erlangen (Germany 1984) and Lisbon (Portugal 1987), and precedes the next one scheduled to take place at La Plata (Argentina 1994). These international gatherings, held periodically at now well-established intervals, are always important events. They bring together specialists from all branches of Jurassic stratigraphy and provide them with an opportunity to bring themselves up to date with the results obtained by the various techniques available, palaeontological, physico-chemical or multidisciplinary.

As organizers of the Poitiers Symposium, we should like very much to thank those bodies who provided financial support, particularly the Centre National de la Recherche Scientifique, the University of Poitiers, the authorities of the Région Poitou-Charente, the Conseil Général du Département de la Vienne, the town of Poitiers, and the oil company Total.

During three days of sessions, some 170 research-workers, academic and from industry, coming from 27 countries, presented their work and took part in discussions. This not inconsiderable number of participants reflects the interest and vitality of work being done in Jurassic stratigraphy today. It was a matter of general regret that, because of economic difficulties, the countries of eastern Europe (the members of the former Soviet Union and of the Balkans) could be only thinly represented. Nevertheless, the range and volume of the results presented and obtained by diverse methods were impressive. Presentations took the form of some 100 oral reports, 25 posters of notable quality, and the 70 publications that appear in the abstracts. These publications are grouped into four Sections according to their subject matter :

- stratigraphy based on palaeontological methods ;
- stratigraphy involving physico-chemical techniques ;
- integrated stratigraphy ;
- palaeogeography and palaeoenvironments.

Each theme is introduced by one or more general reviews. These discuss such matters as limits of applicability of a technique and of progress achieved ; or compare conceptual differences in definitions of biochronostratigraphical units ; or reflect in a little greater depth on our perceptions of geological time ; or themselves present some important new results.

The largest number of publications deals with studies involving palaeontological methods, while those based on physical and chemical techniques are in a minority. A significant number involve a multidisciplinary approach to stratigraphy, in particular that based on the highly fruitful methods of sequence stratigraphy, which is leading to a much broader interpretation and understanding of what is seen in the rocks. This already substantial contribution from a relatively new discipline does much to fulfil one of the original hopes of the organizers. Besides the works on integrated stratigraphy, there are also notable contributions under the headings of :

- new biostratigraphical zonations taking account of faunal provincialism (in ammonites, bivalves, brachiopods, etc.), or based on groups such as the gastropoda whose stratigraphical value had previously been underestimated ;
- further refinements of previous ammonite zonations ;
- interprovincial biostratigraphic correlations, which are making particularly good progress ;
- the Triassic/Jurassic and Jurassic/Cretaceous boundaries ;
- discontinuities in faunal ranges, particularly at Stage boundaries ;
- palaeobiogeography ;
- palaeoenvironments in the western and central Tethys.

The fourth day was, as has become the custom, devoted to the proceedings of the "Stage Boundary Working-Groups", reports of which are also recorded in the present volume. The coordinators of the Working-Groups give accounts of the progress made so far in the selection of reference sections for the definition of Stages by their bases, in accordance with the recommendations of the International Commission on Stratigraphy.

2.2. REPORTS BY THE WORKING GROUP CONVENORS

TRIAS/JURASSIC BOUNDARY W.G.

R. MOUTERDE

The first step concerning the Trias/Jurassic working group activities was the seminar held in Lyon, November 1988, on the initiative of the Secretary Jean GUEX.

The book containing the reports presented during this seminar has been published in 1990 and can be purchased from the Université Catholique de Lyon, 25, rue du Plat (*Cahier Univ. Cath. Lyon*, Sér. Sci. n° 3), analysis in *Géochronique*, n° 39, p. 35.

G. WARRINGTON of the British Geological Survey replaces Jean GUEX as Secretary and will give a new impulse. The Poitiers meeting allowed us to specify the list of the best sections suitable for a boundary stratotype.

• British exposures along the Bristol Channel : refined studies has been achieved concerning microfauna and so are able to be used as reference sections. Nevertheless owing to the transgressive character of the series and the lack of Triassic ammonites, difficulties for correlation are appearing.

• In the USA, the New-York Canyon section shows a succession with Triassic and Liassic ammonites of great interest. Only a preliminary study is now available but the announce of a detailed publication was done by J. GUEX. It seems that fauna includes only ammonites and no other fossil groups.

• Beautiful section outcrops also in Peru (VON HILLEBRANDT) where both *Choristoceras* and *Psiloceras* are present. Studies on other fossil groups should be undertaken. Any problems of access are possible but it is very important to obtain a maximum of informations on every kind of fossils.

• Austrian Alps possess also well exposed sections including fossiliferous ammonites beds in the T/J transition (e.g. Kendelbachgraben). It could be important to obtain the greatest informations on the whole fauna and microfauna. Then a field meeting will be organized for the W.G. members.

• The Queen Charlotte Island (see paper presented in Poitiers) brings also new important data but access is not easy and so it may be better used for comparison.

On the whole, we ask for all the available sections to gather greatest informations allowing the W.G. to achieve a well objective decision.

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TOARCIAN/AALENIAN BOUNDARY W.G.

W. OHMERT

The chairman, R. MOUTERDE opened the session because the convenor of the Toarcian/ Aalenian Working Group, A. GOY, had to depart earlier. A revised zonal/subzonal scheme elaborated by french stratigraphers for the Aalenian stage was shown by MOUTERDE.

OHMERT was charged by GOY to summarize the activities of the Working Group : the last meeting of the W.G. was in Portree (Isle of Skye, Scotland) from 13th-20th April 1991, together with the Bajocian W.G., organized by N. MORTON. Two possibilities for a GSSP there were presented : the one of them at Fuentelsaz (Spain, Iberian Range, by GOY & URETA), the other one at Wittnau (SW Germany, Oberrhein area, by OHMERT, PRAUSS & WEISS). Both are documented in the "Proceedings of Conference on Aalenian and Bajocian stratigraphy, Isle of Skye April 1991, N. Morton (ed.), Birkbeck College, University of London" (September 1991). It is obtainable from N. MORTON (£ 5).

Both sections have several advantages and disadvantages. We agreed that no formal proposition should be made until current studies will have been accomplished (for instance the foraminifera of Fuentelsaz and the radiolaria from Wittnau are still under study). The W.G. also wants to remain open for every other proposal. Anyone intending to contribute, please write to Prof. A. GOY to be invited for the next meeting, which will be organized by D. SADKI in Morocco at the end of April 1994.

Other possibilities for usable boundary sections appear to exist in Portugal (ELMI, MOUTERDE, ROCHA & ALMÉRAS) and in southern Spain (GARCIA-GOMEZ, JIMENEZ, LINARES, RIVAS & SANDOVAL) according to lectures held at the Poitiers Symposium.

Also the stratotype sections of the Toarcian near Thouars reaching up into the basal Aalenian would be helpful if the detailed multidisciplinary investigations (see lecture of GALBRUN *et al.* at Poitiers) could be enlarged up into the Aalenian.

Another valuable boundary section may exist in Iran, where exceptionally well preserved Grammoceratinae were figured by SEYED EMAMI & NABAVI (1985). But the following *Bredyia*-faunas is not yet figured. Correlation with terrestrial sequences there may be also possible by means of widespread plant fossils and related sporomorpha (SCHWEITZER *et al.* 1987). But there rose some discussion on the use of certain sporezones (objections by HERNGREEN and GUY-OHLSON).

Anyway, as in the other Jurassic stages, ammonites are the most useful markers for the definition of the stage boundary. Up to now no definit agreement could be reached on the most appropriate boundary level. *Leioceras opalinum* widely used as boundary marker is not supported by the incoming of any other ammonite taxon or by other faunal components. Also its distribution is not worldwide and its type horizon is not sufficiently known (HELLER & ZEISS 1972 suggest a very high type level).

Fixing the boundary at the base of the torulosum biozone (that is the base of the stage by original definition) would enable us to use also several species of the Grammoceratinae lineage (*buckmani*, *leura*, *lotharingica*, *fluitans*), perhaps also *Bredyia*, which are widespread not only in boreal and mediterranean provinces but also in the Middle East (Iran) and South America (HILLEBRANDT 1987).

Tmetoceras worldwide distributed and known to occur since the aalensis Zone (Switzerland, Spain) is too scarcely represented in the lowermost Aalenian to be used as stratigraphic marker.

ELMI referred to the upper boundary of the Toarcian in the view of the Toarcian Working Group.

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AALENIAN/BAJOCIAN BOUNDARY W.G.

G. PAVIA

The meeting of the Bajocian Working Group was held on 29th September 1991 in Poitiers. More than 30 researchers participated : ammonitologists, magnetostratigraphers, micropaleontologists, etc. Discussions, managed in a very informal way, concerned the following topics.

A. Bajocian basal boundary Stratotype – R. MOUTERDE detailed once more again the peculiarity of the section of Cabo Mondego as possible stratotype. G. PAVIA summarized the conclusions of the recent B.W.G. meeting in Portree, Isle of Skye (April 1991) of which N. MORTON distributed the proceedings : the participants agreed with the impossibility of making any choice between the two proposed reference sections, Cabo Mondego and Bearreraig Bay. In fact, the deficiences shown by both the sections discussed in that occasion prevented from making a formal proposal to the International Subcommission. We have to wait for the next meeting where we hope to be in a position to examine more complete and exhaustive proposals.

B. The next meeting of the B.W.G. will be held in Morocco in April 1994 (after Arkell's symposium in London, September 1993) and organized by D. SADKI of the Marrakech University. Colleagues are invited to present on that occasion details of any discussed or new section they think useful for stratotype proposals.
The meeting in Marrakech will give the opportunity to select a new coordinator of the B.W.G., after a decade of activity by G. PAVIA.

C. The revised biozonal draft proposed in Poitiers by D. CONTINI *et al.* has been discussed ; many problems are still open *e.g.* the subzonal division of the Discites Standard Zone and the significance of the Ovalis unit. As far as the Discites biozone was concerned, G. PAVIA handed out a summary of knowledge, here enclosed. These charts will constitue theme of discussion and revision maybe during the next meeting in Morocco.

D. The coordinator will propose to all colleagues a further collection of reviews of the Bajocian zonal and subzonal units. The former call of papers (see B.W.G. meeting in Piobbico, July 1988) gave poor results, with answers only by W. OHMERT and A. RICCARDI. The idea is to have more material within 1994 for homogenizing the data in a "guide".

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Tmetoceras worldwide distributed and known to occur since the aalensis Zone (Switzerland, Spain) is too scarcely represented in the lowermost Aalenian to be used as stratigraphic marker.

ELMI referred to the upper boundary of the Toarcian in the view of the Toarcian Working Group.

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BAJOCIAN/BATHONIAN BOUNDARY W.G.

CHARLES MANGOLD

There are few news about Bathonian stage, but I would like to emphasize several points.

1 - The convenor remembers to all scientists interested by the Bajocian-Bathonian boundary that in Newsletter n° 20 (February 1991) was enclosed a voting form (enclosure n° 1) concerning the proposal of a Bajocian-Bathonian boundary section in the Digne area (INNOCENTI M. *et al. in* ROCHA & SOARES ed. 1989 (1988) : 2nd International symposium on Jurassic stratigraphy, Lisboa 1987, vol. I, p. 333).
Please return this voting form with your remarks to the convenor (Charles MANGOLD).

2 - During the 3rd International Symposium on Jurassic stratigraphy held in Poitiers (September 1991), the "Groupe Français d'Etude du Jurassique" presented a revised jurassic zonal scheme for France. The Bathonian Chart was established by C. MANGOLD & M. RIOULT.

3 - The field and workshop meeting on the Bajocian/Bathonian boundary provided first in 1992 in the neighbourhood of Digne (France - Alpes de Haute-Provence) is hoped for **1994** if members of the Bathonian boundary W.G. or other people are interested.

The topics of this meeting should be :

- field-trips on boundary sections ;
- workshops devoted to fossils exhibitions, specially ammonites, collected in the Digne area and comparison with collections of the participants.

Please, if you are interested, return the form below

✂- -

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FAMILY NAME ....
FIRST NAME ....
MAILING ADDRESS ....
....
....

Will participate to the Bathonian boundary W.G. meeting 1994

for certain ☐ may be ☐

DATE INDICATION

May ☐ June ☐ September ☐

CALLOVIAN/OXFORDIAN BOUNDARY W.G.

GUILLERMO MELÉNDEZ

ABSTRACT

A brief review of the new results on Oxfordian stratigraphy and the main activities of the Oxfordian Working Group during the last four years since the Lisbon Symposium (1987) is outlined. Two field meetings of the Oxfordian Group, held in Zaragoza (1988) and Basel (1990), have led to significant advances on what concerns the refining of ammonite biostratigraphic scales and correlations. The currently established substages and zone boundaries do not seem to set important problems. On the other hand the discussions on the proposals of a Callovian-Oxfordian boundary stratotype, and the possible modification of the Oxfordian zonal scheme by the re-location of the Oxfordian-Kimmeridgian boundary will be the main item of the forthcoming meetings.

INTRODUCTION

The Meeting of the Oxfordian Working Group took place during the Jurassic Symposium at Poitiers (September, 1991). It was attended by some 30 people. Three main items were introduced by the convenor of the group, (1) : The current state of the group, including a report on the recent meeting and the publication of the proceedings of the 1st Oxfordian Meeting (Zaragoza 1988), (2) : The main activities and results on Biostratigraphy and correlation both between separate areas and between different taxonimic groups. (3) : Forthcoming projects and meetings, most of all on what concerns the proposals for a Callovian Oxfordian boundary stratotype.

RECENT ACTIVITIES

Since the last Jurassic Meeting, at Lisbon, 1987 (see Lisbon symposium vol. I, pp. 27-37), the activities of the Oxfordian Working Group have been intense. A steady progress has been achieved on what concerns the refining of the ammonite biostratigraphic scales and biostratigraphic correlations between separate biogeographic provinces. Progress in biostratigraphy with other fossil groups besides ammonites has also been remarkable, most specially with dinoflagellates and scleractinia (see Lisbon report loc. cit., and POULSEN herein). Two field meetings of the Oxfordian Working Group were held, in Zaragoza (1988) and in Basel (1990). The proceedings of the first, Zaragoza Meeting, were recently published as the vol. 2 of the *Seminarios de Paleontologia de Zaragoza* (SEPAZ), 1990. All colleagues interested in receiving the volume should contact the co-ordinator of the group.

The working session of the group held during the Basel Meeting (September 1990), was mainly devoted to problems of biostratigraphical correlations, chronostratigraphical standard scale and the definition of a basal boundary stratotype for the Oxfordian. Most of the problems were simply reviewed without further discussion, since much work still remains to be done. The results were summarized by the convenor of the group in the 1990 Newsletter of the International Subcommission (Meléndez, 1990).

BIOSTRATIGRAPHIC SCALES

Efforts in refining the current ammonite biostratigraphic scales for the Oxfordian have been important during these years and have led to some interesting findings and/or precisions to the current zonal schemes for the different provinces. The most important contributions were made on the Tethyan (Mediterranean) and Submediterranean provinces.

1. Boreal-Subboreal Province

The currently accepted *Amoeboceras* zonation (Sykes & Callomon, 1979) for the Boreal Province has not suffered any important modification, although two divergent intentions to correlate this zonal scheme with the Submediterranean one of central Poland have been done respectively by Matyja & Wierzbowski (1988) and by Malinowska (1990), on the basis of the record of *Amoeboceras* in this region. An interesting contribution to the Subboreal Perisphinctid succession (*Ringsteadia*) from Central Poland has also been prepared by Wierzbowski (1991, Poitiers Symposium).

2. Mediterranean Province

An attempt to recognize in the Betic Range (S .Spain) the subdivisions proposed by Sapunov (1976) in the Lower Oxfordian of Bulgaria was made by Checa & Sequeiros (1990) at the Corque section (prov. Murcia). A lower, Athletoides, and an upper, Renggeri Zones are recognized on the basis of several different forms of *Neocampylites*, Perisphinctinae, Peltoceratinae, and *Creniceras*. The Renggeri Zone is correlated with the Claromontanus Subzone (i.e. the lower part of the Cordatum Zone) as characterized in the Iberian Range, E Spain, by Melendez *et al.* (1983) and Meléndez (1989). This correlation appears debatable on account of the stratigraphic position of the species *Creniceras renggeri* (OPPEL) assumed by Callomon (1990), at the base of the Scarburgense Subzone, Mariae Zone.

On what concerns other regions in the Mediterranean Province some interesting contributions have been made by Pavia *et al.* (1988) and by Sarti (1988) in characterizing the Middle and Upper Oxfordian in the Ammonitico Rosso of the Monte Lessini series. The Fouquei Zone, proposed by Benetti & Pezoni (1985) for this area, roughly equivalent to the Bifurcatus Zone in the Submediterranean Province, has been partly assumed by subsequent authors (cf. Sarti, loc. cit.)

3. Submediterranean Province

Some significant contributions to the ammonite biostratigraphic scales of this province have been made in the recent years. A first attempt to show the biostratigraphical value of the Taramelliceratinae for the Lower Oxfordian of Cracow has been presented by Tarkowski (1990) on the basis of the analysis of the rich assemblages of *Taramelliceras* and *Popanites* in this area. The Lower Oxfordian is subdivided into two zones (Minax and Paturattensis) and four subzones (Spixi, Baccatum, Oculatum and Paturattensis), which approximately correspond to the classical successive subzones of the Lower Oxfordian of the Submediterranean Province (Cariou *et al.*, 1971), up to the lower part of Vertebrate Subzone. This zonal scheme may be useful whenever a detailed *Taramelliceras* succession can be recognized and looks promising for some areas of the European Sub-Boreal/Sub-Mediterranean Provinces.

The Middle Oxfordian of the Submediterranean Province has been the subject of detailed biostratigraphic revisions in the recent years. A precise characterization of the successive Perisphinctids (M) and (m) subzones from the Lower Plicatilis up to the Upper Bifurcatus Zone was presented by Callomon (1988). The Transversarium Zone was subdivided into the three "classical" subzones, i.e. Parandieri, Wartae and Scilli.

However, new findings on the perisphinctids succession within this zone, especially on the precise stratigraphical position of the species *Perisphinctes (Dichotomosphinctes) wartae* BUKOWSKI at the top of the zone instead of at the middle part, led Cariou and Meléndez (1990) to propose an alternative subdivision of the Transversarium Zone : (a) to propose the new name **Luciaeformis Subzone** for the former Wartae Subzone and (b) to create a new, **Rotoides Subzone** at the top of the Transversarium Zone, between the classical Schilli Subzone and the first *Dichotomoceras* assemblage (i.e. *Dichotomoceras bifurcatoides* ENAY). This new subzone would be characterized by the presence of *Per. wartae* BUKOWSKI and *Per.*

rotoides RONCHADZÉ. The name Wartae Subzone was then eliminated, in order to avoid further confusion. After the new definition, this subzonal succession has been widely recognized throughout Southern Europe an described by the authors : Fontana & Meléndez (1990) ; Cariou, Meléndez & Branger (1991) ; Fontana (1991) ; Meléndez & Fontana (1991). The final subdivision of the Submediterranean Transversarium Zone is Parandieri, Luciaeformis, Schilli and Rotoides Subzones.

4. East Pacific Province

Progress on Oxfordian biostratigraphy of the East Pacific Province has been slow and difficult, mainly due to the lack of detailed ammonite successions and of stratigraphically located ammonite associations. Discussions on the taxonomic status of E Pacific Perisphinctids intergrade with those on the biogeographic relationships of the faunas with European (Western Tethys) area and with the Caribbean and Mexican Subprovinces. It seems that long studies are still necessary to unravel such questions.

However, in a recently published paper, Gygi and Hillebrandt (1991) describe the ammonite successions of the Oxfordian from northern Chile and present some general sections with the precise location of several ammonite associations. The authors go farther to characterize and to correlate with Europe a Tranversarium Zone in a broad sense by the presence of *Gregoryceras riazi* (DE GROSSOUVRE) and *G. transversarium* (QUENSTEDT) ; a Bifurcatus Zone on the basis of *G. fouquei* (KILIAN), and a Bimammatum and Planula Zone on the basis of debatable *"Larcheria" gredingensis* WEGELE and *Idoceras* cf. *neogaeum* BURKHARDT respectively. Besides some debatable questions concerning mainly the perisphinctids, several things appear clear from this contribution : (1) the open communication, at least during the Middle and probably Upper Oxfordian between the East Pacific and Europe, and the free migration of Peltoceratinae and Oppeliids ; (2) the inferred probable biogeographic connections between the Andean and the Caribbean Subprovinces as regards the common elements of Oppellidae (Glochiceratinae, Ochetoceratinae) and Perisphinctidae (*Vina-lesphinctes*, *Antilloceras*, and related forms), as already suggested by Meléndez & Myczynski (1987) and Myczynski & Meléndez (1990).

SELECTION OF A BOUNDARY STRATOTYPE

A first definition of the Oxfordian Stage (Callomon, 1964) was set in terms of its standard ammonite Zones in the NW European Boreal/Subboreal classification. Its lower boundary was placed at the base of the lower subzone of the Mariae Zone, i.e. the Scarburgense Subzone. The type locality and hence the stratotype of this subzone were chosen in the permanent cliff sections of the Yorkshire coast. A formal proposal for the choice of a basal boundary stratotype and the designation of a stratotype section in the Yorkshire area was recently made by Callomon (1990). This author selected one of the sections recently reviewed by Wright (1968 ; 1983) from this area, near the Scarborough castle, at the north end of Cayton Bay. The selected section was the Wright's section 11, at Osgodby Nab. The base of the Scarburgense Subzone was located at the base of bed 10.

Other proposals and reference sections

Recommendations of the I.C.S. state that the selected sections proposed as candidates for stage-boundary stratotypes should fulfill a series of elemental conditions, such as good exposure conditions, accessibility and protection, continuous (as far as possible) stratigraphic record, that is no important gaps at the boundary ; abundant (or at least clear) record of guide fossils (ammonites) and, most of all, good possiblilities of correlation with separate and distant areas. As far as this is concerned, it is clear that in a period of strong provincialism such as the Oxfordian this will play against any proposal within a determinate area. Besides this, other desirable properties of a good boundary stratotype or reference

section should be : good facilities for micropalaeontological sampling (Forams, Dinoflagellates, Nannoplancton), magnetostratigraphy, radiometric dating, etc.

Although it may seem hardly probable for any single section to fulfill all these requirements, one could expect at least that an acceptable stratotype should yield a good representation of some of the ammonite groups currently used as guide-fossils for the biostratigraphic scales in other biogeographic provinces. In our case, as far as the Submediterranean, Tethyan, and probably Eastern Pacific provinces are concerned, this would include the Perisphinctidae (*Prosophinctes*, *Properisphinctes*, *Otosphinctes*), Peltoceratinae (*Peltomorphites*, *Parawedekindia*, *Peltoceratoides*) and Oppeliidae (*Taramelliceras*, *Creniceras*). Any proposal from the Tethyan regions, where the boundary beds are represented under carbonate facies, would appear highly inconvenient, due to the huge extended gap recognized at the Callovian-Oxfordian boundary. However, a good exception could be at SE France, Castellane area, near Digne, where the Callovian-Oxfordian transition is represented by dark clay facies ("Terres noires"), and where ammonite successions include, besides a high share of Cardioceratids, an acceptable representation of other mentioned groups, including Perisphinctids.

This means that there exists the possibility to look for some other candidates for the Callovian-Oxfordian boundary stratotype outside the Boreal/Subboreal Provinces and try to find correlation links with the Tethyan Realm. According to the I.C.S. instructions, all proposals should be presented, discussed and examined in detail by the components of the working group, and voted and approved within the Jurassic Subcommission before being transferred for approval to the I.C.S. Therefore, all the O.W.G. members are welcome to present alternative proposals and raise discussions on them during the next meetings. Furthermore, it should be remembered that besides the choice of a proposal for a boundary stratotype, any further poposal for reference section and/or parastratotype will be equally welcome.

Forthcoming Meetings and problems

The programmed meetings for the next few years will bring the O.W.G. members some good opportunities to discuss in detail and to revise the different proposals. The III O.W.G. Meeting will be held in Warsaw, in September 7-12, 1992. The field trip will consist of a three-days visit to the Oxfordian and Kimmeridgian sections of the Holy Cross Mountains and the Czestochowa upland. All members wishing to take part in it should address to Drs. B.A. Matyja and A. Wierzbowski, Geology Department, University of Warsaw, Al. Zwirki i Wigury 93, 02-089 Warszawa (Poland). Members are also asked to participate actively by submitting biostratigraphical papers on boundaries, zonal subdivisions, and paleontological characterization of horizons, and preparing possible alternative proposals for a Callovian-Oxfordian boundary stratotype and/or reference sections. The papers, presented in English and accepted by the Editorial Board, will be published in a separate volume of *Acta Geologica Polonica*. The maximum length of the papers is estimated at 25-30 pages, line-drawings and half-tone plates included.

Due to the fact that it will be a joint meeting of the Oxfordian and the Kimmeridgian Working Groups, discussions will be partly devoted to the close question of the position of the Oxfordian-Kimmeridgian boundary, and how could the current Oxfordian zonal scheme to be affected by this fact. According to the discussions held at the Poitiers Meeting some reasons of convenience for correlation between the Boreal and the Tethyan Realms would advise to move this boundary downwards, to the Planula-Galar Subzone boundary. Although there could be some convincing palaeontological reasons to justify such decision, it seems that an important matter like this one will still require long discussions.

The programmed W.J. Arkell Symposium in Great Britain, 1993, will surely be a good opportunity to visit the proposed boundary stratotype at Osgodby Nab, Yorkshire, and

to examine the candidate section *in situ* or, at least some of the outcrops referred to as possible reference sections by Callomon (1990), at Stewartby (S of Bedford, Midlands), or in the Dorset coast. The possibility of including a short visit to the outcrop during the programmed excursions will be treated with the organizer committee by the convenor of the group.

Finally, a further joint meeting of the Oxfordian and Kimmeridgian working Groups is being programmed for 1994 in SE France, Castellane area. It will be organized by F. Atrops and G. Meléndez and will bring the possibility to examine the sections proposed as alternative Callovian-Oxfordian boundary stratotype and/or reference sections. This process should culminate with the formal proposal of a basal boundary stratotype for the Oxfordian ot the I.S.J.S. and subsequently to the I.C.S. at the end of 1994 . An acceleration of the process, which should include revision of the sections, detailed study of ammonite successions, publications of the results and further discussions appears, at this moment, improbable.

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JURASSIC MICROPALEONTOLOGY W.G.

D. GUY-OHLSON

By unanimous opinion of those present at the meeting it was decided to abandon the Jurassic Micropalaeontology Working Group and instead establish an informal microfossil group called the Jurassic Microfossil Group, which shall be conducted by a secretary. The purpose of this informal group is to get microfossil workers directly involved with the stage boundary working groups and to get as much work as possible done based on the new stratotypes. The task of the secretary is, by means of newsletters, to inform the microfossil workers about activities in the Subcommission and the stage boundary working groups.

It is important that microfossil workers attend field meetings, and that range charts are established and correlations demonstrated before proposed stratotypes are evaluated. Therefore the Subcommission and stage boundary working groups must send their newsletters, circulars etc. to the secretary of the microfossil group. The name and address of the secretary is :

Dr Donna MEYERHOFF HULL
The University of Texas at Dallas
Program in Geosciences
P.O. Box 830688
Richardson
TEXAS 75083-0688
U.S.A.

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3. OBJECTION TO THE PROPOSED CALLOVIAN BOUNDARY STRATOTYPE, MACROCEPHALEN-OOLITH, ALBSTADT-PFEFFINGEN

R. JORDAN

SUMMARY

The stratotype proposal is thrust aside because inappropriate to International prescriptions (instructions). For all that we add a justification although useless according to the extract of the guidelines below.

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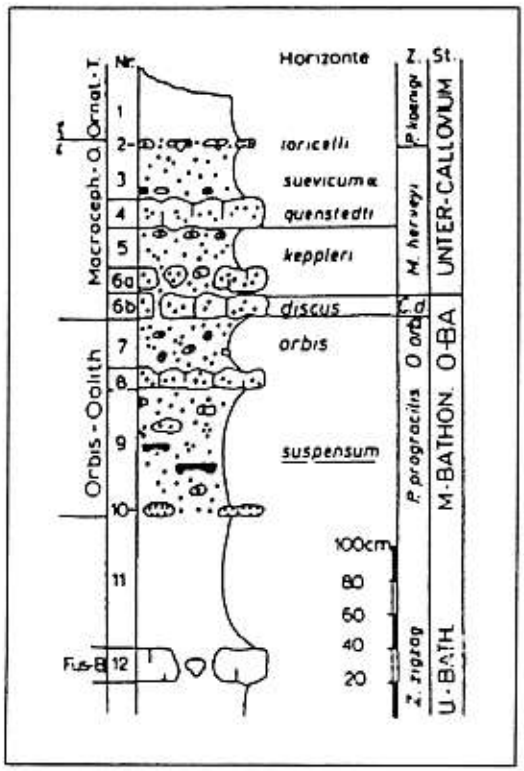
2) Guidelines and Statutes of the Intern. Comm. on Strat. (ICS), Cours. Forsch.-Inst. Senckenberg, 83, 1986.



Profil des Macrocephalen-Oolith (vorgeschlagener Stratotypus für die asis des Calloviums von Albstadt-Pfeffingen (Aus Dietl, 1990. leicht abgeändert).

DETAILED JUSTIFICATION

Theoretically a detailed justification is useless, because recapitulating several points discussed by specialists to attain the guide-lines.

Nevertheless, as guide-lines and the basic reflections may be unknown to any one, we attempt a "radioscopy" of the proposed "stratotype" in the light of a good stratotype conditions.

STARTING-POINT.

During the annual meeting of the German Subcommission on Jurassic Stratigraphy at Albstadt, Baden-Württemberg (7-10.5, 1991), Dr G. DIETL (Stuttgart) has presented the 10.5, 1991 the proposed boundary stratotype into the Macrocephalen-Oolith at Oberes Roschbachtal, Western side of Albstadt-Pfeffingen (see excursion guide-book - F, stop 10, p. 32-33). A rock column of the profile was exposed in the 9.5 evening in the Kräuterkasten Museum with colleagues' signatures of the International Callovian W.G.

As the spectacular figure in the guide-book shows, the whole section of Orbis-Oolith and Macrocephalen-Oolith, is highly condensed, only c. 2,3 m thick within ammonites are distributed in 4-5 zones, particularly in 7 faunal horizons. Samples of rocks from the outcrop, covered by serpulids demonstrate this "situation". The one and only Upper Bathonian is here

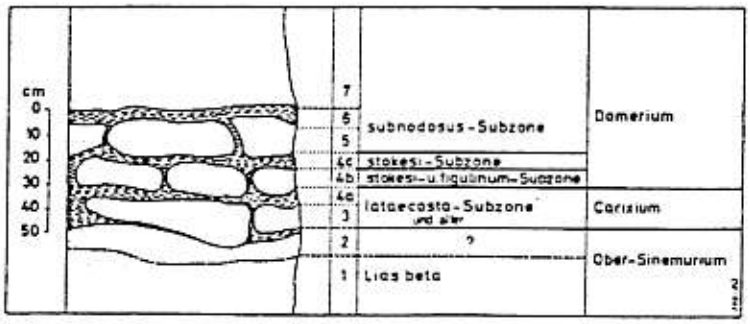
reduced to 0,50 m but reaches 35 m nearby Hildesheim in a quite continuous succession of clayey facies and in a continuous ammonite sequence. (*Geol. Jb.* A 121).

A condensed and lacunar succession is completely inadvisable for the accurate determination of a time boundary. Better, biostratigraphically settings of boundaries have to be done in a section with continuity of sedimentation (see Guidelines), so that a boundary has to be set with a maximum accuracy within a phylogenetic period by the state of evolution of a great number of species/subspecies of one or several ammonite genera or other fossil groups.

In the whole South German "Braun Jura" there is only one true "candidate" for a possible (potential) stratotype : the Opalinus-Ton. "Candidates without prejudice" should be at the most the Hamiten-Dentalien and Ornaten-Ton, therefore only successions characterized by an argillaceous probably continuous sedimentation (and therefore giving fossils in a continuous way). Inversely, all clastic deposits and all faunal horizons sequences are not suitable : this is the case of the greatest part of the "Braun Jura".

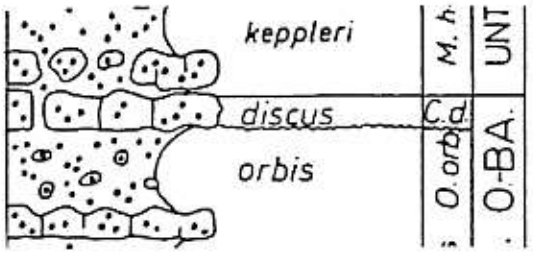
The one who is working in regions with sharply thicker (argillaceous) deposits of the Lias and the Dogger knows that thick (argillaceous) and complete sections with ammonites normally don't contain any distinct faunal horizon. (However if ammonites are occurring in beds, there is probably a secondary enrichment, even if it is not ever lithologically distinct).

Afterwards, "faunal horizons" are to be considered as condensed levels with more or less lithologic characteristics, for instance the boundary bed Lias γ/δ in NW Germany in the Haverlahwiese quarry.



Ehem. Eisenerz-Tagebau Haverlahwiese bei Salzgitter, südöstlicher Bahneinschnitt. Profil im Bereich Ober-Sinemurium bis Domerium (aus R. JORDAN 1960).

Lias γ/δ Grenzbank
(HOFFMANN, K. & JORDAN, R. 1982, Abb. 31)



Ausschnitt aus "Stratotypius"-Profil, Exk.-F., S. 33.

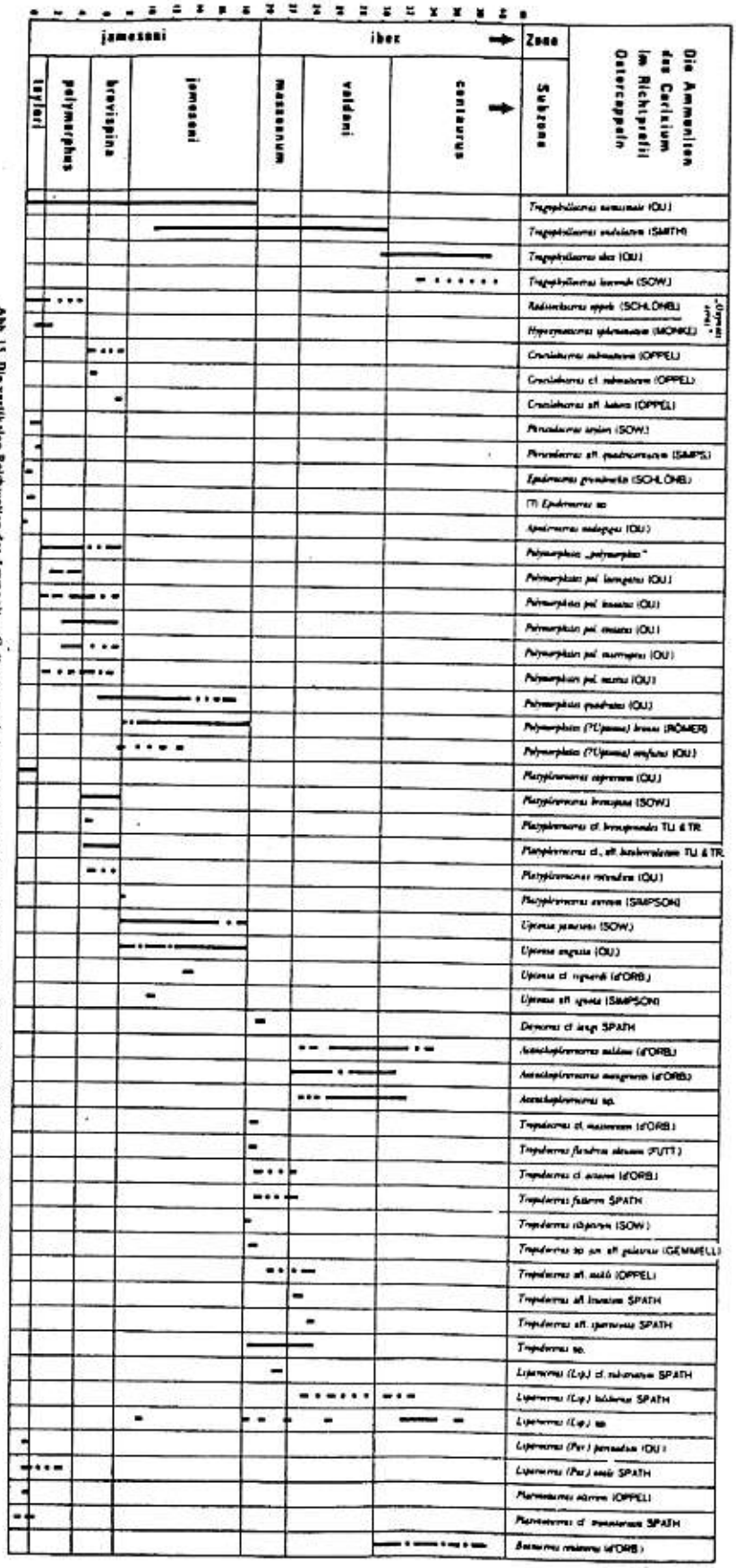


Abb. 13. Die vertikalen Reichweiten der Ammoniten-Gattungen und -Arten des Unter- und Mittel-Carixium im Richtprofil Ostercappeln bei Osnabrück.

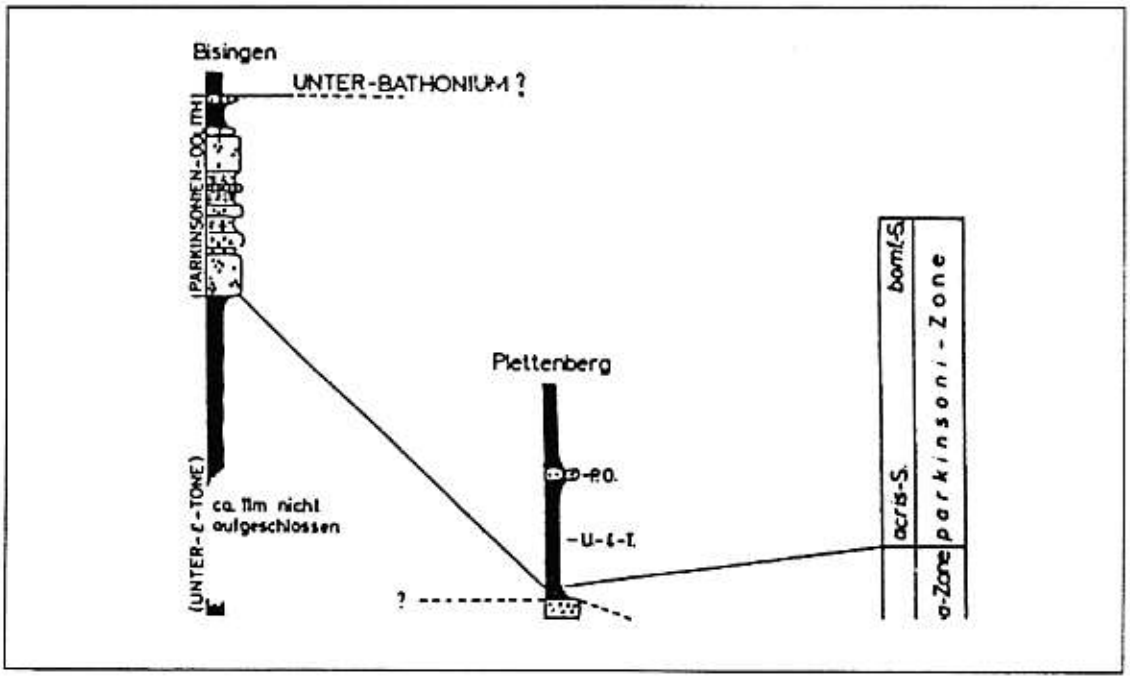
Both sections above are reproduced on the same scale to make a comparison easier.

The great similarity between the Lias γ/δ boundary bed and the section of the Bathonian/Callovian boundary "stratotype" is clear ! None N.-German biostratigrapher never will put accurately a stratotype in the γ/δ boundary bed.

On the other hand, for the main part, the argillaceous section of Ostercappeln marl quarry near Osnabrück is suitable to establish a boundary stratotype owing to its continuous sedimentation (see thickness indications on the left), because this boundary would be well defined through the state of phylogenetic evolution of different ammonites genera and species beneath other fossils groups (see HOFFMAN, fig. 15).

In the same way the meaning of "faunal horizons" (cf. excursion guide-book p. 29, 33, 38-41) should be clearly rejected in a North German view owing to condensed deposits. This is not a problem if we have in mind that condensation processes allow development of numerous "faunal horizons" according to the species range chart given by Hoffman in which they appear or not with gaps (hiatuses) resulting of a half, one, two or three subzones and corresponding to "faunal horizons" of the "Braun Jura" of South Germany and specially those of the "stratotype".

The figure on p. 23 of the guide-book states the setting of "faunal horizons" precisely and the reality of condensation in the "Braun Jura" of Southern Germany.



The figure shows that the Acris Subzone at Plettenberg is in an argillaceous sequence (U-ε T), even if at Bispingen the Subzone is condensed in the lower part of the "Parkinsoni Oolith" (it is no more necessary coming back to the development of condensation processes).

SCHEDULE

The proposed stratotype does not satisfy the International conditions of validity required by the Guidelines. Arguments leading to the Guidelines have been shown in application to the proposed stratotype.

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4. REPORT ON THE OXFORDIAN IN THE DANISH SUBBASIN BASED ON DINOFLAGELLATE CYSTS

E. POULSEN

1. INTRODUCTION

This report deals with the dating and the geographic distribution of the dinoflagellate cyst zones within the Danish Subbasin *(sensu lato)*. The description of the dinoflagellate zonation for the entire Jurassic section in the Danish Subbasin (*sensu lato*) is given in Poulsen (1990; in press a ; in prep. b ; d). The dinocyst zonation at the Middle-Upper Jurassic boundary is discussed and emended.

The standard ammonite zones are here treated as chronostratigraphic units (see Callomon, 1984 ; Wimbledon and Cope, 1978). The ammonite zones are referred to by the species name alone, e.g. Mariae Zone. Where dinoflagellate cyst zones are used, this is not indicated especially, e.g. *Liesbergia scarburghensis* Zone.

1.1. Geological setting

A synthesis of the tectonic evolution of the Fennoscandian Border Zone was given by Liboriussen *et al.* (1987). More recently the tectonic evolution of the transition between the Baltic (Fennoscandian) Shield and the North German Caledonides was reviewed by the EUGENO-S Working Group (1988). The Fennoscandian Border Zone (see Fig. 1) is a tectonic zone along which there has been activity since Early ? - Late Palaeozoic times to the present day (Sorgenfrei and Buch, 1964 ; Liboriussen *et al.*, 1987). The zone was named by Sorgenfrei and Buch (1964). Liboriussen *et al.* (1987) described the zone as the continuation of the Teisseyre-Tornquist Zone. The EUGENO-S Working Group (1988) defined the zone as a separate Scandinavian part of the Teisseyre-Tornquist Zone, named the Sorgenfrei-Tornquist Zone, and as a Mesozoic-Early Cenozoic feature.

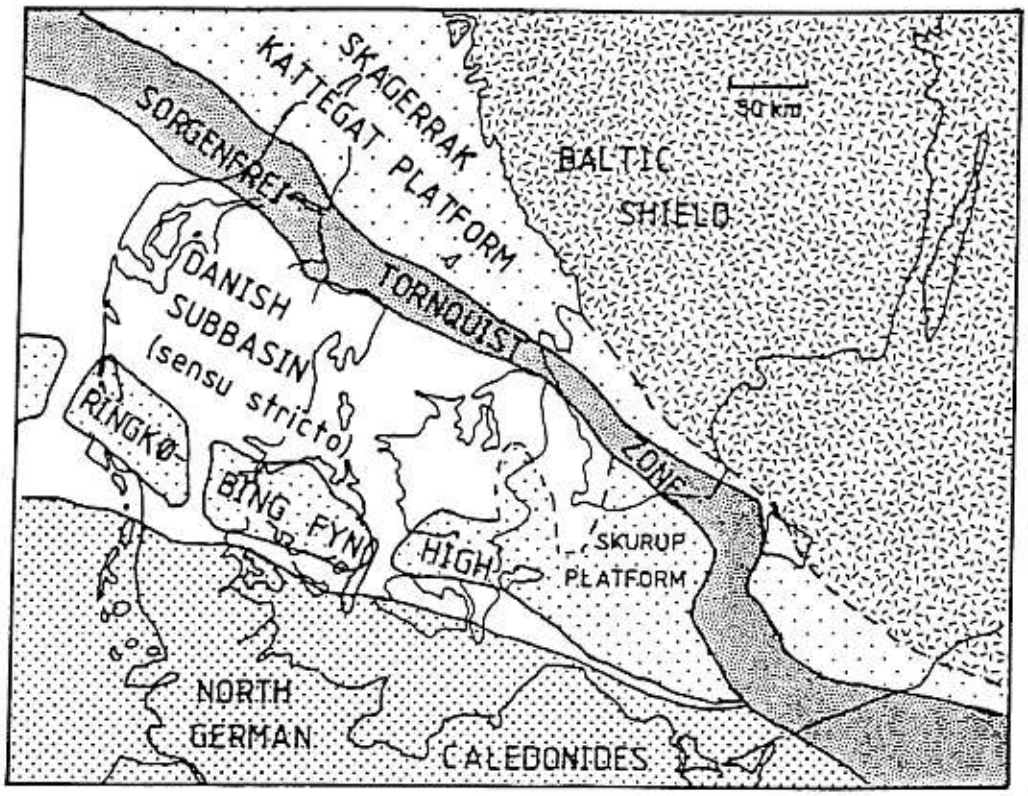

Figure 1 : Structural units of the Danish area after the EUGENO-S Working Group (1988), modifed after N.E. HAMANN (personal commun., 1991).

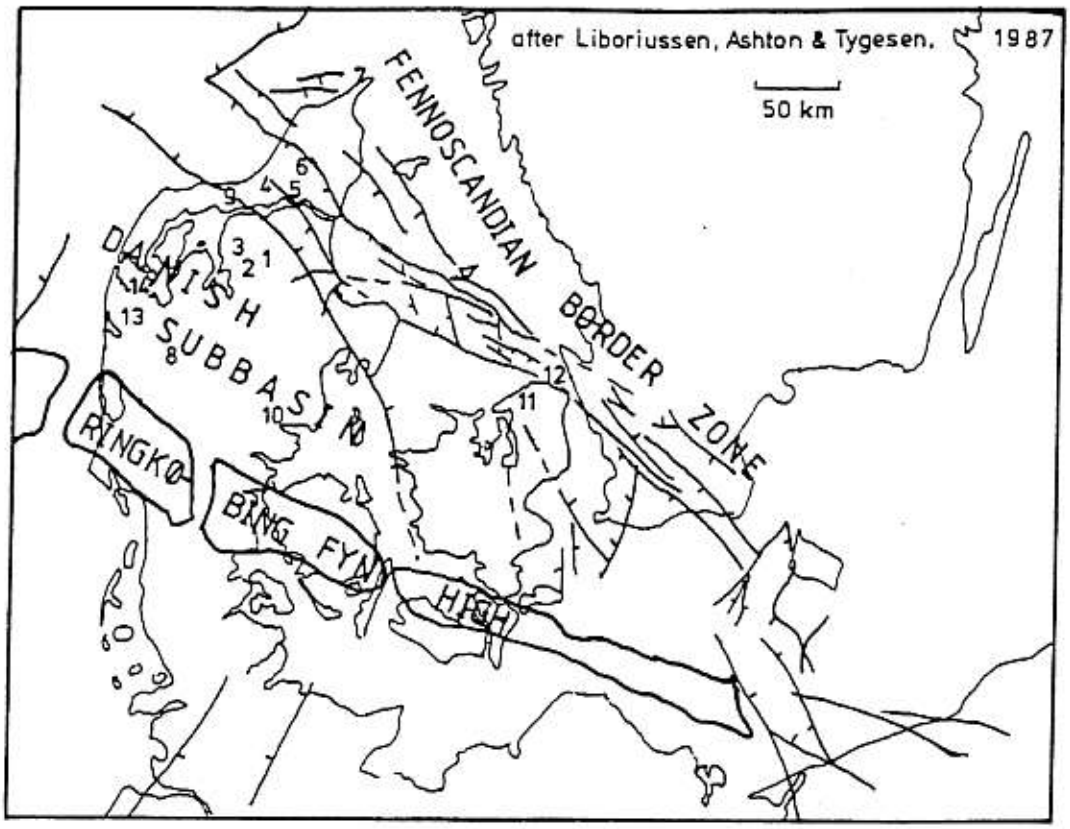

Figure 2 : Locations of boreholes. 1. : Aars-1 – 2. : Farsø-1 – 3. : Hyllebjerg-1 – 4. : Vedsted-1 – 5 : Haldager-1 – 6 : Flyvbjerg-1 – 7 : Skagen-2 – 8 : Vinding-1 – 9 : Fjerritslev-1 and 2 – 10 : Horsens-1 – 11 : Lavø-1 – 12 : Sound-1a, 2, 3, 4, 5, 7, 8, 9, 10, 11, 13, 14 , 15, 18, 19 – 13 : Vemb-1 –14 : Uglev-1.

The area between this zone and the Baltic (Fennoscandian) Shield is named the Skagerrak-Kattegat Platform (EUGENO-S Working Group, 1988). The Sorgenfrei-Tornquist Zone and the Skagerrak-Kattegat Platform were earlier grouped under the name "Fennoscandian Border Zone" (EUGENO-S Working Group, 1988).

The term "Danish Embayment" was presented by Sorgenfrei and Buch (1964) for the region between the Fennoscandian Border Zone and the Ringkøbing-Fyn High. Michelsen used "Danish Embayment" (Michelsen, 1975) and later "Danish Subbasin " (Michelsen, 1978 ; 1989a, b) for the Danish part of the Norwegian-Danish Basin, the Sorgenfrei-Tornquist Zone, and the Skagerrak-Kattegat Platform. In the present paper the definitions of the structural units are adopted as they are defined by the EUGENO-S Working Group (1988). The term "Danish Subbasin (*sensu stricto*)" will be used for the Danish part of the Norwegian-Danish Basin and the term "Danish Subbasin (*sensu lato*)" for the Danish part of the Norwegian-Danish Basin, the Sorgenfrei-Tornquist Zone and the Skagerrak-Kattegat Platform.

1.2. Lithostratigraphy

This section gives a review of the upper Middle Jurassic-Oxfordian Lower Kimmeridgian section. The lithostratigraphic units are described in relation to the dinoflagellate cyst zones.

1.2.1. Haldager Sand Formation

Michelsen (1978) emended "The Haldager Formation of Larsen (1966)" and introduced two members of "the Haldager Formation", the Haldager Sand Member and the Flyvbjerg Member. Koch (1983) described the sedimentology of "the Haldager Formation". The rank of these two members has now been changed to formation and the former "Haldager Formation" is abandoned by Michelsen (1989a), who believed, that there was a regional hiatus between the two members.

The lowermost part of the Haldager Sand Formation has been dated by the occurrence of dinoflagellate cysts to the *Mancodinium semitabulatum* Zone, *Parvocysta nasuta* Subzone (Upper Toarcian-Lower Aalenian) [Poulsen, in prep. d].

The upper part of this is barren of dinoflagellate cysts, except in the Vedsted-1 borehole, where the top of the formation is dated as Late Callovian or younger.

In other samples of the Haldager Sand Formation the absence of age diagnostic dinoflagellate cysts precludes further dating of the formation.

1.2.2. Flyvbjerg Formation

In the Danish Subbasin (*sensu stricto*) and in the Sorgenfrei-Tornquist Zone the base of the Flyvbjerg Formation is found within the *Liesbergia scarburghensis* Zone, **Subzone b** (Middle Oxfordian) (Aars-1, Flyvbjerg-1, and Vedsted-1 boreholes). The top of the formation is referred to the *Scriniodinium crystallinum* Zone, **Subzone d** (Lowermost Kimmeridgian) (Hyllebjerg-1 borehole).

On the Skagerrak-Kattegat Platform (Skagen-2 borehole) the base of the formation belongs to the *Scriniodinium crystallinum* Zone, **Subzone c** (Upper Oxfordian) and the top belongs to the *Endoscrinium luridum* Zone, *Perisseiasphaeridium pannosum* Subzone (Upper Kimmeridgian).

From this, it appears that both the base and the top of the formation are diachronous in direction towards the margin of the Baltic Shield.

1.2.3. Bøglum Formation

In the Danish Subbasin (*sensu stricto*) the base of the Børglum Formation is correlated to the *S. crystallinum* Zone, **Subzone d** (Lowermost Kimmeridgian) and the top is referred to the *Glossodinium dimorphum* Zone, **Subzone c** (Lower Volgian) (Aars-1 and Hyllebjerg-1 boreholes).

Towards the Baltic shield on the Skagerrak-Kattegat Platform the formation thins out. In the Skagen-2 borehole the formation is only 13 meters thick and is found in the *E. luridum* Zone, *P. pannosum* Subzone and probably also to the *G. dimorphum* Zone, **Subzone a.**

This formation is only present at the margin of the Baltic Shield in the Upper Kimmeridgian–Lowermost Volgian, whereas in the other parts of the Danish Subbasin (*sensu lato*) it is of Lowermost Kimmeridgian to Uppermost Lower Volgian age.

2. DINOFLAGELLATE ZONATION

This section gives a review of dinoflagellate zonations at the Middle-Upper Jurassic boundary, the dating of the base of the Oxfordian Flyvbjerg Formation, and with the geographic distribution of the dinoflagellate cyst zones within the Danish Subbasin (*sensu lato*).

2.1. Zonations at the Middle–Upper Jurassic boundary in Northwest Europe

Dinoflagellate cyst zonations for the Jurassic of Northwest Europe are discussed and a few revisions are made by Poulsen (in press a ; in prep. b ; d). However, the two zonations at the Middle-Upper Jurassic boundary proposed by Riley and Fenton (1982) and Woollam and Riding (1983) were not reviewed in those studies.

The boundaries between both zones and subzones in the two above-named zonations may, in some instances, be defined by the same species. As a consequence, zonal and subzonal names may also be identical (Table 1).

	Dinoflagellate zonations				Events	
Chrono-stratigraphy	Riley and Fenton, 1982		Woollam and Riding, 1983		First appearance datums	Last appearence datums
	Zone	Subzone	Zone	Subzone	(base of chron)	(top of chron)
Tenuiserratum					*G. dimorphum*	
Densiplicatum	*Ls*		*Ls*	b		*L. scarburghensis*
Cordatum	*Wd*	*Ls*		a	*L. eumorphum* *L. mirabile*	*L. absidatum* *Wanaea* spp.
Mariae		*Wf*	*Wf*		*W. fimbriata*	*C. continuum*
Lamberti		*Mg*	*Wt*	b	*L. scarburghensis*	*P. prolongata*
Athleta				a	*L. absidatum* *W. thysanota*	

Table 1 : The dinoflagellate cyst zonations and events of Riley and Fenton (1982) and Woollam and Riding (1983). For modifications of events, see text. Ls = *Liesbergia scarburghensis*, Wd = *Wanaea digitata*, WF = *Wanaea fimbriata*, Mg = *Mendicodinium groenlandicum* and Wt = *Wanaea thysanota*.

The taxonomic revision of *Acanthaulax scarburghensis* and *Acanthaulax senta* [*A. senta* is now regarded as a junior synonym of *Liesbergia scarburghensis* (SARJEANT) Berger 1986] necessitates a revision of the "*A. scarburghensis* Zone and the "*A. senta* Subzone" of Riley and Fenton (1982). An extension of the'A. scarburghensis zone" of Riley and Fenton (1982) to the base of the "A. senta Subzone" of Riley and Fenton (1982) leads to a zone similar to the *L. scarburghensis* Zone of Woollam and Riding (1983) (Table 1). However, the index species defining the base of the zone are not the same.

Praecordatum Subchron (Mariae Chron, Early Oxfordian) [Poulsen, in prep. c], corresponding to the upper part of the *L. scarburghensis* Zone, **Subzone a.**

Also in the Aars-1 borehole a core sample within the basal beds of the Flyvbjerg Formation contains a few specimens of *L. scarburghensis*. Again it is in an assemblage otherwise dominated by *Cribroperidinium* spp. The level with *L. scarburghensis* is tentatively correlated to the *L. scarburghensis* Zone as in the Flyvbjerg-1 borehole.

Consequently, the *L. scarburghensis* Zone is the oldest proven zone of the Flyvbjerg Formation.

2.3. *Scriniodinium crystallinum* (Sc) Zone

The zone and its subzones were defined by Woollam and Riding (1983) and emended by Riding and Thomas(1989). The upper boundary of the zone was emended by Poulsen (1990, in press a).

The zone is widely recorded in the northern part of the Danish Subbasin (*sensu lato*) (Skagen-2, Flyvbjerg-1, Haldager-1 and Hyllebjerg-1 boreholes). The lower boundary of the zone is found within the lower part (although not at the base) of the Flyvbjerg Formation (Flyvbjerg-1 and Hyllebjerg-1 boreholes). In the Danish Subbasin (*sensu stricto*) the top of the zone is found in the lower part of the Børglum Formation (Hyllebjerg-1 borehole) whereas near the Baltic Shield on the Skagerrak-Kattegat Platform the top of the zone is found in the middle of the Flyvbjerg Formation (Skagen-2 borehole).

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5. REPORT ON THE 2nd MEETING OF THE BAJOCIAN WORKING GROUP (Portree, April 13-20, 1991)

G. PAVIA

The 2nd meeting of the Bajocian Working Group (B.W.G.) took place in Portree, Isle of Skye (Scotland), in conjunction with the meeting of the Aalenian Working Group. It has been organized by N. MORTON (London) in agreement with A. GOY (Madrid) and G. PAVIA (Torino) and consisted of two conference-days and three field-trips on the Jurassic of Skye district.

29 researchers attended the meeting :

France : S. ELMI, R. MOUTERDE, C. RUGET ; **Germany :** W. OHMERT, A. ZEISS ; **Great Britain :** C. EBDON, J. GREGORY, E. HAILWOOD, S. HESSELBO, T. MACLEAN, N. MORTON, M. PARTINGTON, T. POTTER, K. STEPHEN, K. THOMPSON, H. TORRENS, J. UNDERHILL ; **Hungary :** A. ANDRAS ; **Italy :** S. CRESTA, G. PAVIA ; **Morocco :** D. SADKI ; **Portugal :** M.H. HENRIQUEZ, J. MARQUES, R. ROCHA, A. SOARES ; **Spain :** A. GOY, G. MARTINEZ, M.S. URETA ; **USSR :** K. ROSTOSTEV.

The main topic was the definition of the basal boundary stratotype (G.S.S.P.) of the Bajocian Stage, to which the entire first day of conferences (Monday, 15th) was devoted with these communications :

R. MOUTERDE - Données paléontologiques sur les ammonites de la limite Aalénien-Bajocien de la coupe de Cap Mondego présentées à Piobbico (1988).

N. MORTON - Proposal for selection of Bearreraig (Isle of Skye, N.W. Scotland) as G.S.S.P. for the base of the Bajocian Stage.

F.J. GREGORY - Precision foraminiferal biostratigraphy across the proposed Bajocian boundary stratotype at Bearreraig Bay, N.E. Skye.

E.A. HAILWOOD, D. MORGAN, & N. MORTON - Preliminary magnetostratigraphy of the Aalenian/Bajocian boundary section at Bearreraig, Isle of Skye.

K. ROSTOSTEV - The Aalenian/Bajocian boundary in the Caucasus.

G. PAVIA - Actual problems in defining the Bajocian G.S.S.P.

Further specific activities were concerning :

I) visit to the Bearrearaig Bay section (Wednesday, 17th) ;

II) conclusive discussion and analysis of the possibility to reach a formal proposal for the Bajocian G.S.S.P. (Friday, 19th).

This report would give some detailed information on the final session of the meeting (a punctual report was also published by the local newspaper "Scotland on Sunday") : we stated that there is no general agreement on the choice of the Bajocian basal boundary ; further activity and the place of the next B.W.G. meeting were also planed.

Portree, April 17th 1991

During the meeting reporters have emphasized the good correlation power of the *Hyperlioceras* assemblages (cf. Politum horizon from Dorset : Callomon, 1990) from the subboreal and submediterranean provinces to the western tethysian district (Scotland, Portugal, Spain, N. Kaukasus to North Africa). Sonninids faunas, *Euhoploceras* in particular, or other ammonite groups more widely correlable, as many times suggested by different authors, are not so fine know on the biostratigraphic, phyletic and taxonomic point of view ; their use to characterize the Aalenian-Bajocian boundary needs such a long study to vanish any immediate application. Therefore we can confirm the actual opportunity to fix the basal Bajocian boundary where *Hyperlioceras* assemblages are well represented and

documented ; some auxiliary stratotypes for correlation would be chosen in the same or in a different paleobiogeographic setting.

G. PAVIA summarizes the situation as far as the Bajocian G.S.S.P. is concerned.

During the 1st meeting of the B.W.G. (Piobbico, 1988) we selected two sections as possible stratotypes : Cap Mondego in Portugal and Bearreraig Bay in Scotland. By the Proceedings of that meeting authors were expected to produce the best data they had and to collect as much new information as possible for the next Bajocian meeting, the present one. The results have been positive for Bearreraig, not so complete for Cap Mondego. The two sections objectively present up-to-date positive (+), doubtful (?) and negative (-) characters.

Cap Mondego :
(+) ammonite faunas useful for correlation
(?) magnetostratigraphy
(-) biostratigraphy at the base of the Politum horizon (i.e. at the very base of the Bajocian Stage) concerning the *Hyperlioceras* distribution (by stratigraphical gap, taphonomy or collection failure ?)
(-) biostratigraphy other than ammonites.

Bearreraig :
(+) *Graphoceras-Hyperlioceras* lineage
(+) other biostratigraphic data with nannofloras study in progress
(+) magnetostratigraphy
(?) no direct correlation way by ammonites
(-) biostratigraphic gap between last *Graphoceras* and first *Hyperlioceras* assemblages.

In summary, the Bearreraig Bay section appears the best documented one with large possibility of bio- and magnetostratigraphic correlations. Nevertheless the lacking of ammonite data in the two meters of marls just below the first record of *Hyperlioceras* hinders to fix the boundary in a definitive position : in fact (M.H. HENRIQUEZ) we can imagine that future collectings of significant *Hyperlioceras* will force to move downwards the possible "golden-spike". (The use of a "golden-fork" by H. TORRENS does not seem very formally suitable !).

On this subject N. MORTON points out that the biostratigraphic gap between the last *Graphoceras* and the first *Hyperlioceras* in the Bearreraig Bay section may be of no high significance ; in fact the Bearreraig sequence across the Aalenian-Bajocian boundary seems to be characterized by a constant and continuous sedimentation-rate without any bed-plane, i.e. without any diasthem. These two ammonite-less meters of sediments may correspond to any small discontinuity we usually register in a well stratified sequence, where we would have and some working groups had no problems to state a G.S.S.P.

W. OHMERT, H. TORRENS, A. ZEISS confirm the necessity to have a complete documentation in the layers below and above the proposed boundary ; it is clear that this is not the case neither for the Cap Mondego nor for the Berreraig Bay sections. English and Portuguese colleagues are invited to produce this documentation and to cover the biostratigraphic gaps. All people agree that, by this way, both sections will obtain more favour in the future.

Other participants (S. ELMI, R. ROCHA) remember the great interest of Cap Mondego as intermediate paleobiogeographic sector by the coexistence of Graphoceratids and Sonninids useful for more direct correlations, R. ROCHA assures the possibility to better the knowledge on this section.

In conclusion, it is clear that there are no possibilities to take any decision on the basal Bajocian boundary stratotype. The lack of general agreement on the proposal of the

Bearreraig Bay as Bajocian G.S.S.P. and the faults shown by both discussed sections prevent us from arranging any formalisation for the International Subcommission (G. PAVIA, A. ZEISS). We have to wait for the next meeting, where we hope to be in a condition to examine more complete and exhaustive proposals. Colleagues are invited to present in that occasion any new section or correlable datum they think useful for this purpose.

The next Bajocian meeting is expected in Morocco, October 1993. D. SADKI will organize a four-days field-trip through the Atlas Jurassic and two-days conferences in Marrakech.

G. PAVIA wishes to thank the participants and in particular N. MORTON for the perfect organisation of the meeting.

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6. JOINT MEETING OF THE OXFORDIAN AND KIMMERIDGIAN WORKING GROUPS (Warsaw, 7-12 september 1992)

F. ATROPS, R. ENAY & G. MELÉNDEZ

Introduction

The third meeting of the Oxfordian Working Group of the ISJS was held in Warsaw, from 7th to 12th September 1992. The meeting, programmed as a joint meeting of the Oxfordian and Kimmeridgian working groups was superbly organized by the Jurassic team of University of Warsaw comprising Drs B.A. MATYJA and A. WIERZBOWSKI as organizers and A. DREWNIAK, E. GLOWNIAK and J. GUTOWSKI as assistant staff. Prof. A. RADWAŃSKI contributed in the elaboration of the guidebook and field excursions and Prof. J. KUTEK offered an introductory lecture and took part as well in the explanation of the excursions.

About thirty specialists, mainly from Poland and from west-european countries, attended the meeting. The exceptions from extra-european countries were W.A.S. SARJEANT (Canada) and Jai KRISHNA (India). Most of the participants were coming from the field of ammonites biostratigraphy. However, an increasing number of non-ammonite specialists is being welcome to these meetings, mainly on palynomorphs (Dinoflagellates) and sponges.

The meeting started at Warsaw on Monday 7th September with the visit of the ammonite collections at the Geological Survey, kindly offered by Drs Lidia MALINOWSKA and W. BROCHWICZ-LEWIŃSKI, and the inaugural session at the Warsaw University. Then the participants were transferred to Bocheniec (Holy Cross Mountains), where the oral presentations and the working sessions took place on Tuesday 8th. Then, the field trip developed from Wednesday 9th to Friday 11th across the most classical localities of the Holy Cross Mountains and Polish Jura.

The oral presentations

Twelve contributions were presented during the Meeting sessions at Bocheniec, most of them on biostratigraphic problems of the Oxfordian and Kimmeridgian stages. This question of refining the currently established biostratigraphic scales has been (and it still is) the major goal of the specialists during the last years since the beginning of the activities of the working groups. It reflects the main concern of the biostratigraphic work for these last ten years since the first ISJS at Erlangen, 1984, and it also shows the long road ahead we have to go through, until a sound and acceptable proposal for the boundary stratotype can be presented, according to the ICS guidelines.

The refining of the biostratigraphic scales has undergone a remarkable progress in these last years, mainly on the fields of ammonites and dinoflagellates (Poulsen, *in litt.*). Dinoflagellates, and the correlation of their biostratigraphic scales with those of ammonites through the Oxfordian and Kimmeridgian were the main subject of two lectures (Arhus *et al.* ; Poulsen). The palaeogeographic reconstruction in some selected points of the South European platform under carbonate facies was carried out in three main lectures : Tramer, for the Oxfordian of Poland, to show the value of fossil sponges as palaeoenvironment indicators within the frame of the development of the sponge megafacies ; Aurell and Badenas for the Kimmeridgian of the Iberian platform on the basis of computermodelization of facies and thickness distribution, development of reef complexes, etc. Marques et al. presented an interesting analysis of the Middle-Upper Oxfordian platform of the Algarve (S. Portugal) on the basis of sea-level fluctuations and ecostratigraphic changes, as evidenced by changes in ammonite spectra and correlative variations in the distribution of benthic groups.

The rest of the presented communications were devoted to ammonite biostratigraphic problems of the Oxfordian and Kimmeridgian stages. Here again it is worth noting that most of the submitted papers were dealing on ammonite successions in extra-european areas, showing the significant progress achieved on the knowledge of Oxfordian and Kimmeridgian

in recent years. The Kimmeridgian-Tithonian boundary at the Cuencamé area (Mexico) was studied by Oloriz *et al.*, proposing to delineate the boundary coinciding with the first record of the endemic genus *Mazapilites*. Krishna, and Krishna *et al.* presented a synthetic updated view of the Oxfordian ammonite stratigraphy, and a characterization of the Kimmeridgian stage, and the Kimmeridgian-Tithonian boundary, at the SE Tethys, mainly the region of Kachchh India. Some specially noteworthy aspects concerning the Oxfordian are the recognition of a thick marly sedimentary episode, similar to the Renggeri marls in Western Europe, ranging from Upper Callovian to Lower Oxfordian, and the identification of some important biogeographic links with the Western Tethys areas, such as *Campylites*, *Peltoceratoides*, *Dichotomosphinctes*, *Gregoryceras*, *Kranaosphinctes*, *Subdiscosphinctes*. A similar progress has been achieved on what concerns the Kimmeridgian-Tithonian boundary. The results of the faunal analysis in this case reinforce the idea of the unique Indo-East-African biogeographical Province during the Upper Jurassic.

The ammonite successions across the Oxfordian-Kimmeridgian boundary in North Africa (Tellian basin, Algeria) and their relation with tectonically-induced palaeogeographic changes were studied by Atrops and Benest, showing a detailed succession of ammonite assemblages through the Planula Subzone, and evidencing a change in the sequencial polarity at the base of the Lower Kimmeridgian, Platynota Zone. Finally, the Oxfordian-Kimmeridgian ammonite successions in Europe were discussed in three contributions : Vidier *et al.*, who presented an extremely detailed succession at the Boulonnais, Normandy, ranging from Upper Athleta to Upper Mariae Zone and identifying some important biogeographic links among Oppeliids and Peltoceratids with southern areas, besides Cardioceratids. On the other hand, Atrops *et al.* presented a detailed revision of the Middle Oxfordian to lowermost Kimmeridgian *Amoeboceras* successions in the Submediterranean areas, from SE France, Switzerland and Central Poland, and their correlation with the classical Submediterranean Perisphinctids successions. Fontana and Meléndez presented a detailed correlation of the Middle Oxfordian, Transversarium and Bifurcatus Zone sediments, in numerous sections across the Iberian Chain (E Spain), showing the validity of the Perisphinctids subzones and horizons proposed in the recent years.

The field trip through the Jurassic of SW Poland

The Callovian-Oxfordian boundary and the associated gaps, and biostratigraphical problems at the Lower Oxfordian were shown at Gniezdziska quarry ; Wysoka and Wrzosowa quarries. The Middle Oxfordian biostratigraphy, ammonite successions and biohermal complexes associated were seen at Olsztyn, Zborow Hill, Wysoka quarry, Niegowonice, Kromolowiec, Syborowa Hill. The Middle Oxfordian ammonite successions, from Plicatilis (Antecedens Subzone) to Upper Bifurcatus Zone were revisited at the famous quarries of Zawodzie, Czestochowa. The Late Oxfordian to Lower and Late Kimmeridgian successions were observed at the localities of Malogoszcz, Julianka, Bydlin quarry, Latosowka quarry and Raciszyn. Many of these localities are classical names in the european Upper Jurassic literature and have provided many stratigraphical and paleontological names to the Oxfordian and Kimmeridgian Biostratigraphy. All participants are grateful to our polish colleagues, for offering this opportunity to get closer to the Jurassic of this country. All details of the organization only meant to increase the pleasant souvenir of the nice field trip.

The working sessions

Introduction

The programmed working sessions of the Oxfordian and the Kimmeridgian working groups were held on Tuesday 8th afternoon, after the oral presentations. Discussions focused

Alternative choices and forthcoming work

As far as other ammonite groups are concerned this would mean the close correlation of boreal Cardioceratids and submediterranean Perisphinctids scales. Perisphinctids appear as the most suitable group for the Tethyan Realm. Their proved suitablility for fine biostratigraphic subdivisions at the Middle Oxfordian (Cariou & Meléndez, 1990 ; Cariou *et al.*, 1991) has been recently enhanced by the description made by Page (1991) of the Callovian-Oxfordian transitional forms of Perisphinctids from the Oxford Clay. This includes the identification of the *Alligaticeras* (*Alligaticeras*) (M & m])and *Alligaticeras* (*Properisphinctes*) (M & m) as a continuous evolving lineage through the Callovian-Oxfordian boundary, across the Lamberti and Cordatum Zones.

Other groups of macrofossils sufficiently resolutive lacking a good alternative choice will be provided by the microfossils and specially the Dinoflagellates. In a recent report by Poulsen (in press) the Lamberti-Mariae boundary is shown to coincide with the last appearance of *Parvocysta prolongata* and the first appearance of *Wanaea frimbriata*, according to the zonation proposed by Riley & Fenton (1982), and Woollam & Riding (1983). The use of other microfossil groups for this biostratigraphic interval is still to be shown but it would be a desirable requirement for the future stratotype candidate to be also suitable for detailed sampling and further studies. As far as magnetostratigraphic studies are concerned, the selected section should be proved successful for palaeomagnetic reversal evaluations at this stratigraphic interval, providing an independant test of the geological events. Some advanced studies in that field have already been fulfilled, mostly on the Middle Oxfordian calcareous facies and a first sampling has been started as well on the Lower Oxfordian in clay facies, although in that case they are still waiting for results.

On the other hand, the currently known areas in the true Mediterranean Province, represented in condensed successions under "Ammonitico Rosso" facies appear specially inadequate for trying to select a stratotype candidate, so it seems that our search should be rather directed to those areas in the Submediterranean Province where the Callovian-Oxfordian transition is represented in argillaceous facies (see above), at the overlapping areas with the Subboreal Province, where parallel successions of Cardioceratids and Perisphinctids can be recognized and correlated (see Enay, 1980, for a description of this "overlapping" area).

The main programmed activities of the Oxfordian Working Group in these next two years, 1993-94, as regards the celebration of the IVth ISJS Congress to be held in Argentina, in September 1994, will include, therefore, the detailed revision of some selected sections in SE France, near Laragne (Hautes-Alpes). Also, we should be open to the reception of further boundary stratotype proposals from other areas in southern England, to serve as alternative candidates in the future discussions. Our intention would be to visit and revise the selected british sections with the occasion of the next Arkell Symposium, to be held in England, in September 1993. This Meeting could also represent a good moment to celebrate a small, informal working session of the Oxfordian Group. The final goal would be to present, at the Jurassic Symposium of Argentina, a set of possible section as alternative candidates for the Callovian-Oxfordian boundary stratotype, for discussion and eventual decision between the members. An intense work ahead and long discussions are still waiting for us.

Problematics of the Oxfordian-Kimmeridgian Boundary

Difficulties in defining a boundary stratotype for the Oxfordian-Kimmeridgian boundary have been hard to solve and have delayed an eventual agreement on both the most adequate ammonite scale to adopt and the most suitable area to propose the choosing of a stratotype section across the Boreal and Tethyan Realms. These questions are mainly connected with the problems derived from the strong provincialism observed at the turn of

the Oxfordian and Kimmeridgian stages. As far as this is concerned provincialism has impeded the detailed correlation not only between the Boreal and Tethyan Realms but also between biogeographic provinces and subprovinces within realms : a true Mediterranean and a Submediterranean Province can be recognized within the extension of the Western Tethys area, whereas a Subboreal and a true Boreal Province are classically defined in the Boreal Realm. The Boreal and Tethyan Realms are clearly separated by an intermediate area characterized by a well-differenciated ammonite fauna, intermediate between the Subboreal and Submediterranean Provinces, in Aquitaine ("Franco-German Biome", Hantzpergue, 1989). Within each geographic subdivision the local abundance of some particular ammonite groups and sometimes the scarcity of common elements with other provinces have led to the setting of separate biostratigraphic scales in separate areas, based on different ammonite successions. Difficulties in the detailed biostratigraphic correlation between provinces generally arise from the lack of the key species outside their typical province.

The current state of progress

The modern biostratigraphic scale for the Boreal Realm has been firmly established by means of Cardioceratids (Sykes & Callomon, 1979 ; Birkelund & Callomon, 1985), as the *Amoeboceras* zonation. In sharp contrast, biostratigraphic scales in the Tethyan Realm have been classically established by means of representatives of families Perisphinctidae, Ataxioceratidae as well as Oppeliids and Aspidoceratids, which appear widespread and dominant in the true Mediterranean Province (Oloriz, 1978). On the other hand, a remarkable progress has been achieved in the last years by the convenor of the Group (Atrops, 1982, Atrops & Benest 1981, 1982, 1984, 1986 ; Atrops & Marques, 1986, Atrops & Meléndez 1985), in trying to set a detailed correlation between the Mediterranean and Submediterranean Provinces by means of representatives of Ataxioceratidae and Aspidoceratinae (*Sutneria*). Finally, ammonite successions through the Oxfordian-Kimmeridgian boundary have been firmly established by Hantzpergue (1988,1989) in the Aquitaine region by means of representatives of the family Ataxioceratidae.

The position of the Oxfordian-Kimmeridgian Boundary

The question of the precise position of the Oxfordian-Kimmeridgian boundary has raised difficult problems and long discussions in the last ten years, since the Erlangen meeting (1984). According to its historical definition, the base of the Kimmeridgian stage is located at the base of the Baylei Zone, which starts at the base of the Kimmeridge Clay, in Dorset S. England, where a fine assemblage of *Pictonia* spp. has been classically recognized. The main problems arise in characterizing this boundary elsewhere in Europe, where this basal assemblage of Pictonia appears to be largely absent. Throughout the Tethyan Realm, the basal boundary of the Kimmeridgian is placed at the base of the Platynota Zone. This has made traditionally difficult to correlate the different biostratigraphic scales currently used in separate provinces, the supposed synchronism between the base of Baylei and Platynota Zones, generally assumed by many authors, being not really supported by sound palaeontological evidence.

The *Pictonia baylei* assemblage being difficult to identify outside the type area, a solution to this problem seems to be in the sudy of Cardioceratids. A first discussion of the problem of correlation between the Boreal-Subboreal Cardioceratids succession and the Submediterranean and NW European scales was made by Sykes & Callomon (1979, p. 894). These authors suggested the possibility that the lower boundary of the Lowermost Kimmeridgian, Baylei Zone should not be delineated at the base of Platynota Zone but rather somewhere within the Planula Zone, which should therefore be included ("most if not all") into the Lower Kimmeridgian. This idea was somewhat in accordance with the opinion

expressed by Arkell (1956, p. 111, table 9) who established a tentative correlation between the Baylei Zone and a joint *Sutneria platynota* and *S. galar* Zone. This idea was subsequently recovered by Atrops (1982 p. 340), for whom, the base of the Baylei Zone would find its equivalent in the Submediterranean Province at the base of the Galar Subzone rather than at the base of Platynota Zone.

The lack of a definitive argument was the still insufficient knowledge of the *Amoeboceras* successions during the Lower Kimmeridgian at that moment, but the idea was further exposed and discussed during the working sessions of the Jurassic Symposium at Erlangen, 1984 (Enay & Meléndez 1985). Further evidence was supplied by Birkelund & Callomon (1985, pp. 16-17) who established a horizon of *Pictonia densicostata* SALFELD at the base of the Baylei Zone, and showed the co-occurrence of this first species of *Pictonia* and the cardioceratid species *Amoeboceras bauhini* OPPEL at the section of South Ferriby. The interest of this correlation received further support by the recorded presence of this species within the Galar Subzone of Southern Germany quoted by these authors, and has been recently enhanced by new findings in the Swiss Jura (Atrops *et al.* this volume).

The Baylei Zone corresponds, therefore, to the vertical range of the genus *Pictonia*, and its lower boundary is marked, in fact, by the first record of representatives of this genus. A closer correlation between Boreal and Submediterranean scales has recently been reached by means of the species *Amoeboceras baylei*. which forms a well-defined horizon at the upper part of Baylei Zone (Birkelund & Callomon, loc. cit. p. 13, fig. 5). New evidence has led to the recognition of this species as well at the base of the Platynota Zone, *Orthosphinctes* Subzone in both SE France (Atrops, 1982, "Horizon à *Amoeboceras*") and Switzerland (Atrops *et al.*, 1992). This makes correlation between both biostratigraphic scales more solid. It confirms the different position of the lower boundary of Platynota Zone and Baylei zone and gives further supports to the alternative choice for placing the Oxfordian-Kimmeridgian boundary, in the Tethyan Realm, at the base of Galar Subzone. A further advantage of placing the boundary at this level would lie on purely lithological grounds, since in wide areas across Southern Europe this boundary is also marked by a sharp lithologic change, from calcareous to marly facies and a change in the sedimentary trend, indicating the beginning of a new sequence (the "Kimmeridgian Sequence", Atrops & Ferry, 1990 ; Aurell, 1990).

Proposals for boundary stratotype and forthcoming work

In selecting a good section for the Lower Kimmeridgian boundary stratotype two main factors are to be taken into account. On one hand, Cardioceratids, rather than any other, appear as the most idoneous group, as a well-known continuous evolving lineage across the Oxfordian-Kimmeridgian boundary, to be used as stratigraphic marker. Most specially since they have supplied a well-established succession of species, so that the basal, Densicostata Horizon of the Baylei Zone can be identified, besides the presence of *Pictonia densicostata* (SALFELD), by the presence of *Amoeboceras bauhini* (OPPEL). The finding of this *Amoeboceras* species in different regions of the Submediterranean Province makes this choice specially valid for correlation purposes. For this reason those sections showing the most continuous Cardioceratid successions would appear as the most suitable candidates for the boundary stratotype. Besides the type locality of the Kimmeridgian at Kimmeridge, Dorset, some classical localities, such as Staffin Bay at the Isle of Skye have been known for long time. Similarly, the section of South Ferriby in Yorkshire, as referred by Birkelund & Callomon (1985, p. 17) as "one of the thickest, most complete, and fossiliferous successions through the Oxfordian-Kimmeridgian boundary in NW Europe" might be an alternative good candidate deserving, perhaps, a more detailed description.

A second factor to take into consideration would be the good possibilities a candidate section should show for correlation between the biostratigraphic scales of Boreal and Tethyan Realms. As far as this is concerned, a further good candidate for boundary strato-

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7. OTHER SUBCOMMISSIONS INFORMATIONS

7.1. SUBCOMMISSION ON STRATIGRAPHIC CLASSIFICATION

R. ENAY

The past chairman was Amos SALVADOR and the ISJS was represented by our colleague A.C. RICCARDI. The new chairman is M.A. MURPHY and A.C. RICCARDI was elected Vice-Chairman.

The Subcommission is very active and delivers a lot of circulars : not less than six (n° 81 to 86) since january 1992, and also mostly very thick, which preclude wide delivering.

Under the guidance of chairman Amos SALVADOR, the main activity was the revision of the International Stratigraphic Guide, which began as soon as the first edition was published in 1976. During these 16 years the ISSC distributed thirty two circulars and published three notes, one on "Stratigraphic Classification and Nomenclature of igneous and metamorphic rocks bodies" (1987), two concerning new chapters of the revised Guide (see below). Some of us were informed by A.C. RICCARDI.

The edited draft of the revised Guide was attached to the Circular n° 85 of August 19, 1992. This second edition is divided into 10 chapters, two more than the first edition and new on "Uncomformity Bounded Units" (chap. 6) and "Magneto-stratigraphic Polarity Units" (chap. 8). The eight others have been revised more or less, the most drastic revision being required for chap. 7 on Biostratigraphic Units and chap. 9 on Chronostratigraphic Units.

It is quite not possible either to comment here on the revised Guide, or to list comments sent during revision procedure by our colleagues J. REMANE, G.F.W. HERNGREEN, G.E.G. WESTERMANN, A.C. RICCARDI. You will find here enclosed copy of the whole new chapter 7 on Biostratigraphic units and two comments, the first by M.A. MURPHY, the second by Amos SALVADOR from the ISSC circular.

"The revised **Guide**, like the original, is a compromise perhaps not completely satisfactory to anyone. We should, therefore, place a high priority on resolving the differences between the regional guides and codes and the International Stratigraphic Guide. To this end I ask those members who have other codes or guides, to evaluate the differences and see if it is possible to conform them to the **International Stratigraphic Guide**. If not, the disagreements should be discussed within the Subcommission with the goal of making the adjustments required to assure accurate and precise communication. In this regard, although the **International Stratigraphic Guide** represents an international consensus, we should not regard it as a sacrosanct document, but progress toward a goal".

"We know that it is obviously impossible to come up with a version of the **Guide** that pleases all stratigraphers all over the world, with their very varied backgrounds and experiences. The revision of the chapter on biostratigraphic units best illustrates the impossibility of pleasing every body - it was the first chapter to be worked on and the last to be completed. It was clear during the revision of this chapter that opinions of biostratigraphers vary radically depending of their fields of interest, and the kind of fossils they work with - Paleozoic vs. Mesozoic v. Cenozoic, planktonic vs. benthonic, marine vs. non marine, microfossils vs. macrofossils etc."

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REVISED GUIDE

Chapter 7
Biostratigraphic Units

A. NATURE OF BIOSTRATIGRAPHIC UNITS

Biostratigraphic units (biozones) are bodies of rock strata that are defined or characterized on the basis of their contained fossils.

Biostratigraphic units exist only where the particular diagnostic biostratigraphic feature or attribute on which they are based has been identified. Biostratigraphic units are, therefore, objective units based on the identification of fossil taxa. Their correlation depends on the identification of either their defining or characterizing attributes. Biostratigraphic units may be enlarged to include more of the stratigraphic record, both vertically and geographically, when additional data are obtained. In addition, since they depend on taxonomic practice, changes in their taxonomic base may enlarge or reduce the body of rock included in a particular biostratigraphic unit. Biostratigraphic units, therefore, are as objective as the current status of interpretation of the taxa on which they are based allows, and they are geographically as extensive as their particular diagnostic taxa.

A biostratigraphic unit may be based on a single taxon, on combinations of taxa, on relative abundances, on specified morphological features, or on variations in any of the many other features related to the content and distribution of fossils in strata. The same interval of strata may be zoned differently depending on the diagnostic criteria or fossil group chosen. There are thus several kinds of biostratigraphic units.

Because of this diversity of possible biostratigraphic units, gaps or overlaps frequently occur both vertically and laterally between the different kinds of biozones, between biozones based on different fossil groups, or even between biozones of the same kind or based on the same fossil group.

Biostratigraphic units are distinct from other kinds of stratigraphic units in that the organisms whose fossil remains define them show evolutionary changes in character through geologic time that are not repeated in the stratigraphic record. Fossil assemblages representing organisms whose occurrence and distribution where closely controlled by the environment in which they lived may recur with little overall change in stratigraphic sequences representing short intervals of time with the recurrence of the controlling environment. However, over any considerable period of geologic time, evolutionary changes have made the assemblages of any one age distinctive from any other.

The relationship of biostratigraphic units to other kinds of stratigraphic units is discussed in Chapter 10.

B. THE FOSSILS

1. Value of fossils. Because of their morphological uniqueness and local abundance, fossils are often important simply as distinctive lithologic features of rock strata. As the remains of once living forms, they are, moreover, sensitive indicators of past environments of deposition and essential in the interpretation of paleoecology, paleobathymetry, paleobio-

geography, and paleooceanography. Finally, because of the irreversibility of organic evolution, fossils are particularly valuable in time-correlation of strata and in placing strata in their proper relative chronologic position.

2. Fossil Assemblages. Fossils usually constitute only a minor disseminated, fractional part of a rock stratum. Even within fossiliferous sequences, fossils are rarely found in every bed or formation, nor are they found everywhere along a bed or formation. There are barren spaces or intervals in all stratigraphic sequences. The fossils found in sedimentary strata are either remains of organisms that lived in an area and were covered by its deposits (bioceonosis) ; or remains of organisms that were brought to an area by different means only after death (thanatocoenosis) ; or remains of organisms transported alive away from their normal environment. They are commonly a mixture of the three categories. All three categories of fossils may be the basis for biostratigraphic zonation.

3. Reworked Fossils. Fossils from rocks of one age may have been eroded, transported and redeposited in sediments of younger age. The reworked fossils may thus be mingled with indigenous fossils, or they may constitute the only fossils present in the younger sediment. In some cases, the reworked fossils can be distinguished readily from the indigenous ones, but in other cases they cannot. This last is particularly true in the case of micro- or nannofossils, where a fossil specimen may behave like a single grain of sediment and pass through one or more cycles of sedimentation with little evidence of wear. All fossil remains, whether indigenous or reworked, may constitute distinctive features of a sediment and may serve as the basis for biostratigraphic zonation ; however, because of the difference in their significance with respect to age and environment, fossils that can be identified as reworked should be treated apart from those believed to be indigenous.

4. Introduced or Infiltrated Fossils. Under some circumstances, rocks may contain fossils younger than the enclosing material. Sometimes this is due to infiltration of fluids carrying micro- or nannofossils from one formation into the pore spaces or fractures of an underlying formation, or it may be that younger sediments fill caves or cavities in older rocks. It also happens that animal burrows or root cavities extending down into one formation may be filled with fossiliferous material from an overlying formation. Likewise, sedimentary dikes or diapirs may contaminate a formation with either younger or older fossil material. Such introduced fossils should be distinguished from indigenous fossils in biostratigraphic zonation.

5. Effects of Stratigraphic Condensation. Extremely low rates of sedimentation may result in fossil representatives of different ages and different environments being mingled or very intimately associated in a very thin stratigraphic interval, even in a single bed.

C. DEFINITIONS

1. Biostratigraphy. The element of stratigraphy that deals with the distribution of fossils in the stratigraphic record, and the organization of strata into units on the basis of their contained fossils.

2. Biostratigraphic classification. The systematic subdivision and organization of the stratigraphic section into named units based on their fossil content. Those parts of the rock record without fossils, have no biostratigraphic character and are not amenable, therefore, to biostratigraphic classification.

3. Biostratigraphic Zone (Biozone). A general term for any kind of biostratigraphic unit. *Biozone* is a short alternative term for biostratigraphic zone. "Bio" should be used

in front of the term "zone" to distinguish biostratigraphic zones from other kinds of zones whenever there is any danger of confusion (see Section 3.A.8). However, the term "zone" may be freely used instead of "biozone" after an explicit statement to that effect has been made, or when the meaning of the term is clear from the context of the topic under discussion. A similar convention may be followed in the use of the terms indicating the kind of biozone being discussed : after the kind of biozone is made clear (taxon-range biozone, assemblage biozone, etc.) the complete name need not be repeated every time that the biozone is mentioned. The *Globigerina brevis* Taxon-range Biozone, for example, can be referred to simply as the *Globigerina brevis* Zone.

Biozones vary greatly in thickness and geographic extent. They may range from a local single thin bed to a unit thousands of meters thick and extending over a widespread geographic area. The time they represent may likewise vary widely.

4. Biohorizon. A stratigraphic boundary,surface, or interface across which there is a significant and distinctive change in biostratigraphic character. It may correspond to a boundary surface between biozones or be recognized within a biozone. The features on which biohorizons are commonly based in a given stratigraphic section include lowest occurrences, highest occurrences, distinctive occurrences, changes in frequency and abundance, or changes in the character of individual taxa (e.g., changes in the direction of coiling in foraminifers, or in number of septa in corals).

The term "biohorizon" has also been applied to a thin bed or interval characterized by a particularly distinctive fossil assemblage. However, the term should be applied to surfaces or interfaces, not to beds or stratigraphic intervals, no matter how thin or distinctive.

Biohorizons have been called surfaces, horizons, levels, limits, boundaries, bands, markers, indexes, datums, datum planes, datum levels and key horizons. "First appearance datums", or FADs, and "last appearance datums", or LADs, are kinds of biohorizons in common use.

5. Subbiozone (Subzone). A subdivision of any kind of biozone established when necessary or useful to express finer biostratigraphic detail.

6. Superbiozone (Superzone). A grouping of several biozones with common biostratigraphic features.

7. Zonule. Even though the term "zonule" has been used with different meanings (see Glossary of Stratigraphic Terms), it is now generally used as a subdivision of a biozone or of a subbiozone. The use of the term should be discouraged.

8. Barren intervals. Stratigraphic intervals lacking fossils are common in the stratigraphic section, both between successive biozones and within a biozone. These intervals are not, therefore, subject to biostratigraphic classification, but may be referred to informally as *barren intervals* and identified with reference to adjacent or enclosing biozones, for example, the *Exus parvus* to *Exus magnus* barren interval, or the barren interval near the top of the *Exus albus* Assemblage Zone. In normal practice these designations may indicate that the intervals are barren of the specific fossil group that the particular biostratigrapher is studying, such as vertebrates, foraminifers, conodonts, ammonites, etc., and not that it does not contain any kind of fossils.

D. KINDS OF BIOSTRATIGRAPHIC UNITS

1. General. Strata may be zoned biostratigraphically in many different ways. For this reason, there are different kinds of biozones, each having a different significance and each

ii. Boundaries. The boundaries of a taxon-range zone are surfaces (biohorizons) marking the outermost limits of known occurrence in each and every local section of specimens of the taxon whose range is to be represented by the zone. The boundaries of a taxon-range zone in any one section are the horizons of lowest stratigraphic occurrence and highest stratigraphic occurrence of the specified taxon in that section. Thus, the *Linoproductus cora* Taxon-range Zone is the total body of strata enclosed within the outer limits of the established occurrence of specimens of *Linoproductus cora*, and the *Globotruncana* Taxon-range Zone is the total body of strata enclosed within the outer limits of the established occurrence of specimens of any species whatsoever of *Globotruncana*.

iii. Name. The taxon-range zone is named from the taxon whose range it expresses, for example, *Didymograptus* Taxon-range Zone, or *Globigerina brevis* Taxon-range Zone.

iv. Local Range of a Taxon. The terms *teilzone*, *local-range zone*, and *topozone* have been used to indicate the range of a taxon in some particular area or locality as contrasted with its total range. However, the range in a local area is not meaningful unless the name of that area is given. The Guide, therefore, suggests that instead of using these terms, reference to the local range of a taxon be made as "the range zone of taxon A at section X", or "at well Y", or "in the Mediterranean region", without any additional modifying zonal term.

b. Concurrent-Range Zone. See Figure 6.

i. Definition. A *concurrent-range zone* is the body of strata including the concurrent, coincident or overlapping parts of the range zones of *two* specified taxa selected from among the total forms contained in a sequence of strata. Other taxa may be included as characterizing members of the zone, or beginning or terminating in the zone, but only two can be used for defining the boundaries. By their nature, biostratigraphic classifications employing successive concurrent-range zones have gaps that are not biostratigraphically zoned or overlaps where the same strata are included in more than one zone.

ii. Boundaries. The boundaries of a concurrent-range zone are defined in any particular stratigraphic section by the lowest stratigraphic occurrence of the higher-ranging of the two defining taxa and the highest stratigraphic occurrence of the lower-ranging of the two defining taxa.

STRATIGRAPHIC SECTIONS

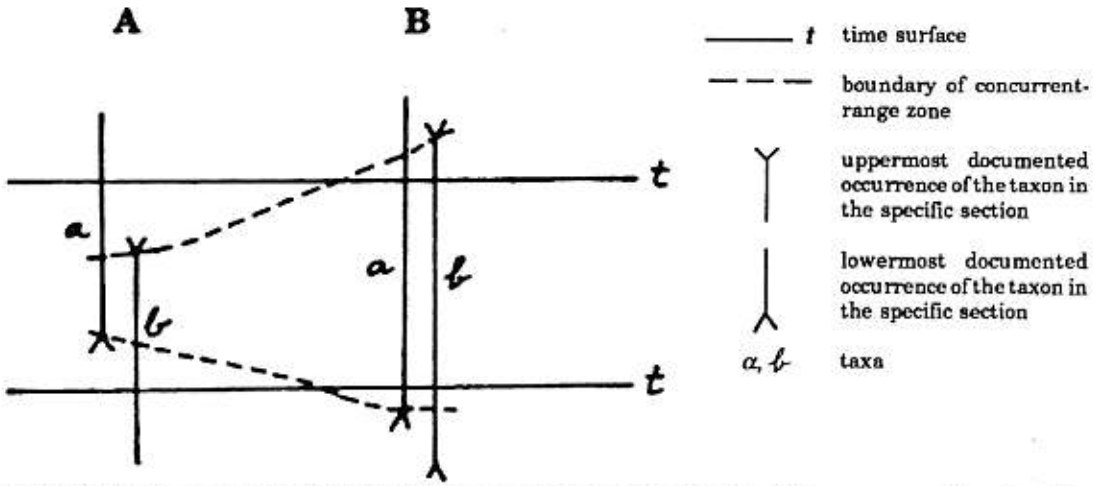

Figure 6. Concurrent-range Zone. The lower, upper, and lateral limits of this zone are determined by the range of concurrent occurrence of taxa a and b.

iii. Name. A concurrent-range zone is named from both of the taxa which characterize the biozone by their concurrence, for example, *Globigerina sellii-Pseudohastigerina barbadoensis* Concurrent-range Zone.

The term "concurrent-range zone" is expressive of the meaning of the zone, although difficult to translate from English into some other languages. Concurrent-range zones have been referred to as *overlap zones or range-overlap zones.*

3. Interval Zone. See Figure 7

a. Definition. An *interval zone* is a body of *fossiliferous* strata between two specified biostratigraphic horizons (biohorizons). Such a zone is not itself necessarily the range zone of a taxon or concurrence of taxa ; it is defined and identified only on the basis of its bounding biohorizons. Barren intervals between two distinctive biohorizons *are not* interval zones.

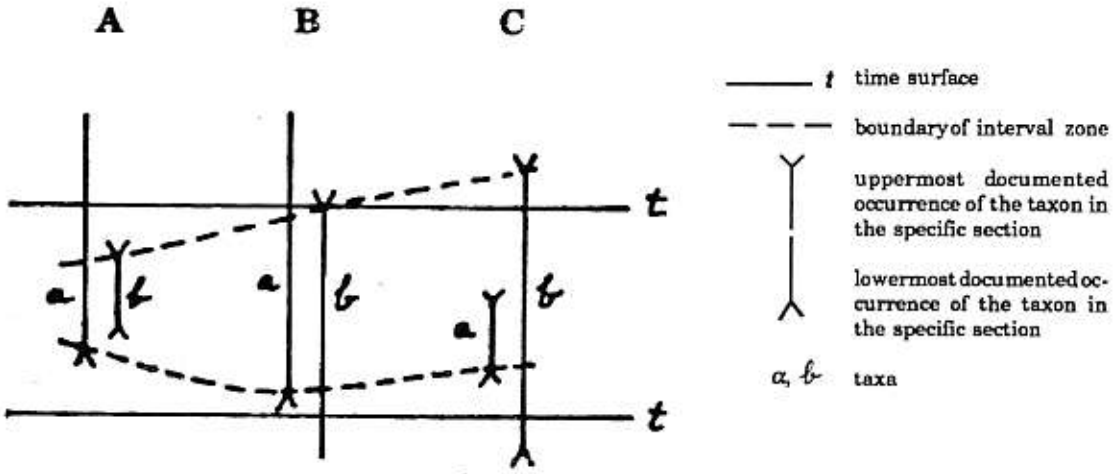

Figure 7. Interval Zone. In this example, the lower limit of the zone is the lowermost known occurrence of taxon a and the upper limit is the highest known occurrence of taxon b. The zone extends laterally as far as both the defining biohorizons can be recognized.

The base or the top of an interval zone might be marked by

- the horizon of the lowermost documented occurrence of a specified taxon in any particular section.
- the horizon of the uppermost documented occurrence of a specified taxon in any particular section.
- any other distinctive biostratigraphic feature (biohorizon).

In subsurface stratigraphic work, where the section is penetrated from top to bottom and paleontological identification is generally made from drill cuttings, often contaminated by recirculation of previously drilled sediments and material sloughed from the walls of the drill hole, interval zones defined as the stratigraphic section comprised between the highest known occurrence (first occurrence downward) of two specified taxa, are particularly useful (Figure 8). This type of interval zone has been called *"last-occurrence zone"* but should preferably be called *"highest-occurrence zone"*.

STRATIGRAPHIC SECTIONS

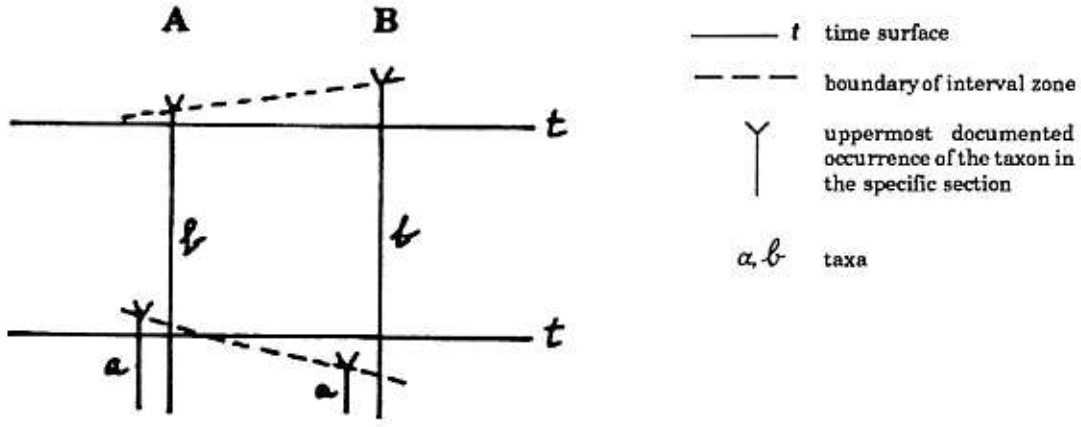

Figure 8. Interval Zone (Highest-occurrence Zone). This kind of interval zone is particularly useful in subsurface work.

Interval zones defined as the stratigraphic section comprised between the lowest known occurrence of two specified taxa (*lowest-occurrence zone*) are also an extremely useful type of biozones.

Interval zones established to partition the range of a taxon on the basis of the occurrence of two other taxa whose ranges do not overlap, the part of the range of the taxon above the uppermost documented occurrence of one taxon, and below the lowermost documented occurrence of the other taxon, have been called *partial-range zones* (Geological Society of London, Report of the Stratigraphical Code Sub-Committee, 1967, p. 85). An example is the *Globigerina ciperoensis* Partial-range Zone which, by definition, is the interval zone between the uppermost occurrence of *Paragloborotalia opima opima* and the lowermost occurrence of *Globorotalia kugleri*, and occupies only a part of the range of *Globigerina ciperoensis*.

b. Boundaries. The boundaries of an interval zone are defined by the occurrence of the biohorizons selected for its definition.

c. Name. The names given to interval zones may be derived from the names of the boundary horizons, the name of the basal boundary preceding that of the upper boundary,for example, *Globigerinoides sicanus–Orbulina suturalis* Interval Zone. A name of this type, however, does not tell whether the named taxa appear or disappear at the zone boundaries, or if some other criterion is involved (e.g., abundance, dwarfing or gigantism, coiling direction).

Alternatively, the name of a single taxon well represented in an interval zone, *though not necessarily confined to it*, may be used to name the zone, even though the boundaries of the zone may have been selected on the basis of the occurrence of other taxa.

4. Lineage Zone. See Figures 9 and 10

Lineage zones were treated in the first edition of the *International Stratigraphic Guide* (1976) as a type of range zones. It has also been argued that they should better be considered as a type of interval zone, or even that lineage zones are more chronostratigraphic than biostratigraphic in character and should, therefore, be considered as a type of chronozone.

In some respects, lineage zones are different from other kinds of biostratigraphic units that are based on the proper location of fossil taxa in the stratigraphic section, and their objective identification. Interval zones, in contrast, require for their definition the assurance that the taxa chosen for their characterization represent successive elements in a segment of an evolutionary lineage. This, in many cases, involves a considerable amount of interpretation.

For this reason, lineage zones are discussed as a separate category of biostratigraphic units in this revised edition of the *Guide*.

a. Definition. A *lineage zone* is a body of strata containing specimens representing a specific segment of an evolution lineage.

Whenever the lowest appearance of successive elements in an evolutionary lineage over the area of their distribution can be considered as essentially synchronous, lineage zones have strong chronostratigraphic connotation and approach closely chronostratigraphic units. A lineage zone, however, differs from a chronozone in being restricted to the actual spacial distribution of the segment of the evolutionary lineage upon which it is based, and not to all rock bodies anywhere formed during the time span of the segment.

STRATIGRAPHIC SECTIONS

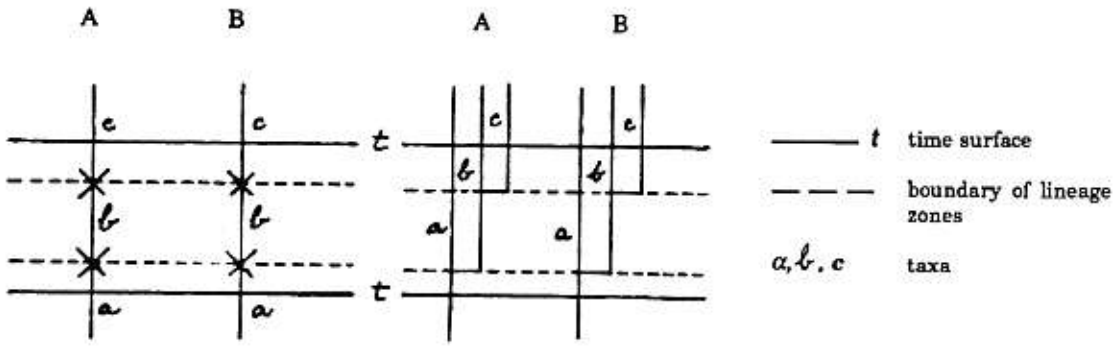

Figure 9. Examples of lineage zones.

In theory, a system of overlapping zones based on several lineages offers good assurance of reliable time correlation on a biostratigraphic basis. In practrice, the assurance may be lessened by uncertainty about evolutionary courses and by the subjectivity of taxonomic identification.

b. Boundaries. The boundaries of a lineage zone are determined by the biohorizons representing the lowest occurrence of successive elements in the evolutionary lineage under consideration.

c. Name. A lineage zone is named for the taxon in the lineage whose range it represents. For example, the *Globorotalia fohsi fohsi* Lineage Zone. This type of biozone has also been called an *evolutionary zone*, a *morphogenic zone*, or a *phylogenetic zone*.

The term "*phylozone*", though having etymological affinity, has been applied to a kind of stratigraphic unit different from a lineage zone. As originally defined by van Hinte (1969, p. 271) a phylozone is the "belt of rock formed during a biochron". Since a biochron is a unit of geologic time, the total span of time of existence of a taxon, the phylozone, as defined by van Hinte, represents all the rocks formed anywhere during such a time span, whether or not the taxon is actually present. It is, therefore, a chronostratigraphic unit, not a biostratigraphic unit.

STRATIGRAPHIC SECTIONS

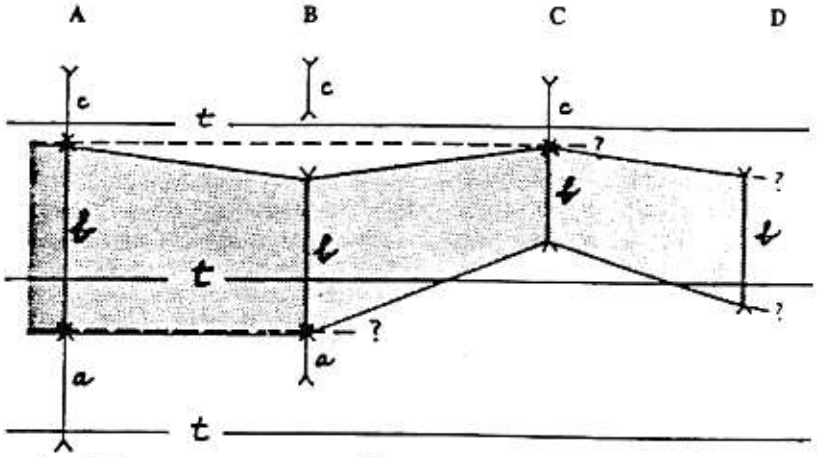

Figure 10. Comparison between range zone and lineage zone of taxon b. In section A, the lineage zone of taxon b is present because both ancestral and descendent taxa (a and c respectively) are present in sequence with b and without any gap in occurrence for the employed sampling program. Section B exhibits the base and lower part of the lineage zone of taxon b, because only the ancestral taxon is present in sequence and without gap. Section C exhibits only the top and upper part of the lineage zone of taxon b, because only the descendent taxon is present in sequence and without gap. Only the range-zone of taxon b is present in section D, because neither ancestral nor descendent taxa are present.

5. Assemblage Zone. See Figure 11

a. Definition. An *assemblage zone* is a body of strata characterized by a distinctive assemblage or association of three or more fossil taxa that, taken together, distinguishes it in biostratigraphic character from adjacent strata.

STRATIGRAPHIC SECTIONS

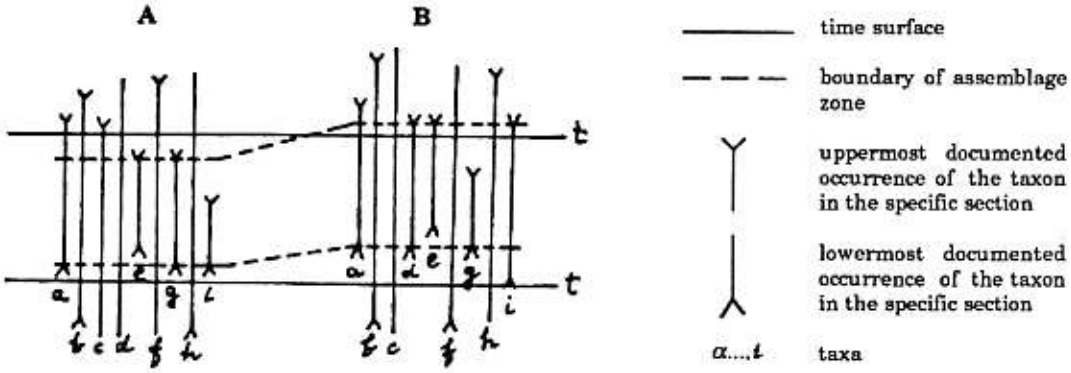

Figure 11. Assemblage zone. In this example, the assemblage diagnostic of the zone includes nine taxa with diverse stratigraphic ranges. For this assemblage zone to be useful, it may be necessary to provide some explicit definition of its boundaries, for example, the lower boundary can be said to be placed at the lowermost occurrence of taxa a and g, and the upper boundary at the highest occurrence of taxon e. Most of the taxa of the assemblage characteristic of the zone should, however, be present.

An assemblage zone may be based on all kinds of fossils present, or it may be restricted to only certain specified kinds. Thus we may have an assemblage zone based only on fossil *fauna* or one based only on fossil *flora* ; an assemblage zone of corals, or of foraminifers, or of mollusks ; an assemblage zone of planktonic forms or an assemblage zone of benthonic forms ; and so on.

Assemblage zones are usually linked to local areas or regions, as they are closely associated with life environments that vary greatly geographycally. However, marine planktonic fossil assemblages may approach worldwide extent within restricted latitude ranges and under conditions where variation in temperature is low. Assemblage zones, therefore, may be particularly significant as indicators of environment. They also may be indicators of geologic age.

(The Oppel zone, named after the German biostratigrapher Albert Oppel, has previously been considered as a type of assemblage zone or as a multi-taxon concurrent-range zone. However, neither Oppel nor subsequent biostratigraphers have precisely defined the biozones used by Oppel, which in any case, do not appear to correspond consistently to any one kind of biozone. For this reason, the Oppel zone has not been included as a distinct kind of biozone in this revised edition of the *International Stratigraphic Guide*).

b. Boundaries. The boundaries of an assemblage zone are drawn at surfaces (biohorizons) marking the limits of occurrence of the assemblage characteristic of the unit. Not all members of the assemblage selected for its characterization need occur in order for a section of strata to be assigned to an assemblage zone and the total range of any of its constituents may extend beyond the boundaries of the assemblage zone. Identification of the zone and its boundaries is thus a matter of interpretation and judgement. Whenever an assemblage zone is established, the fossil assemblage that characterizes it, and the basis for defining its boundaries should be explicitly given. However, in cases when an assemblage zone is defined on the basis of many fossil taxa with diverse stratigraphic ranges, the definition of its boundaries is difficult (Figure 11).

c. Name. The name of an assemblage zone should be derived from the name of one, or preferably no more than two, of the prominent and diagnostic constituents of the fossil assemblage, for example, *Eponides* Assemblage Zone.

The term "*cenozone*", from the Greek *koinos*, meaning common, has been suggested as a substitute for "assemblage zone" (Moore, 1957). Although this term has the advantage of being derived from a classical language and lends itself better to translation to other languages, it does not satisfactorily express the significance of an assemblage zone and for this reason the English language term seems preferable.

6. Abundance Zone. See Figure 12

a. Definition. An *abundance zone* is a stratum or body of strata in which the abundance of a particular taxon or specified group of taxa is significantly greater than is usual in the adjacent parts of the section, regardless of either association or range.

Unusual abundance of a taxon or group of taxa in the stratigraphic record may be the result of a number of processes, many of them influenced by local environmental, ecological, or post-depositional conditions, and may, therefore, vary in stratigraphic position between geographically separated sections or occur at several levels anywhere within the stratigraphic range of the taxon or group of taxa under consideration (Fig. 12). The only sure way to identify a particular abundance zone is to trace it laterally. More than content of taxa alone must be used, or an unwarranted assumption of continuity may mistakenly be made. Abundance zones, therefore, are generally of local utility only.

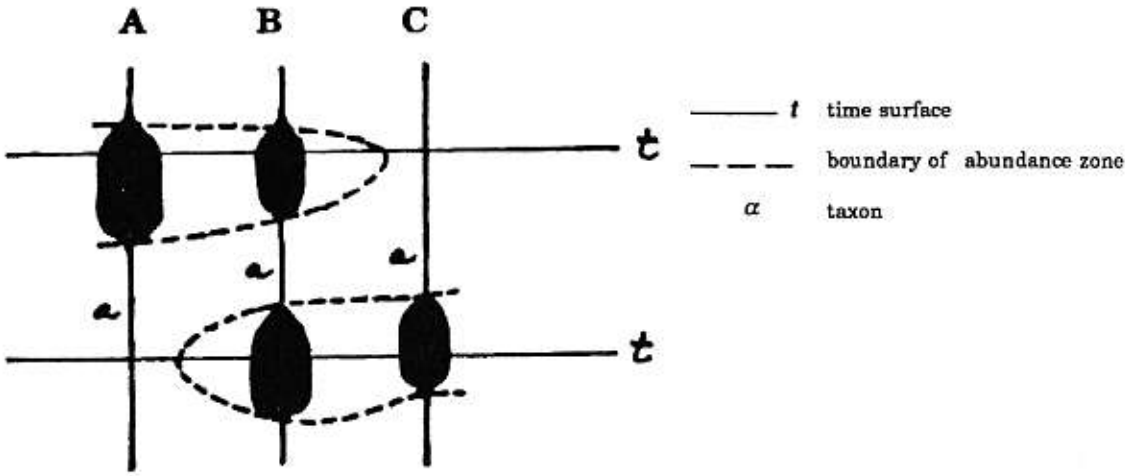

Figure 12. Abundance zones.

b. Boundaries. The boundaries of an abundance zone are defined by the biohorizons of notable change in abundance of the taxon or group of taxa chosen to characterize the zone.

c. Name. The abundance zone takes its name from the taxon or taxa whose significantly greater abundance it represents.

The abundance zone has been called *acme zone* (first edition of the *International Stratigraphic Guide), peak zone, and flood zone.*

E. HIERARCHIES IN BIOSTRATIGRAPHIC UNITS

The different kinds of biostratigraphic units described above do not represent different ranks of a biostratigraphic hierarchy. Range zones, for example, are not subdivided into assemblage zones or *vice versa*. Some kinds of biozones, however, may be usefully subdivided into subbiozones (subzones), and/or grouped into superbiozones (superzones) (see Sections 7.C.5 and 7.C.6).

With respect to taxon-range zones, there is no need for a hierarchy of biozone terms because the hierarchical system of biological taxonomy extends also to these biostratigraphic units in the sense that the range zone of a species is subsidiary to the range zone of the genus to which it belongs, and so on.

F. PROCEDURES FOR ESTABLISHING BIOSTRATIGRAPHIC UNITS

General procedure for establishing stratigraphic units is discussed in Section 3.B, and the procedure for biostratigraphic units accords closely with that for other stratigraphic units in most respects. Special mention is made again, however, of the need to specify the *kind* of biostratigraphic unit being proposed and the basis used for defining its limits. Figures and descriptions of the taxa diagnostic of a unit should also be provided or references to the literature in which they can be found should be given.

In setting up new biozones or in selecting for use biozones that already have been proposed, practicability in identification and correlation should be considered. Other things

being equal, units based on abundant, widespread, stratigraphically restricted and readily recognized taxa should be preferred. Esoteric zonal criteria lose value because of difficulty of application.

Biostratigraphic units are often based on concepts which cannot readily be tied in advance to a specific interval of the stratigraphic section since the stratigraphic scope of the unit may vary widely with increasing information. The scope and character of a biostratigraphic unit should, therefore, be defined by carefully specifying the kind of zone under discussion, and the diagnostic taxon or taxa on which it is based. However, it is desirable that the definition and description of a biostratigraphic unit and of its boundaries include the designation of one or more specific reference sections that demonstrate the occurrence of the taxon or taxa diagnostic of the unit, and that permit its recognition elsewhere. The designation of one or more reference sections serves as protection against the inadequacies of language, fossil recovery, and the uncertainties of taxonomic identification.

G. PROCEDURES FOR EXTENDING BIOSTRATIGRAPHIC UNITS-BIOSTRATIGRAPHIC CORRELATION

Biostratigraphic units are extended away from the areas where they were defined or from their reference sections by biostratigraphic correlation, which is the establishment of correspondence in biostratigraphic character and position between geographycally separated sections or outcrops based on their fossil content. Biostratigraphic correlation is not necessarily time-correlation. It may approximate time-correlation, or it may be the identification of the same biofacies and potentially diachronous because homotaxy does not always imply synchroneity.

H. NAMING OF BIOSTRATIGRAPHIC UNITS

The formal name of a biostratigraphic unit should be formed from the names of one, or preferably no more than two appropriate fossils combined with the appropriate term for the kind of unit in question.

A disadvantage of names formed from more than two taxa is their often cumbersome length. This difficulty has commonly been circumvented by naming the biozone for a single taxon that occurs in the interval although is not otherwise specially diagnostic of the biozone. The function of the taxon thus selected is name-giving. It may or may not be common, and may or may not be a particularly good-guide among the members of the assemblage. Single-taxon names of this type may be considered formal provided their introduction is duly proposed and is accompanied by an unequivocal designation of the zonal limits.

The same name should *not* be used for different biostratigraphic units of the same kind, even if of different rank.

The printing of fossil names for stratigraphic units should be guided by the rules laid down in the *International Code of Zoological Nomenclature* and in the *International Code of Botanical Nomenclature*. The initial letter of generic names should be capitalized ; the initial letter of the specific epithets should be in lowercase ; taxonomic names of genera and species should be in italics. The initial letter of the unit term (Biozone, Zone, Assemblage Zone) should be capitalized ; for example, Exus albus Assemblage Zone.

The name of the fossil or fossils chosen to designate a biozone should include the genus name plus the specific epithet and also the subspecies name, if there is one. Thus *Exus albus* Assemblage Zone is correct. After the first mention, the genus name may be abbreviated to

its initial letter if there is no danger of confusion with some other genus beginning with the same letter ; for example, *Exus albus* may be shortened to *E. albus*. On the other hand, the use of the specific epithet alone, in lowercase or capitalized, in italics or not (*albus* Assemblage zone, *Albus* Assemblage zone, albus Assemblage zone, or Albus Assemblage zone), is inadvisable because it can lead to confusion in the case of frequently used species names. However, once the complete name has been cited, and if the use of the specific epithet alone does not cause ambiguous communication, it may be used, in italics and lowercase, in the designation of a biozone, for example, *uniformis* Zone.

Codification of biostratigraphic zones by letters or numbers or a combination of both is becoming a common practice. If used consistently and judiciously such code designations can be extremely useful. They are brief and they avoid repetition of the lengthy formal names of zones (an advantage in both written and oral presentations) ; also, letter and/or number sequences automatically indicate the sequence and relative positions of the zones (not true of their formal names) ; and they facilitate liaison between biostratigraphers, geologists and other professionals such as engineers. On the other hand, code designations do not lend themselves readily to insertions, combinations, eliminations or revisions within a zonal sequence once it has been published. Letter/number designations have no intrinsic meaning, and confusion can arise if two or more stratigraphers have applied them in different senses within the same general area. Code designations of biostratigraphic units if used for reasons of brevity should be considered informal nomenclature. They should be explained in each published work in which they are used, or references to the literature in which they are set forth should be given.

I. REVISION OF BIOSTRATIGRAPHIC UNITS

Revision of stratigraphic units in general is discussed in Section 3.B.4, and the basic rules of priority are discussed in Section 3.B.5.b. Priority should be preserved for the sake of stability and ease of communication, but in the case of biostratigraphic units, it must be kept in mind that out of the almost limitless number and variety of overlapping biozones that could be proposed, the first to be described and named is not necessarily the most useful. This means that workers must continually be free to propose new zones or improve previous proposals in both scope and nomenclature. Among critical considerations affecting the adoption of any newly proposed biozone or revision of an already existing biozone should be adequacy of description, freedom from ambiguity, extent of applicability, and, of course, that the new biozone is not a synonym.

Names of biostratigraphic units should be changed to conform with changes in names of taxa required by the *International Code of Zoological Nomenclature* and by the *International Code of Botanical Nomenclature*. Also, named biostratigraphic units will automatically change to accord with changes in the scope of taxa that may have been recognized subsequent to the naming of the unit. A fossil name once used for a biozone should not be available for use in a different zonal sense by a later author. If it is desirable to continue use of a taxonomic term which is no longer valid, the term should be in quotation marks, for example, *"Rotalia" beccarii* Zone.

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7.3. SUBCOMMISSION ON DEVONIAN STRATIGRAPHY

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(Bureau elected August 1992)

CONCERNING : Proposal for the Global Stratotype Section and Point (GSSP) for the ***Frasnian-Famennian boundary.***

FROM : Subcommission on Devonian Stratigraphy

To : ICS and IUGS for acceptance and ratification 30 October 1992

(1) The Subcommission on Devonian Stratigraphy (SDS) wishes to recommend an horizon and locality for a basal Famennian GSSP at the base of Bed 32 of the Upper Quarry at Coumiac, Montagne Noire, France. Two candidate sections were on a preliminary Ballot held on 31 March 1991, Coumiac and Steinbruch Schmidt (Germany). This gave a 59 % majority vote in favour of Coumiac, but not the 60 % required under the rules. A final Postal Vote naming only Coumiac was held on 1st July 1991 with the following result. In favour, CHLUPAC, DINELEY, FEIST, GARCIA-ALCALDE, HOU, HOUSE, OLIVER, PEDDER, RICHARDSON, TALENT. Against, BULTYNCK, SANDBERG, STREET, WALLISER, YOLKIN, ZIEGLER. No replies counted under the Rules as Yes votes ; HÜNICKEN, KLAPPER, YU. This gave 13 votes in favour of Coumiac and 5 against, or 70 % of Titular Members in favour of Coumiac.

(2) In earlier phases of the deliberations of the SDS potential GSSP's had been considered in Belgium, Germany, France, Morocco, P.R. China, and the USA. It had been agreed that a boundary at the base of the Lower *triangularis* conodont Zone would be preferred.

(3) In accordance with the requirements for submission to the ICS of a candidate for a GSSP, statements required under the *Guidelines and Statutes* are given in the attached Appendix together with full details of the section and its locality with full illustration (Appendix Figures 1-11).

M.R. HOUSE, Chairman

CONCERNING : Proposal for the Global Stratotype Section and Point (GSSP) for the ***Frasnian-Famennian boundary.***

FROM : Subcommission on Devonian Stratigraphy

To : ICS and IUGS for acceptance and ratification

APPENDIX

1. Motivation for choice of boundary level

Historically several different levels have been used to define the base of the Famennian. In the type area for the naming of the stages in southern Belgium, precise documentation in recent years has been given to a new reference section replacing the now-infilled classic section in the Senzeilles railway cutting (Bultynck *et al.* 1988). Largely resulting from work in the first quarter of this century in Germany another boundary has been that based on the entry of the goniatite *Cheiloceras* in the pelagic realm. In the latter half of this century the considerable growth of conodont studies has led to much refinement of the biostratigraphy. But the level taken as the base of the Famennian has varied between a level at the base of the *crepida* Zone down to the base of the Lower *triangularis* Zone. The need for an international definition has become urgent. The Subcommission has given careful consideration to which level is most appropriate for international correlation and it decided, at a meeting in Washington in 1989, that a GSSP should be sought in relation to the base of the Lower *triangularis* conodont Zone. The Final Postal Ballot was on that basis.

2. Correlation of the proposed boundary level

The boundary proposed represents perhaps the best correlated horizon in the Devonian. A review of more than 30 international sections has been presented by Sandberg, Ziegler, Dreesen & Butler (1988) including localities in North America and Europe. Documented correlation is established in North Africa (Becker, House & Ashouri 1988), China (Jae *et al.* 1989) and Australia (Becker et *al.* 1992). The boundary corresponds to the extinction of the conodonts *Ancyrodella* and *Ozarkodina* and the loss of all but a few species of *Icriodus, Ancyrognathus, Palmatolepis* and *Polygnathus* (Sandberg *et al.* 1988). There is a well-known extinction among goniatites of the Gephuroceratidae and Beloceratidae and the record for both conodonts and goniatites at Coumiac demonstrated this well. The last of the brachiopod Atrypidae occurs just below the boundary level (Becker *et al.* 1992). At the GSSP 78 % of all known Upper Frasnian trilobite species are represented. Of special importance is the youngest documented occurrence of Dalmanitidae, Odontopleuridae, Harpidae and Aulacopleurinae which all disappear at the base of the end-Frasnian Upper Kellwasser Bed level of Bed 31g. There is a major spore change in the Belgian sequence (Vanguestaine *et al.* 1983) and an extinction of corals (Sorauf & Pedder 1986, Scrutton 1988) and stromatoporoids (Stearn 1987) has also been well documented. A changeover of benthonic ostracod faunas across the boundary at Coumiac has been published (Lethiers & Feist 1991).

3. Motivation for the choice of the stratotype

It has been recognized by the Subcommission that, in general, Devonian sections in pelagic realm facies are more likely to be complete than those in the neritic facies. The pelagic facies forms a better basis for biostratigraphic precision needed for international correlation. In particular the conodont and goniatite records are better in those facies. That is not to imply that there are not facies rich in other groups, spores and brachiopods, for example, which are very important for correlation, but it is normally easier to correlate into such sections secondarily from primary sections in the pelagic facies. In the last resort the Subcommission

concentrated on two such sections, one at Steinbruch Schmidt (Sandberg *et al.* 1990, Schindler 1990) and the other at Coumiac [Feist (Ed.) 1990].

The sequence chosen shows a complete succession through the early Frasnian to late Famennian. It is unfaulted and has no tectonic problems. The beds are approximately vertical. Equivalent sections can be found elsewhere in the area. The rocks are of low grade metamorphism and thermal maturity (CAI 2-3) and comprise an homogeneous pelagic calcilutite sequence without marly or shaly interbeds. There is a complete zonal succession with a rich fossil content, especially of the index groups of conodonts, ammonoids, trilobites, tentaculites and ostracods. Detailed documentation is provided later of this (Figures 5-11). Geochemical work has been published across the boundary at Coumiac (Goodfellow *et al.* 1989, Grandjean *et al.* 1989, Grandjean *et al.* 1992, Joachimski & Buggisch 1992) and currently other investigations are being undertaken. Magnetostratigraphic work indicates the area was remagnetized during the Permian.

4. Location of type section

The recommended GSSP is above the Upper Quarry at Coumiac, near Cessenon, Montagne Noire, France (Figure 1). The section is situated in the southeastern Montagne Noire, Département Hérault, District of Cessenon (topographic sheet 1 : 25 000, N° 2544 E Murviel-lès-Béziers ; Lambert's coordinates : x = 130,75, y = 658,55). It is adjacent to the southeastern border of the disused upper marble quarry (UQ) of Coumiac at 175 m WSW of Les Granges farmhouse, at about 1,5 km NE of Cessenon village. It can be reached easily by a path running up the hill from Les Granges farm house near to the road D136 from Cessenon to St Nazaire-de-Ladarez.

Protection : The ground is owned by the commune of Cessenon and is already protected being part of a water supply area. Conservation and protection of the section has been assured by communal and departmental officials. Free access for scientists is confirmed.

5. Description of type section

The Upper quarry at Coumiac comprises most of the Frasnian and the succession continues above the quarry to the proposed GSSP. Higher is a succession to the late Famennian and above (Figure 3). The sequence (Figures 4,5) is one of pelagic micrites and calcilutites, mostly red tinted and represents a well-bedded sequence the bedding probably related to Milankovitch-Band climatic control during sedimentation. The sequence has been described in published accounts (Becker *et al.* 1989, Kapper 1989, House *et al.* 1985). The section is shown in Figure 4. Distinctive is Bed 31g, which is correlated with the Upper Kellwasser Kalk, and shows a hypoxic grey cacilutite to calcarenite above which is the most marked faunal boundary. But both Bed 31g and 32a are pelagic in their caracter.

The faunal description is given in a series of diagrams submitted to the SDS and included in Feist (Ed.) 1990 by group specialists. Figure 6, submitted by R.T. Becker and M.R. House gives the goniatite ranges. Figure 7 gives the conodont data of G. Klapper giving critical zonal definition and showing the remarkable extinctions at the boudary. Figure 8 by R. Feist shows the range of trilobite taxa ; high correlative value of the latest Frasnian prior to the Upper Kellwasser level is best documented by phylogenetic lineages of *Palpebralia* and *Cryphops* which are both characterized by unidirectional trends of eye reduction and whose representative are known from distant areas such as the Rhenish Slate Mountains, the Harz Mountains, as well as the Canning Basin of Western Australia (Feist 1991). The brachipoda and bivalve preliminary records of C. Babin and P.R. Racheboeuf are given in Figure 9. Rich homoctenid faunas are recorded on Figure 10 determined by M. Tryols-Massoni. Ostracod data of F. Lethiers is given on Figure 11 where more than 30 different species are recognized in the topmost beds ; among the benthonic forms, the Frasnian/ Famennian boundary is characterized by a major extinction since 65 % of all recorded taxa disappear there (Lethiers & Feist 1991). It bears evidence of an extraordinary breadth of

faunal representation which enables correlation into regimes with better spore and acritarch records. The SDS views this documentation as the best it has achieved for any of the levels it has recommended.

6. Relationship to marker horizons

The main sedimentary marker of the horizon is the top of the distinctive level known in Germany as the Upper Kellwasser Kalk. Black hypoxic limestones occur at several levels around the Frasnian/Famennian boundary but the Upper and Lower Kellwasser Kalk levels are two which represent an acme of the spread of a distinctive facies and which are in many sections precisely constrained by conodont dating.

In parallel with the work of the SDS in recent years has been the recognition of an important extinction event near the Frasnian/Famennian boundary. Some of these extinctions were listed in section 2 above.The recommendations of the Subcommission for a GSSP fall at the level thought to mark the acme of extinctions which is at the base of the Lower *triangularis* Zone. The most precise documentations for this (Becker *et al.* 1989) has been followed by data assembled for the Subcommission and shown here on Figures 6-11. Following especially the work of Sandberg *et al.* (1988) this level has been widely traced internationally.

There has, however, been much debate on the cause of the sedimentary pertubation represented by the Upper Kellwasser Kalk. The matter cannot be said to be resolved. Indeed, some members of the Subcommission earlier took the view that a more accurate boundary might be chosen away from the sudden faunal and sedimentary change at the base of the Lower *triangularis* Zone but in the end, the ease of international correlation based on the faunal changes led to this boundary being recommended.

Three main groups of hypotheses have been invoked to explain the faunal and sedimentary changes around the base of the Lower *triangularis* Zone. Firstly, causes related to a bolide impact or impacts (McLaren & Goodfellow 1990, Sandberg *et al.* 1988). Secondly, events, probably tectonic, producing a spread of anoxic conditions on continental shelves associated with ocean overturn (Buggisch 1991, Wilde & Berry 1984).Thirdly, a peak of cold climatic conditions, resulting in a rise of the pycnocline (Copper 1986).

Whatever the cause may be, the Subcommission is of the opinion that the hypoxic perturbations below the base of the Lower *triangularis* Zone have resulted in a considerable faunal changeover and an horizon which may be correlated internationally with perhaps more precision than any other in the Devonian. It is in the light of this view that the Subcommission wishes to recommend Coumiac for the GSSP to define the base of the Famennian Stage.

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Michael R. House & Raimund Feist
October 1992

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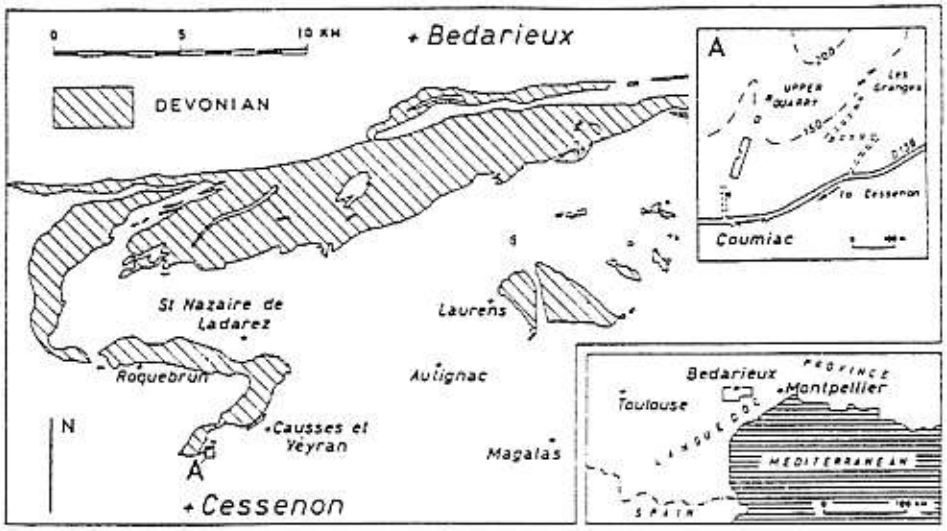

Figure 1. Maps showing the position in the Montagne Noire of south-eastern France of the proposed GSSP for the base of the Famennian at the Upper Quarry at Coumiac (inset map A). Modified from Becker *et al.* (1989).

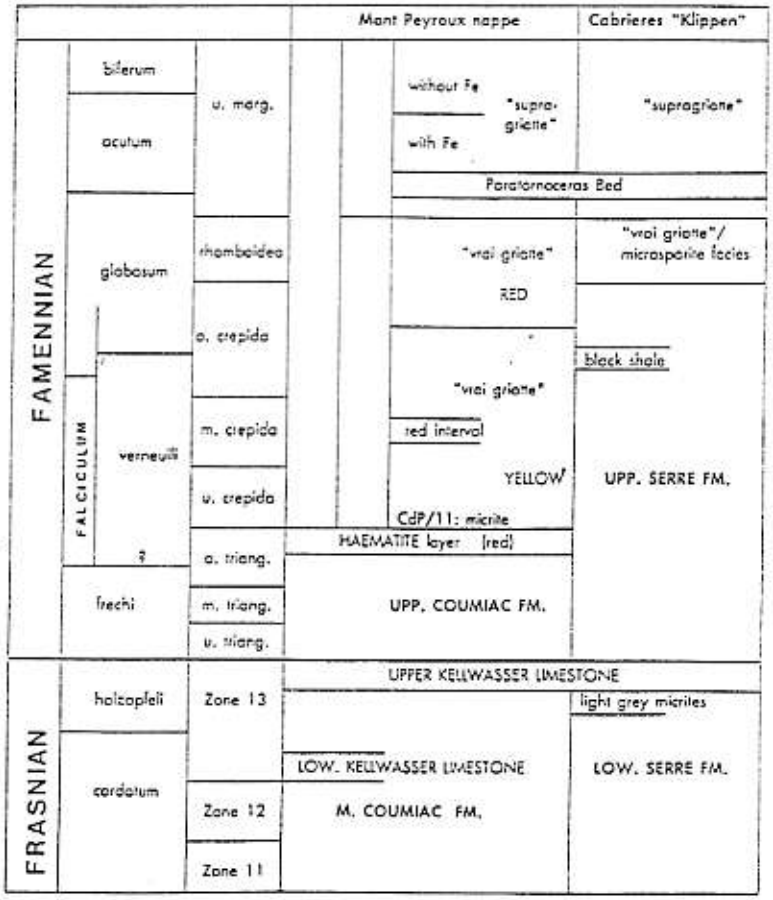

Figure 2. The local stratigraphy and goniatite and conodont zones around the boundary in the Montagne Noire. From Feist (Ed.) 1990.

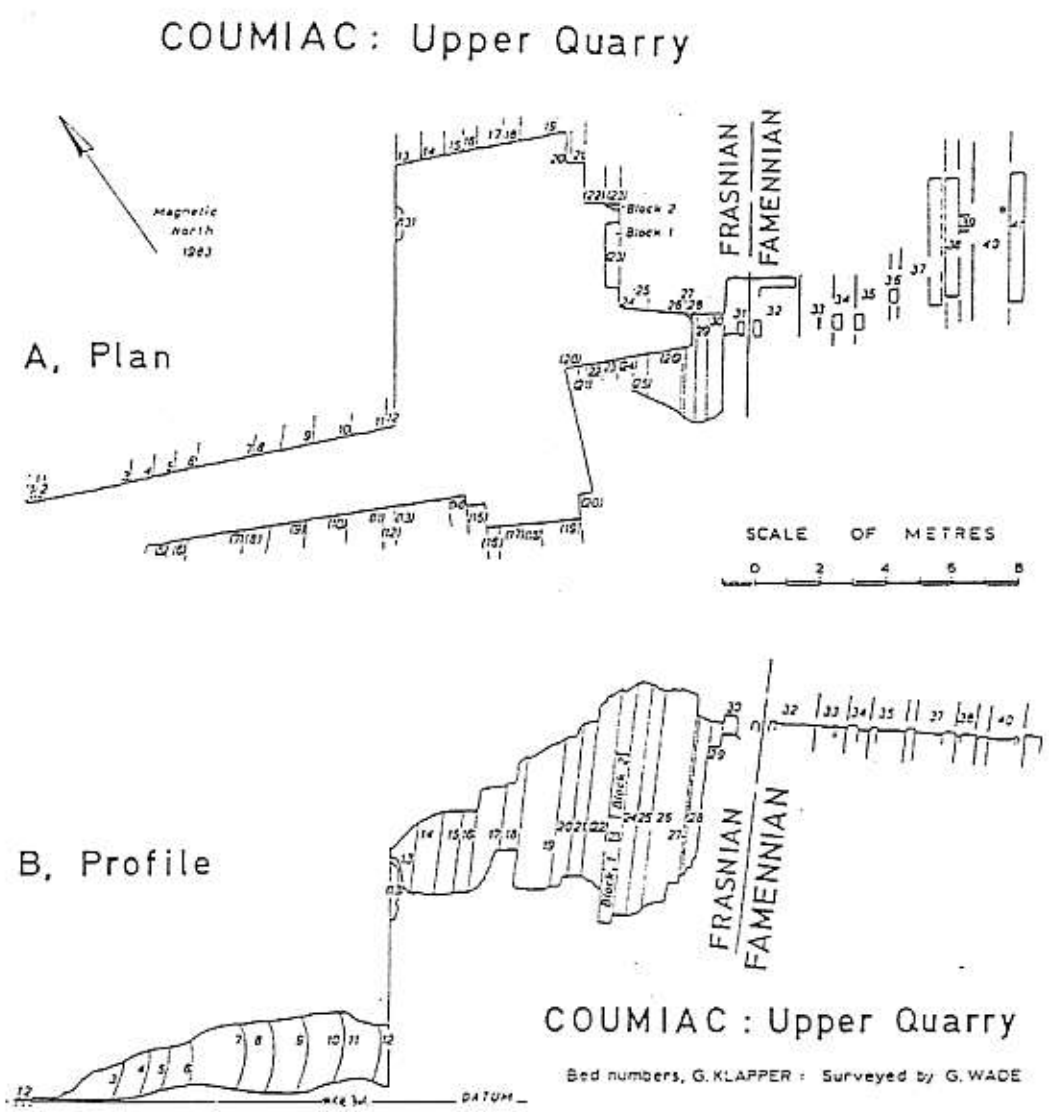

Figure 3. Plan and profile of the succesion in the Upper Quarry at Coumiac showing the position of the proposed GSSP at the boundary between Bed 31 and Bed 32. Modified from House *et al.* 1985).

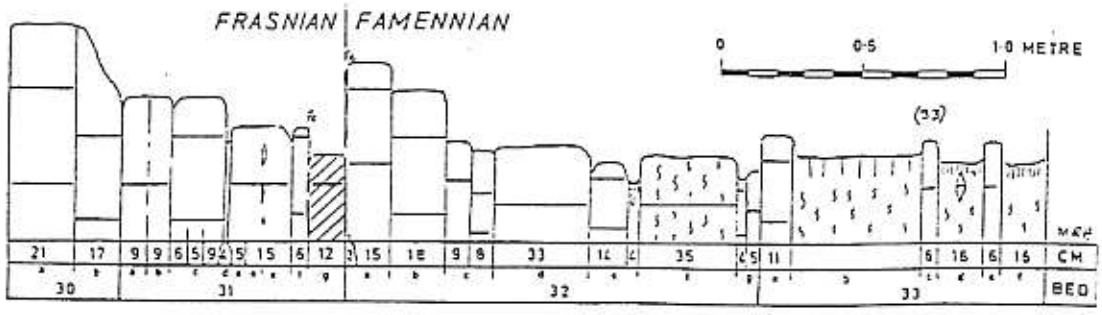

Figure 4. The detailed succession of beds around the proposed GSSP boundary at the junction of Bed 31g and Bed 32a in the Upper Quarry at Coumiac.

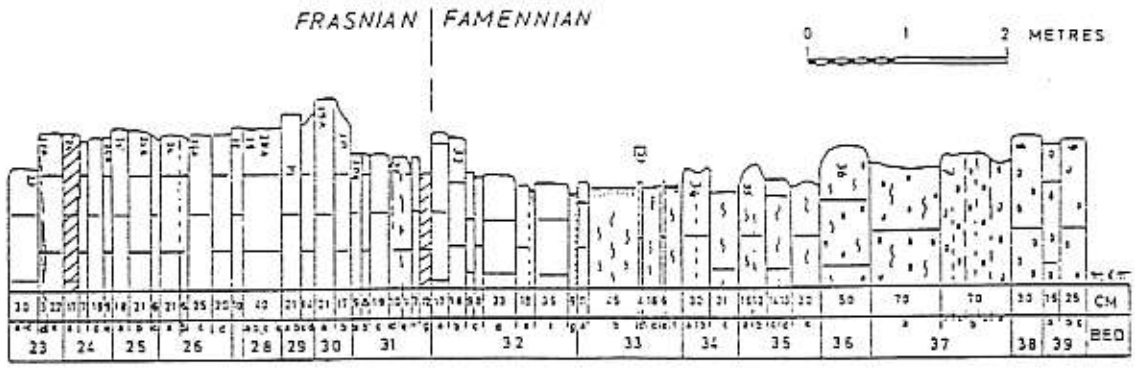

Figure 5. The sequence between Beds 2 and 39 in the Upper Quarry at Coumiac showing bed numbering and bed thicknesses. From Feist (Ed.) 1990.

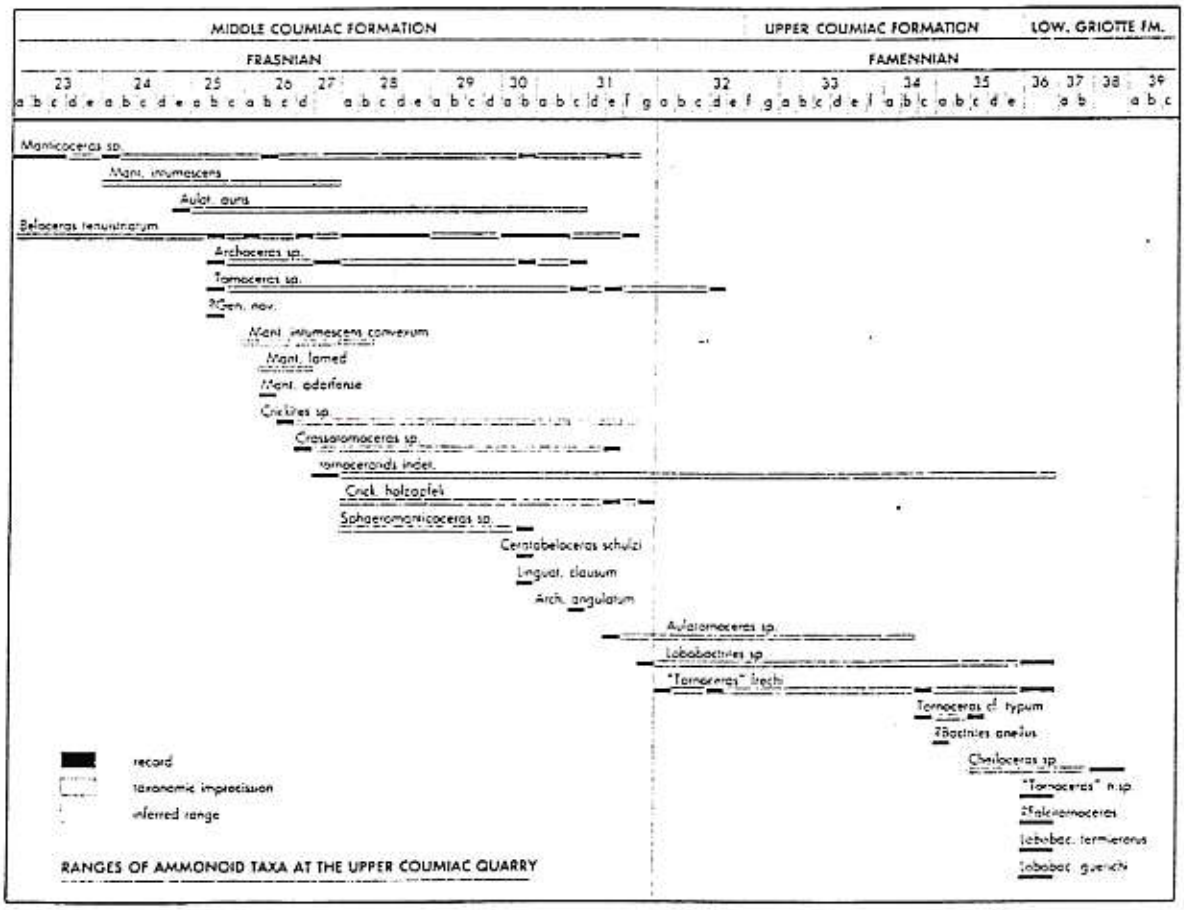

Figure 6. The succession of goniatites known from Bed 23 to Bed 39 in the Upper Quarry at Coumiac.

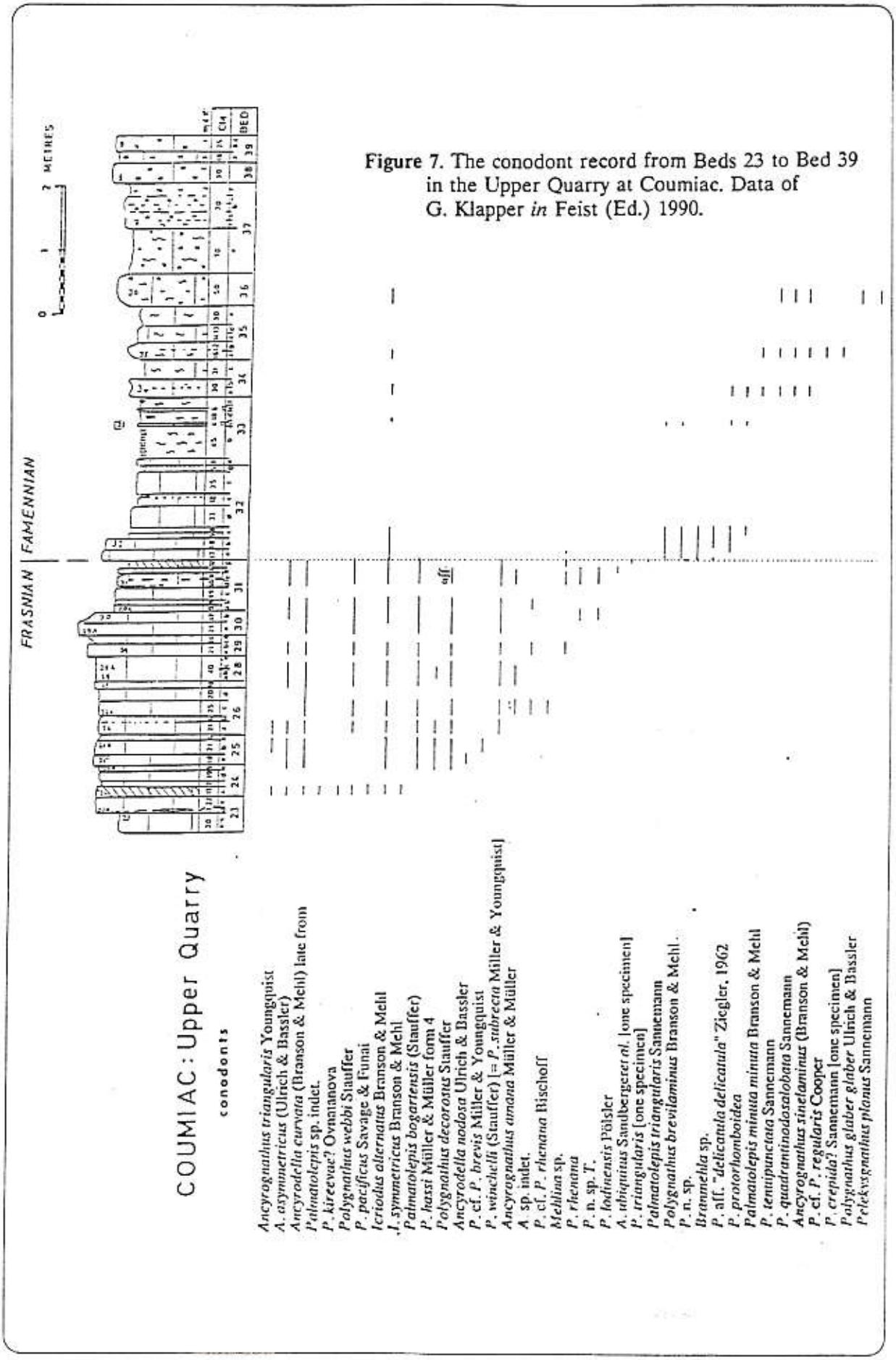

Figure 7. The conodont record from Beds 23 to Bed 39 in the Upper Quarry at Coumiac. Data of G. Klapper *in* Feist (Ed.) 1990.

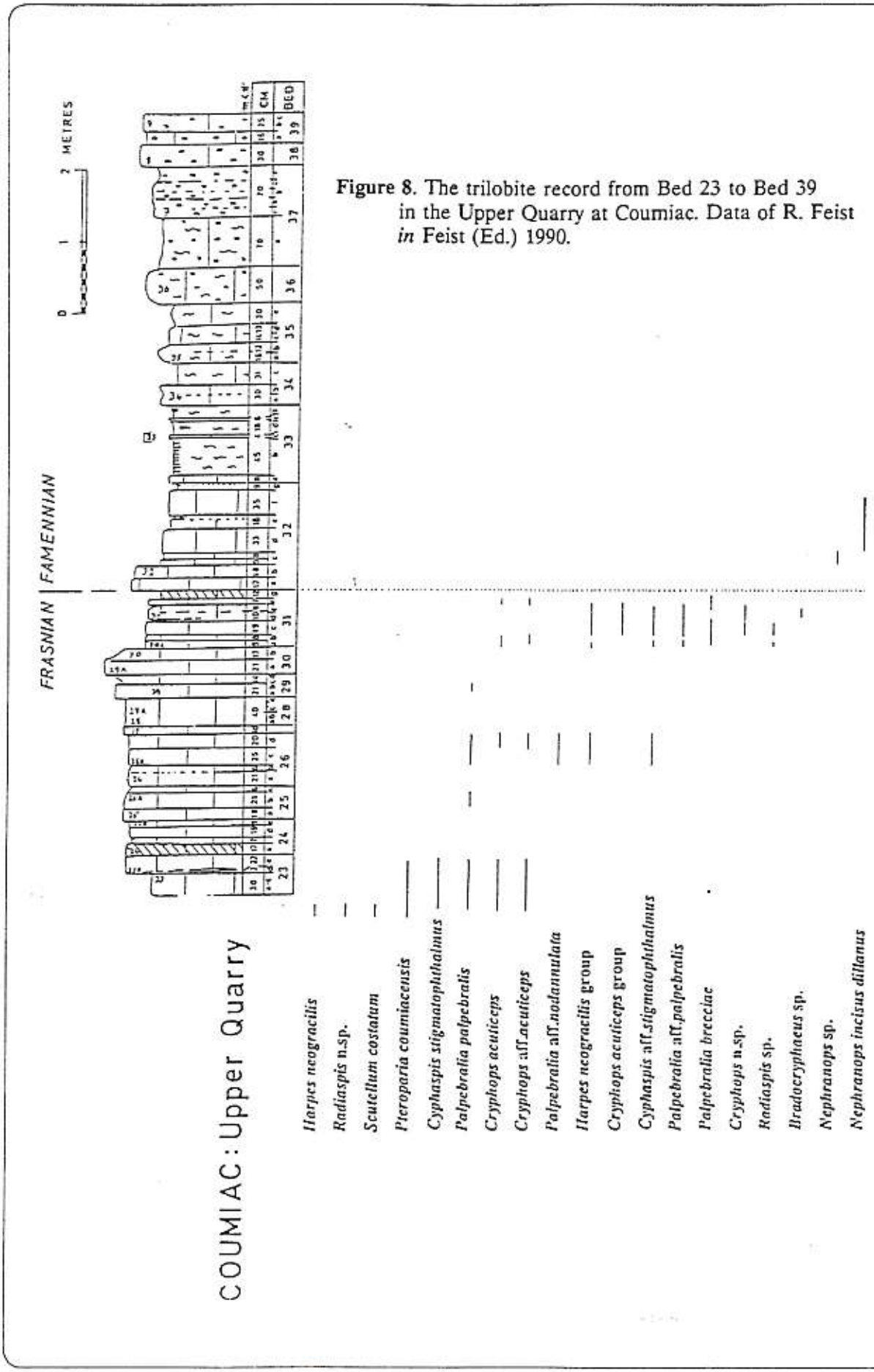

Figure 8. The trilobite record from Bed 23 to Bed 39 in the Upper Quarry at Coumiac. Data of R. Feist *in* Feist (Ed.) 1990.

Bed n°

21c : *"Striatochonetes"* sp. 1 (1vv, 1dv)
Dualina sp.

21e : ? *Cypricardinia* sp.
Buchiola sp.

23a : *Buchiola* ssp.

24b : cf. *Monelasmina* sp. (1dv)

26b : Pectinacea undet.

26d : *"Striatochonetes"* sp. 1 (1vv)
Strophcodontacea sp. 1 (2vv)

28a : *Buchiola* sp.

31a : *"Striatochonetes"* sp. 1 (1vv)
Rhynchonellid undet. (1cs)

31b : cf. *Skenidium* sp. (1vv)
Strophcodontacea sp.1 (1vv))
"Striatochonetes" sp. 1 (1dv)
Buchiola ssp.
Leiopterid undet.

31c : cf. *Skenidium* sp. (1vv)
Strophcodontacea sp. 1 (1cs)
Rhynchonellid undet. (2cs)
Buchiola ssp.
? *Kralovna* sp. (1)
Leiopterid undet. (1)
? *Cypricardinia* sp.

31e1 : Strophcodontacea sp. 1 (4vv)
"Striatochonetes" sp. 1 (3vv)
Rhynchonellid undet. (2cs)
Buchiola ssp.
? *Cypricardinia* sp.

31e2 : Strophcodontacea sp. 1 (7vv, 2cs)
"Striatochonetes" sp. 1 (1vv, 3dv)
Rhynchonellid undet. (2cs)
"Cyrtina" sp. (1vv)
Buchiola sp.
? *Cypricardinia* sp.
Pterioid undet.

31f : *"Lingula"* sp.
"Striatochonetes" sp. 1 (3vv, 1dv)
Bivalve undet.

32b : Bivalve undet.

32c : *Buchiola* sp.

32d : *Buchiola* ssp.
Bivalve undet. (large shells)

35 : Bivalve undet. (large shells)

vv = ventral valve
dv = dorsal valve
cs = complete shell

Figure 9. Record of brachiopods and bivalve molluscs in the Upper Quarry at Coumiac. Data of C. Babin and P.R. Racheboul *in* Feist (Ed.) 1990.

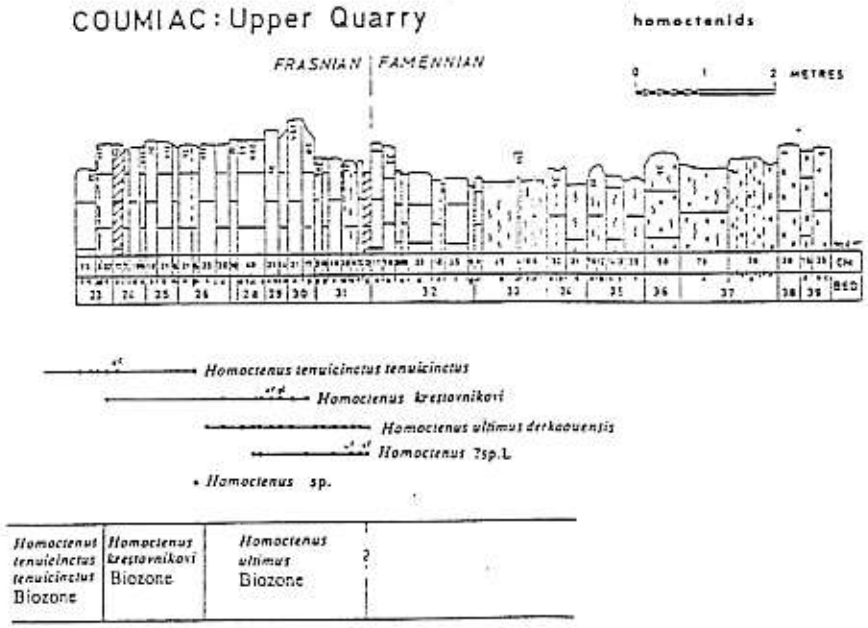

Figure 10. Record of homoctenids in the Upper Quarry at Coumiac. Data of Truyols-Massoni *in* Feist (Ed.) 1990.

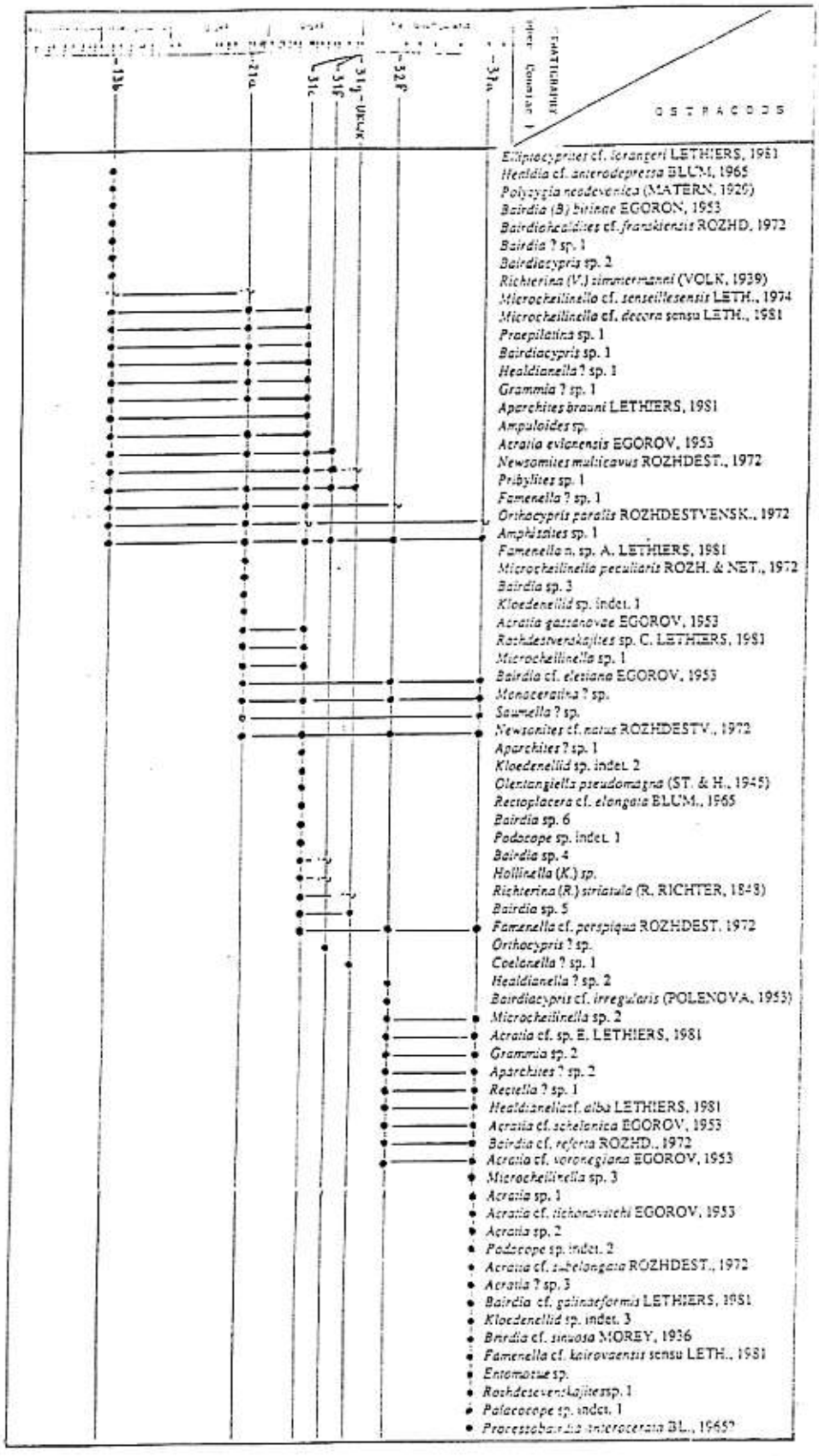

Figure 11. Record of ostracoda in the Upper Quarry at Coumiac. Data of F. Lethiers *in* Feist (Ed.) 1990.

8. ANNOUNCEMENTS

8.1. THE ARKELL INTERNATIONAL SYMPOSIUM ON JURASSIC GEOLOGY

To celebrate the 60th anniversary of the publication in 1933 of W.J. Arkell's monumental and influential work "The Jurassic System in Great Britain", the Arkell International Symposium on Jurassic Geology will be held in September 1993. Conference sessions in London and one day field trips during the period 8th to 13th September will be followed by longer field trips (incl. Dorset, Yorkshire, combinedYorkshire/Dorset, Hebrides, Moray Firth) on 14th to 20th September. The Conference Chairman is Dr John COPE (Cardiff) and the Conference Secretary is Dr. Stewart BROWN (Petroleum Science and Technology Institute, 25 Ravelston Terrace, Edinburgh EH4 3EX, tel. 44 31 451 5231, fax 44 31 451 5232), from whom further information can be obtained. A first circular will be distributed in April 1992.

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8.2. AALENIAN AND BAJOCIAN WORKING GROUPS
MEETING IN MARRAKECH, MOROCCO, SPRING 1994

FIRST CIRCULAR, March 1993

According to the proposals of the Aalenian-Bajocian meeting in Portree (April 1991), confirmed during the symposium of the Jurassic Subcommission in Poitiers (September 1991), the joint meeting of the Alenian and Bajocian working groups will be held by the Faculty of Sciences Semlalia, University Cadi Ayyad of Marrakech, in the early Spring 1994.

The programme will consist of :

- 2 days in Marrakech with scientific sessions ;
- 5 days on the field in the Central High-Atlas of Morocco.

Topics to be discussed, mainly in sight of the Subcommission Symposium in Argentina (October 1994), are :

1) Aalenian and Bajocian stratigraphy : biozonations, correlation charts, multidisciplinary scales, magnetostratigraphy results, isotopic logs, etc.

2) Proposals, maybe definitive, for the Bajocian basal boundary stratotype (Bearreraig Bay, Cap Mondego, or what ?) mainly taking in account the data discussed by Contini and by Sadki in Poitiers.

3) Dating Aalenian-Bajocian eustatic sea-level changes and tectonic events, comparison between different areas.

4) ———————————————————— (your suggestions)

5) Selection of the new coordinator of the Bajocian W.G.

Please, fill in the schedule on back and return to D. SADKI no later than June 15th, 1993. Further information will be sent to those who have answered the first circular.

Antonio GOY
Madrid University

Giulio PAVIA
Torino University

Driss SADKI
Marrakech University

Concerning a few open problems on the Bajocian stratigraphy, we enclose a copy of the report sent by G. PAVIA for the Proceedings of the Poitiers Symposium. Please note the Point D : material for this collection of historical data is requested.

INTERNATIONAL SUBCOMMISSION ON JURASSIC STRATIGRAPHY

AALENIAN and BAJOCIAN WORKING GROUPS
Meeting in Marrakech, Spring 1994

Please fill in and return
by June 15th, 1993 to

dr. Driss SADKI
Department of Geology
University Cadi Ayyad
B.P. S15
MARRAKECH, Morocco

Surname _____ Name _____
Institution _____
Mailing Address _____
_____
Code and Town _____ Country _____
Phone _____ Fax _____

1) Your attendance to the Meeting is: highly probable ____
possible ____
unlikely ____

2) Which date do you prefer?
one week between 26.03-10.04.1994 ____
one week at the end of May 1994 ____

3) Do you intend to partecipate in the field-trip? Yes ____
No ____

4) Will you be accompanied by another person? Yes ____
No ____

5) Do you intend to submit: oral paper ____
poster ____

Provisional Title _____
_____
_____

6) Other comments _____
_____
_____

7) Are you interested to be comprised
in the future lists of the Aalenian W.G. Yes ___ No ___
Bajocian W.G. Yes ___ No ___

(Please, note that no answers to point 7 automatically mean your resignation from any list)

Date _____ Signature _____

8.4. PROJECT PROPOSAL : JURASSIC PALAEOGEOGRAPHY OF EUROPE

M. Elias

The scope of the project

- global synthesis of lithofacies and biofacies
- palaeogeographic reconstruction
- basin development and basin analysis
- correlation of the Boreal Realm and the Tethyan Realm

The form of the cooperation

- partnership of the collaborating institutions and scientists.

The main strategy of the investigations

- lithologic and palaeontologic characteristics of the main Jurassic facies and/or lithostratigraphic units, their sedimentology and palaeoecology ; Jurassic volcanism ;
- biostratigraphic and chronostratigraphic correlations of the facies in the principal areas ; applications on the concepts of the event stratigraphy, the seismic stratigraphy, the cyclostratigraphy and the sequence stratigraphy ;
- compilation of the facies successions, construction of the facial models ;
- compilation of the lithofacies and biofacies maps in the scale 1 : 2 000 000 - 1 : 5 000 000 for the important chronostratigraphic levels and of the details maps for some important areas in more detail scales ;
- case studies and/or solutions of some special problems (carbonate platforms, reefs etc), which are connected with the palaeogeography of the European Jurassic ;
- plate-tectonics history of the Jurassic ; the reflections of the plate nontion on the development of the European platform ;
- basin analysis of selected basins ;
- palaeogeographic reconstruction of the European Jurassic–paleogeographic maps of the Jurassic ;

Some of these proposed research activities according to this project may be correlated with others activities of the Jurassic Subcommission, with the I.G.C.P. projects and with the projects of the Carpatho-Balcanian Association (CBGA).

Expected benefits of this project

- maps of lithofacies and biofacies and palaeogeographic maps of the European Jurassic and adjoint areas in the scale 1 : 2 000 000 - 1 : 10 000 000 with explanatory texts ;
- results of special investigations of some related topics (biostratigraphy, sedimentology, correlations), basin analysis cf. selected basins ;
- correlations of the results of the classical and the new stratigraphic methods ;
- precisions of the stratigraphic tools for the purposes of the applied (economic) geology ;
- exchange of the expertises and of the scientific methods will upgrade the professional experience of the investigators. The gained knowledge can then be applied to future research projects ;
- education and training of personal research , especially young scientists and research fellowship for advanced scientific workers.

Duration of this project

- 4 up to 5 years

Contact address

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Cesky geologicky ústav
Malostranské nam. 19
PRAHA 1 118 21 Czechoslovakia
Tel. : (42) 2 53 36 41 - Fax : (42) 2 53 35 64

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