NEWSLETTER ON CARBONIFEROUS STRATIGRAPHY

Volume 15 July 1997

SCCS

I.U.G.S. SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY

Table of Contents

CHAIRMAN'S COLUMN 1

SCCS ANNUAL REPORT 1996 2

SECRETARY/EDITOR'S REPORT 1996-97 3

WORKING/PROJECT GROUP REPORTS 4

Working Group to establish a boundary close to the existing Tournaisian-Visean boundary 4

Working Group to define a GSSP close to the Moscovian/Kasimovian boundary 5

Project Group 4: Zonation in Late Namurian successions 9

SPECIAL ARTICLE

Revision of the Carboniferous part of the IUGS Global Stratigraphic Chart (I. Metcalfe) 12

CONTRIBUTIONS BY MEMBERS 19

Recognition and correlation of eustatic flooding events in the late Visean of Utah (SW USA) and Britain (NW Europe). (Titus & Riley) 19

Paleogeographic significance of a new upper Carboniferous macroflora locality in Bay St. George Basin, western Newfound-land, Canada. (Bashforth *et al.*) 22

Finds of Viséan polyplacophorans from the Nízky Jeseník Mts. (Král & Marek) 25

Carboniferous Time Scales Revised 1997: Time Scale A (min. ages) and Time Scale B (max. ages). Use of geological time indicators. (Menning *et al.*) 26

The Carboniferous-Permian boundary in Argentina. (Gonzalez & Taboada) 29

Elevation of atmospheric CO_2 near the Westphalian-Stephanian boundary: evidence from stomatal densities. (Cleal *et al.*) 31

A provisional list of GEOSITES for Carboniferous palaeobotany. (Cleal & Thomas) 32

Carboniferous of Barai River (West Verchoyanie). (Budnikov *et al.*) 33

Russian Comission for the Carboniferous system: Information on Resolutions of the Commission for the Carboniferous System. (Kagarmanov & Kossovaya) 35

Carboniferous of Brazil. Contribution to the Late Paleozoic stratigraphy of the Parnaíba Basin. (Lima Filho & Anelli) 36

Carboniferous spores sequence from the Southwest part of Tarim Basin, Xingjiang, China. (Gao Lianda) 38

Report on research activity at Amoco. (Groves) 39

Facies and biostratigraphy of the Late Carboniferous sequence in the Carnic Alps (Austria/Italy). (Krainer & Davydov) 40

Eoparastaffella, its evolutionary pattern and biostratigraphic potential. (Hance) 40

BOOK REVIEWS 42

Recent advances in Lower Carboniferous geology by P.Strogen, I. D, Somerville and G. Ll. Jones (eds). 1996. Reviewed by Amanda Chapman 42

The Carboniferous of the World, III by Martinez Diaz, C., R.H. Wagner, C.F. Winkler Prins and L.F. Granados (eds). 1996. Reviewed by Ian Metcalfe 43

VALE: DAGMARA MAXIMILIANOVNA RAUSER-CHERNOUSOVA 44

ABSTRACTS 45

FORTHCOMING CONFERENCES 47

8th Coal Geology Conference, Prague, 1998 47

XIV-International Congress on Carboniferous-Permian 47

PUBLICATIONS BY SCCS MEMBERS 48

SCCS VOTING & CORRESPONDING MEMBERSHIP 1997 50

SCCS OFFICERS AND VOTING MEMBERS 1996-97 59

Newsletter on Carboniferous Stratigraphy

Edited by I. Metcalfe

IUGS SUBCOMMISION ON CARBONIFEROUS STRATIGRAPHY / VOL. 15 - 1997

Chairman's Column

The International Commission on Stratigraphy (ICS) has, over the past year or so been undertaking revision of the IUGS Global Stratigraphic Chart. This chart sets out to define the semi-formal and formally approved names for the major stratigraphic subdivisions (Period/System, Series/Epoch, Age/Stage) and also indicates the positions of Global Boundary Stratotype Section and Points (GSSPs).

Some Systems are far better defined that others. For example the Silurian and Devonian Systems and their stages are fully defined by GSSPs. The number of GSSPs for other systems within the Phanerozoic ranges from none (Triassic) to four. Our Carboniferous System currently has GSSPs located at the base of the Tournaisian, the mid-Carboniferous boundary and at the base of the overlying Permian System, with only one of these having been defined by a purely Carboniferous working group. The time has come for us to pool our vast knowledge of stratigraphy and establish GSSPs for the remaining major subdivisions of the Carboniferous. This is no mean task because of problems inherent to the Carboniferous. These include a rapid deterioration in global climate from around the end of the Visean, glaciation in Gondwana, the development of provincialism amongst the biota, and glacially induced fluctuations in sea level causing cyclical sedimentation and widespread unconformities.

Three current Working Groups are actively attempting to find the necessary biostratigraphic information in suitable sections for the Tournaisian-Visean, the Visean-Serpukhovian/ Namurian and the Moscovian-Kasimovian boundaries. These three contributions will consititute just a small part of the total number of GSSPs required if all of the stages of the Carboniferous are to be properly defined. Some of our members are also making good progress outside formal working groups; for example conodont research in the Upper Carboniferous is making great strides in the United States and Russia as a result of work from groups based mainly in Iowa and Moscow, respectively. The Russian subcommission on Carboniferous stratigraphy has also been active and has provided SCCS with a large amount of biostratigraphic data.

Recently I was asked by the ICS to provide a list of undefined GSSPs, with a deadline for the anticipated completion of the work. Of the above three potential GSSPs, in only one case, the Tournaisian-Viséan boundary, has sufficient information been assembled to establish a means of defining the boundary, but the Working Group is still searching for a suitable section which contains the evolutionary succession between two species of *Eoparastaffella*.

During the past three months the Voting Members of SCCS have been engaged in hot debate about the subdivision of the Carboniferous. Where should the major subdivisions be based? Which names should appear on the Global Chart? Should we dispense with the existing names and replace them with names without regional significance? What biostratigraphic data are available for definition of GSSPs at the critical boundaries? Do unconformities prevalent at the bases of many major subdivisions of the Carboniferous render these units invalid as stratotype sections? Should we use global events such as flooding events as indicators of the major subdivisions?

I ask all workers on the Carboniferous to read the article prepared by Ian Metcalfe from documentation sent to SCCS during this time so that they familiarise themselves with the problems, and at the same time ask that they think seriously how they and their work may help solve some of these problems.

Commencing at the next Field and General Meeting of SCCS at the University of New England in Armidale, Australia, we plan to move rapidly to gain approval to formalise the use of a number of subdivisions proposed on the Carboniferous chart, and to plan the establishment of a number of new and/or revitalised Working Groups. Please contribute your ideas on possible new working groups, how they might be established, who might be members of the groups, and how the activities of these groups might be financed. Your replies should be sent, preferably by e-mail, to Ian Metcalfe whose address is on the inside back cover of this newsletter.

Good thinking, and let us all work towards the goal of a better defined Carboniferous System.

John Roberts

SCCS ANNUAL REPORT 1996

Membership:

The Subcommission has 22 Voting members including the Executive Officers. In addition to this, corresponding membership at the date of publication stands at 257 and 7 libraries also receive the Newsletter.

Bureau Officers:

Chairman:
Professor J. Roberts
School of Applied Geology
The University of New South Wales
SYDNEY NSW 2052
AUSTRALIA.
PHONE: +61 2 9385 4279
FAX: +61 2 9385 5935
E-MAIL: J.Roberts@unsw.edu.au

Vice-Chairman:
Dr J.T. Dutro Jr
5173 Fulton St. NW
Washington DC 20016
U.S.A.
PHONE: +1-202-343-3222
FAX: +1-202-343-8620

Secretary/Editor:
Associate Professor I. Metcalfe
Division of Earth Sciences
School of Physical Sciences & Engineering
University of New England
ARMIDALE NSW 2351
AUSTRALIA
PHONE: +61-67-732860
FAX: +61-67-733300
E-MAIL: sccs@une.edu.au

Activities in 1996:
The Secretariat for the Subcommission was relocated from the University of Newcastle to the University of New England, NSW, Australia. Other activities of the Subcommission are incorporated in the reports of Working and Project Groups on the next pages.

The major achievement was the formal ratification of the Mid-Carboniferous Boundary GSSP by ICS and IUGS at the Arrow Canyon Section in Nevada marking the base of the Upper Carboniferous.

SCCS Work Plans for 1996-1997:
1996: Establishment of the new SCCS Secretariat at the University of New England, Armidale. The setting up of a home page for SCCS on the internet.

1997: Organisation of the SCCS Field and General Meeting in Australia, September, 1997. Ensure that the existing research program is continued into the succeeding years and that the formal SCCS Working Groups and Projects proceed efficiently towards their goals, preferably within a reasonable timeframe.

STATEMENT OF INCOME and EXPENDITURE FOR 1996:
(Definitive accounts are maintained in Australian currency. US dollar conversions are calculated, unless otherwise specified, at the conversion rate of AUS$1.00 = US$0.75).

INCOME (Oct. '95 - Sept. '96)	**$AUS** Definitive	**$US** Estimated
IUGS Grant 1996 (CHF 1,075)	1,067.75	843.52
Donations from Members	987.00	779.73
Bank Interest	6.54	5.17
TOTAL INCOME	**2,061.29**	**1,628.42**
EXPENDITURE		
Newsletter 14 publication/ postage)	1,192.65	942.19
Bureau postage and stationery	873.85	690.34
Bank Charges	8.89	7.02
TOTAL EXPENDITURE	**2,075.39**	**1,639.55**

Explanatory notes:

1. Definitive income and expenditure are quoted in Australian dollars. All income and expenditure has been converted at the exchange rate of A$1.00=US$0.79.
2. The IUGS subsidy originally granted was US$870. Transfer of these funds to Australia via Swiss Francs to Australian dollars reduced the grant to the equivalent of US$843.52 as a result of bank charges and currency variations.

BALANCE SHEET (1995-96)	**$AUS** Definitive	**$US** Estimated
Funds carried forward from 1995	32.18	24.14
Exchange rate gain/loss		1.29
PLUS Income 1995-96	2,061.29	1,628.42
LESS Expenditure 1995-96	(2,075.39)	(1, 639.55)
CREDIT balance carried forward to 1996-97	**18.08**	**14.30**

BUDGET REQUEST FOR 1997	**$US**
Newsletter 15 (preparation/ printing/postage (Net requirement assuming receipt of US$200 donations)	700
Other Bureau expenses	400
Assistance for Field & General Meeting 1997	300
PROJECTED EXPENDITURE	**1,400**

The Subcommission has been advised by ICS that it has been allocated US$1015 in IUGS funding for 1997.

Secretary/Editor's Report 1996-97

Following the appointment of the new Executive Officers of SCCS in August, 1996, the SCCS Secretariat was relocated from the University of Newcastle to the University of New England where it is now housed in the Division of Earth Sciences, School of Physical Sciences & Engineering. The relocation went very smoothly due in large part to the former Secretary, Brian Engel, having the files in very good order and all ready packed for the journey when I arrived in Newcastle! I also spent a very valuable day going over SCCS matters with Brian and have continued to enjoy access to his "corporate memory" following his "retirement". I am sure that all SCCS members will join me in thanking Brian for all the work he has put in on behalf of the Subcommission over many years. As editor of the Newsletter on Carboniferous Stratigraphy, he set new standards, not only for its presentation, but also for its content, and I hope that I, along with our new Chairman, John Roberts, shall be able to keep up those high standards!

One of the first objectives as secretary that I took on board was to get an SCCS presence on the internet. I am happy to report that this has now been achieved and we are located at: "http://www.une.edu.au/sciences/schoolphyseng/SCCS/SCCS.html".

In addition to general information and address/fax/e-mail details of members, the Newsletter will also be available in the SCCS Home Page.

I had anticipated a reasonably quiet first year as Secretary with time to familiarise myself with the job. However, this all changed with the ICS request for comments on their proposed revision to the IUGS/ICS global chart! For the four months of March, April, May and June, there was a flurry of activity while we gathered suggestions, comments and had discussions with SCCS Voting Members on this issue. Inevitably, discussion became emotive at times, but the whole exercise has rejuvenated the whole qustion of Carboniferous global subdivision and generated intense international discussion, not only on the interim global chart, but also on where the SCCS should be going in the future. The vast majority of discussions were healthy and positive, and I would like to thank all those who took part and thank them all for their prompt responses to my requests for information/comments etc. Please see separate items in the Newsletter on the global chart for details.

I would be most grateful if all Voting and Corresponding Members of the SCCS would let me know of any changes to their contact details so that we may update our records. Please also keep articles for the Newsletter coming in and let me know of any other items that may be suitable for posting in our WWW Home Page.

Ian Metcalfe
July, 1997

Donations in 1996/1997:

Publication of this *Newsletter* is made possible with generous donations received from the following members during 1996-97, combined with an IUGS subsidy of US$843.52 in 1996, and additional support from a small group of members who provide internal postal charges for the *Newsletter* within their respective geographic regions.

L.E. Anelli
S. Stojanovic

SCCS ON THE INTERNET

http://www.une.edu.au/sciences/schoolphyseng/SCCS/SCCS.html

COVER ILLUSTRATION

Carboniferous zircons from the Martins Creek Ignimbrite Member of the Newtown Formation, Gilmore Volcanic Group, NSW, Australia, before (left) and after (right) probing by the SHRIMP ion microprobe. The age of the ignimbrite is 332.3+/-2.2 Ma. The core of the crystal is Archaean in age.

Working Group to establish a boundary close to the existing Tournaisian-Visean boundary within the Lower Carboniferous

Report on a field meeting of the Tournaisian-Viséan Working Group in Guangxi, South China, November 1996

L. Hance, P. L. Brenckle, M. Coen, H.F. Hou, Z.T. Liao, P. Muchez, E. Paproth, T. Peryt, N. J. Riley, J. Roberts, and X.H. Wu.

The absence of early representatives of *Eoparastaffella* in the Belgian stratotype section for Tournaisian-Viséan (T-V) boundary means that an alternative stratotype is required. Recent collaborative Chinese-Belgian research on the T-V boundary in South China (Hance et al., 1996) has provided data which give a new insight on the problem. At the instigation of the SCCS and to acquaint the T-V working group and other interested subcommission members with the preliminary results, Luc Hance and Hou Hongfei organized a field meeting in Guangxi Autonomous Region, South China (Fig. 1) in November 1996. Eleven participants visited potential boundary candidate sections to examine the lithostratigraphy and evaluate biostratigraphic criteria for boundary definition.

The sections investigated are situated near the cities of Guilin and Liuzhou in north-central Guangxi (Fig. 1). During the Early Carboniferous this region was a marine platform bordered to the north by the Yangtze Oldland and to the southeast by the Zhengcheng-Leiqiong Oldland (Wu and Chen, 1989). Mixed siliciclastic-carbonate sediments were deposited along the margin of the Yangtze Oldland shoreward of a widespread carbonate platform. Slope and basinal facies were restricted to narrow, intraplatform basins. The most promising fossil groups to improve the biostratigraphy of the T-V transition are the foraminifers, much more abundant and diversified than in the type Dinant area (southern Belgium), the conodonts and the rugose corals. The latter group is however subject to more endemism. In the slope and basinal facies, the cooccurrence of foraminifers (derived from shallower areas) and conodonts makes the biostratigraphic interpretation more constrained and allows to work out a sequence stratigraphical framework (Hance et al., in press).

After living discussions, the field trip participants unanimously agreed on the following points which could serve as guide-lines for further researches on the T-V transition.

1. It is appropriate to keep the Tournaisian-Viséan boundary at a stratigraphic level consistent with its traditional placement in the Dinant type region of southern Belgium.
2. The change from *Eoparastaffella* Morphotype 1 to Morphotype 2 warrants consideration as a boundary-defining event (see Hance, this issue). The proposal is attractive because the morphological change takes place within a demonstrable evolutionary lineage and approximates the traditional boundary in Belgium.
3. Sedimentation across the T-V boundary has been strongly influenced by sea-level fluctuations in Eurasia and possibly worldwide. The boundary should, therefore, be defined only in both biostratigraphic changes and sequence stratigraphic events that may be applicable to global correlation. Results from South China suggest that a major unconformity affecting the platform areas is bracketed by the transition of *Eoparastaffella* Morphotype 1 below and *Eoparastaffella* Morphotype 2 above.
4. An approach based on the study of a type basin rather than a type section would produce more satisfactory results in defining the T-V boundary. Primary and auxiliary stratotypes chosen from representative depositional environments within the basin would facilitate correlation of shallow and deeper-water facies and integration of biozonations based on different fossil groups.
5. The data from central Guangxi have greatly clarified our understanding of T-V boundary events, but the continuous sedimentary sequences in the intraplatform basins are restricted. Fossil assemblages are not diverse, and information on ammonoids, deep-water trilobites and brachiopods is scant. Future research within the region should be directed to more open marine basins farther south in China or in Vietnam.

References

Hance, L., Hou H., Muchez, P., Coen, M., Groessens, E., Wu X., and Xu S., 1996, Field meeting on the Tournaisian-Viséan transition in South China: *IUGS Subcommission on Carboniferous Stratigraphy, Working Group on the Tournaisian-Visean Boundary, Guidebook*, 51 p.

Hance, L., Muchez, P., Hou, H.F., and Wu, X., in press. Biostratigraphy and sequence stratigraphy of the Tournaisian-Viséan transitional strata in South China (Guangxi). *Geological Journal*.

Wu, X, and Chen, W, 1989, Studies on lithic facies and palaeogeography of Carboniferous in South China (Middle and Upper Yangtze region). In: XIe Congrès Int. Strat. Géol. Carbonifère Beijing, 1987, *Compte Rendu*, v.4, pp. 127-134.

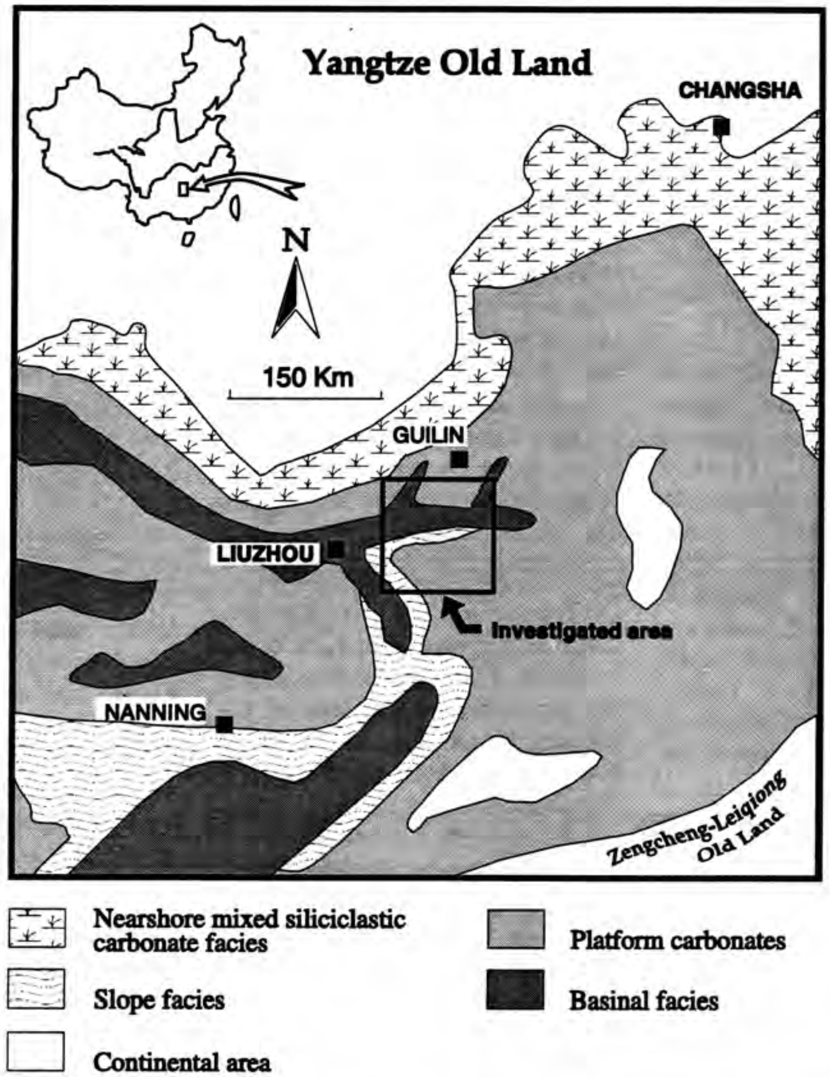


Figure 1 Palaeogeographic map of South China at the end of the Tournaisian (after Wu & Chen 1989).

Request for information. In order to make significant progress in evaluating the biostratigraphic use of *Eoparastaffella*, additional material is needed from different places. Members interested in this problem are invited to contact Luc Hance, Geological Survey of Belgium, Jennerstr., 13, B1000 Brussels, Belgium. Fax: +322 6477359 E-mail : hance@page.ucl.ac.be

Working Group to define a GSSP close to the Moscovian/Kasimovian boundary

SEARCHING FOR A LEVEL OF CORRELATION WITHIN THE UPPER CARBONIFEROUS

E. VILLA, Departamento de Geologia, Universidad de Oviedo, 33005 Oviedo, Spain (With contributions from James E. Barrick, Alexandra V. Dzhenchuraeva, Holger C. Forke, Philip H. Heckel, George A. Sanderson, Katsumi Ueno, George L. Verville and Gregory P. Wahlman).

PRESENT SITUATION OF WORKING GROUP STUDIES

Since the last report (Villa, 1996) on the studies of this Working Group (formerly Project Group 5), we have continued work in several areas toward the greater precision of stratigraphic correlation. These studies have been, and still are, mainly focused on the detailed analysis of marine faunas in continuous stratigraphic successions, because we consider our first priority is to find relevant events in the evolution of marine biota that might be used as biostratigraphic markers.

The sections so far considered as more relevant are those situated in the Russian Platform (Domodedovo and Afanasievo sections), Cantabrian Mountains (Las Llacerias section), Donetz Basin (Kalinovo section) and the American Mid-Continent, since they seem to contain a rather complete fossil record through the interval of interest. Two of these sections (Las Llacerias and

Domodedovo) have been compared and correlated in a first attempt to find a characteristic level for long distance correlation (Villa, *et al.*, in press). Other areas that have also been reported on by members of the Group have provided further useful and interesting information. New sections and localities are starting to be investigated.

So far conodonts and fusulinids have provided the most promising data (see reports below). Therefore, further investigations are now devoted to the detailed analysis of these two fossil groups, although other fossil elements will be studied as well. Paleontological analyses are being coordinated with sedimentological and stratigraphic analyses, which will enable us to position biostratigraphic events in a broader context, and thereby linking them to paleoenvironmental and paleoegeographic situations.

Also in this direction, isotope analyses through the interval of interest have been carried out (thanks to the colaboration of Dr. M. D. Brasier, from the University of Oxford) in the Moscow Basin and in the Cantabrian Mountains, providing stimulating results. These studies are now being extended to other stratigraphic sections. Progress in this task has been slow, but we think we are headed in the right direction, and that these studies will contribute significantly to the correlation of the Upper Carboniferous successions. It must be stressed that this research is progressing thanks to the enthusiastic collaboration of members of the Working Group. In spite of the many difficulties concerning time and financial support, the members are committed to reaching the goals set by the SCCS for the Working Group.

Working Group Meeting (Ukraine)

As reported in Krakow in 1995, a Working Group meeting was organized in Ukraine in September 1996. Twenty four members of the Group (from Germany, Japan, Kyrghyztan, Russia, Spain, Ukraine and USA) attended this meeting, which was very successful. We would like to express our gratitude to the Institute of Geological Sciences of Kiev and particularly to Dr. Tamara Nemirovskaya, who along with the help of several Ukrainian colleagues, did an excellent job in making arrangement for the meeting.

On September 19th, the Working Goup was received in Kiev at the Institute of Geological Sciences of the Academy of Sciences of the Ukraine by its Director, Dr. Petro F. Shpak. On September 20th, we travelled to the Donets Basin, where we visited several sections and outcrops of Carbonifeorus successions for four days. This field trip was guided by Dr. T. Nemirovskaya, Dr. V. Poletaev and Dr. A. S. Alekseev. The visits included not only the Kalinovo section (which is the most important section embracing the Moscovian/Kasimovian transition) but also other sections showing rocks from the Mid-Carboniferous boundary and higher in the section.

On September 25th we returned to Kiev and had workshops for three days. Mainly discussions concerned the identification and significance of conodont and fusulinid collections that were brought by participants from their differents research areas. It was stressed by several participants that this was the first occasion in the history of Carboniferous research that Russian, Ukrainian and American conodont specialists started to directly compare their respective materials.

The meeting finished on September 28 with a joint session held in the Institute of Kiev, at which all the workshop groups presented their final conclusions. The discusions continued that evening in a more festive atmosphere at the Dr. Tamara Nemirovskaya home, where she kindly organized a nice farewell dinner.

Working Group Meeting (Spain)

A field trip and general Working Group meeting will be held in Asturias (Northern Spain) from September 28th to October 6th, 1997. During the field trip we will visit several Carboniferous outcrops situated in the Picos de Europa area, where marine successions range from the base of the Carboniferous System to the top of the Kasimovian. After the field trip, three days of laboratory sessions and discussions are plnned to be held at the Department of Geology in Oviedo. So far, more than 20 members of the Working Group have announced their intention to attend this meeting.

Observations on conodont faunas across Desmoinesian/Missourian and Moscovian/Kasimovian boundaries.

Report by James E. Barrick and Philip H. Heckel (USA

Direct comparisons of conodont faunas from the Russian Platform, Donets Basin, Spain, and Midcontinent North America indicate an overall similarity in taxa from these areas. The morphological differences that do exist in Pa elements of *Idiognathodus* seem to be more a function of phenotypic responses to different environments than to the presence of endemic species. The conodont faunas from Russia, Donets, and Spain were obtained largely from shallower water carbonates, whereas the best known faunas from Midcontinent North America come from the deeper water core shales of cyclothems. Additional work must be completed in the shallower water facies, mostly carbonates, of Midcontinent cyclothems and equivalent beds in the Illinois and Appalachian basins in order to fully determine the range of morphologic variation controlled by the environmental setting. Sufficient conodont material exists to make a provisional correlation of the North American Desmoinesian/ Missourian stage boundary with the Eurasian Moscovian/ Kasimovian succession. The first species of *Idiognathodus* similar to Midcontinent Missourian forms appear in limestones of the Khamovnichesky in the Moscow Basin and in the O1 limestone of the Donets Basin. Both of these horizons lie near the appearance of the fusulinid *Montiparus*, well above the base of the Kasimovian and the first occurrence of the fusulinid *Protriticites*. Conodont faunas of the basal Kasimovian, the Kreviakinsky, are like those recovered from upper Desmoinesian units in the Midcontinent region. The main difference between the Eurasian and Midcontinent successions is that the last occurrence of the genus *Neognathodus* appears to be much earlier in Eurasia than in North America. This correlation is supported by comparison of conodont and fusulinid occurrences in the Honaker Trail section in the Paradox Basin of Utah, USA. There *Protriticites* occurs in bed 88 (Greg Wahlman, Amoco), which lies approximately 45 meters and at least three major eustatic cycles below the appearance of Missourian conodonts in bed 111. These correlations indicate that a significant interval of geological time exists between the current levels at which the base of the Kasimovian and the base of the Missourian are placed. The conodont faunas are sufficiently distinct through this interval to permit the correlation of a Middle/Upper Pennsylvanian boundary at several levels from the base of the Kasimovian into the lower part of the Missourian. However, any level at which the boundary is placed will require considerable adjustment of either Eurasian or North American stage boundaries, or both, to accommodate the new boundary.

Protriticitid fusulinaceans in the Late Desmoinesian of the Rocky Mountains, western USA

Report by Gregory P. Wahlman, George L. Verville, and George A. Sanderson (USA)

The fusulinacean *Protriticites* is reported for the first time from the United States, where it has been found in Utah, Nevada, and Idaho associated with the Late Desmoinesian fusulinids *Beedeina*, *Bartramella*, and *Plectofusulina*. These new protriticitid occurrences have significant bearing on the correlation of the North American Desmoinesian-Missourian boundary and the Eurasian Moscovian-Kasimovian boundary, but integrated biostratigraphic data from conodonts, ammonoids, and other goups are needed.

The protriticitids appear to be restricted to a fairly narrow stratigraphic range in the middle Late Desmoinesian, occurring between the Zone of *Wedekindellina* (Early Desmoinesian) and the Zone of Beedeina megista (latest Desmoinesian), and being most commonly associated with *Beedeina* ex gr. *haworthi*, *B.* cf. *erugata*, *B. retusa*, and *Bartramella bartrami*.

The new protriticitids and their significance will be discussed at the PaleoForams conference to be held in Bellingham, Washington, USA, in August, 1997.

ADDITIONAL INVESTIGATIONS IN OTHER CARBONIFEROUS AREAS

Several members of the Working Group have submitted brief reports dealing with their respective investigations in diverse areas of the world.

Research in the South Tien-Shan, Kara-Chatyr Mountains

Report by Aleksandra V. Dzhenchuraeva (Kyrghyzstan)

A sedimentary succession of rocks, ranging from the middle part of the Carboniferous to the Permian, is exposed in the western part of the Kara-Chatyr Mountains (South Tien-Shan). These strata, with a thickness up to 7000 m, mainly correspond to shallow marine deposits with some terrestrial intercalations. The Moscovian/Kasimovian boundary is observed in several sections in which not only foraminifera, but also remains of other fossil fauna, as well as terrestrial flora and trace fossils, can be observed. At the Moscovian/Kasimovian boundary there is thin bed that provided paleomagnetic data indicating a positive zone.

One of the most relevant sections is the Akchaku section, which shows strata belonging to the Shunkmazar horizon (uppermost Moscovian, *Fusulinella schwagerinoides* Zone) and to the Dzhilinsai horizon (lower Kasimovian, *Obsoletes obsoletus* Zone). Apparently, there is neither an unconformity, nor a washout at the boundary between these two horizons, but only a lithological change.

The base of the Shunkmazar horizon is characterised by the presence of *Fusiella* sp., *Ozawainella angulata*, *Neostaffella umbilicata*, *N. parasphaeroidea*, *Fusulinella pseudobocki*, *F. rara*, *F. bocki*, *F. schwagerinoides* and *Hemifusulina regularis*. The top of the horizon has yielded *Fusulinella* aff. *bocki*, *F.* aff. *cumpani*, *Fusulina elegans*, *Hemifusulina bocki mosquensis*, *H. truncatula* and *Fusulinella schwagerinoides*.

Strata belonging to the Dzhilinsai horizon have yielded *Fusiella praelancetiformis*, *Fusulinella* ex gr. *mosquensis*, *F. bocki*, *F. schwagerinoides*, *F. adjuncta*, *Protriticites subovatus*, *P. globulus turkestanicus, P. variabilis, P. pseudomontiparus, P. subschwagerinoides inflatus, Fusulina donbassica asiatica, Quasifusulinoides(?) bosbiensis, Q. parafusiformis, Obsoletes fusiformis, O. minutus asiaticus* and *O. vetus.*

The Akchaku section has been studied during the 80s. However, additional research taking into consideration different fossil groups that occur abundantly, should be undertaken to better characterize the Moscovian/ Kasimovian transition.

Research in the Carnic Alps (Austria/Italy)

Report by Holger C. Forke (Germany)

Several outcrops exposing Carboniferous deposits of uppermost Moscovian and lower Kasimovian ages are being currently studied in the Carnic Alps. These rocks contain both fusulinid and conodont faunas providing which is of interest to the present SCCS Working Group.

The stratigraphic sequence of the Carnic Alps (Austria/Italy) comprises two depositional cycles, separated by Variscan (Hercynian) tectonic events. The Lower Paleozoic cycle started during the Ordovician and is terminated by the Lower Carboniferous Hochwipfel Formation. The Variscan Orogenic Phase reached its climax during middle Westphalian times and was followed by the Carboniferous to Mesozoic cycle, starting with the Upper Carboniferous Auernig Group and comprising Late Paleozoic and Lower to Middle Triassic rocks. These sediments unconformably overlie the folded Variscan basement. Currently, a detailed restudy of the Upper Carboniferous/Lower Permian sequence is in progress by Dr. Karl Krainer (University of Innsbruck) and Prof. Erik Fluegel, Dr. Beate Fohrer, Elias Samankassou and Holger C. Forke (all University of Erlangen-Nürnberg). Research is devoted to controls on cyclic sedimentation patterns, formation of mounds and reefs and systematic survey of paleontological data (ostracods, foraminifers, conodonts, calcareous algae), enabling more precise biostratigraphical and paleoenvironmental interpretations. Most paleontological and biostratigraphical studies of Late Paleozoic sediments concerned fusulinids (due to the long-lasting work of Franz Kahler), which allow correlations with the Russian standard zonation. Plant fossils have been studied by Adolf Fritz enabling correlations of macrofloral subdivisions and biostratigraphical zonations based on fusulinids (Fritz et al., 1990). Conodonts, recently found in Upper Carboniferous (Luppold, 1994) and Lower Permian sediments (Forke, 1995) are an important clue for global correlations. The earliest marine transgressions on the Variscan basement took place during Uppermost Moscovian?-Lower Kasimovian times (Kahler, 1986 a, b) in the Naßfeld (Pramollo) area. There-fore, concerning the research of the SCCS Working Group (formerly Project Group 5), several sections with sedimentary contact to the underlying variscan basement are under investigation by means of fusulinids and conodonts. Investigations in the Mount Cavallo area (Roßkofel) are undertaken in collaboration with F.W. Luppold (LfB Hannover). The sediments are represented by shallow-water, mixed siliciclastic- carbonate deposits. Cono-donts and fusulinids occur together in the same sample, allowing direct correlation of conodont and fusulinid based zonations. Impregnations of fusulinid wall in some of the beds led to an excellent preservation of wall microstructure, which provides the opportunity to study evolutionary changes in the wall structure from *Protriticites* to *Montiparus.*

Investigation of a potential section across the Moscovian/ Kasimovian boundary in the Loei-Wang Saphung area, Northeast Thailand

Report by Katsumi Ueno (Japan)

In the Loei-Wang Saphung area of Northeast Thailand, which is geologically situated at the western margin of the Indochina Block, the Late Paleozoic shallow marine strata are widely exposed. Igo (1972) was the first to report Moscovian to Asselian fusulinaceans and their biostratigraphy in this area. He described *Protriticites tethydis* which is the only latest Moscovian or earliest Kasimovian fusulinacean known in Thailand. In spite of recent accumulation of additional data concerning the Carboniferous fusulinaceans in this area, the Moscovian/Kasimovian boundary and its fusulinacean faunal change have not been clarified yet. The Carboniferous succession in this area, called the Wang Saphung Formation, is represented mostly by detrital clastic sediments with frequent intercalations of impure limestone lenses and/or impure bedded limestones. Recently, a preliminary field survey has been made in the southern part of the Loei-Wang Saphung area for finding a potential Moscovian/ Kasimovian boundary section. Two localities are being considered for this purpose: Ban Na Charoen and Ban Sam Muang, both about 30 km southeast of Wang Saphung, Changwat Loei, Northeast Thailand. In these and nearby localities, the occurrence of upper Moscovian and Kasimovian fusulinaceans has been reported (Fontaine *et al.*, 1994), but details of the faunas have not yet been published.

According to preliminary examination of thin sections made from several rock samples collected from these two localities, *Protriticites*? (or transitional *Protriticites-Montiparus* forms), *Montiparus,* *Rauserites*, *Quasifusulinoides*?, and *Quasifusulina* species are identified. However, because of the preliminary sampling from several isolated outcrops and float blocks, as well as poor condition of exposure by heavy vegetation and weathering, the stratigraphic relationships of these sample are not exactly determined at present. Now, Titima Charoentitirat (a postgraduate student in the fusulinid laboratory of the University of Tsukuba) has just started a study on the fusulinacean biostratigraphy of Northeast Thailand. A further field survey will be carried out next year, by which more information on the faunal change across the Moscovian/ Kasimovian boundary is expected to be provided.

References

Fontaine, H., Suteethorn, V. and Vachard, D. 1994. The Carboniferous corals of Southeast Asia with new discoveries in Laos and Thailand. *Proceedings of the International Symposium on Stratigraphic Correlation of Southeast Asia*, 25-42.

Forke, H. C. 1995. Biostratigraphie (Fusuliniden; Conodonten) und Mikrofazies im Unterperm (Sakmar) der Karnischen Alpen (Naßfeldgebiet, *Österreich). Jb. Geol. B.-A.*, 138(2): 207-297, Wien.

Fritz, A., Boersma, M. & Krainer, K. 1990. Steinkohlenzeitliche Pflanzenfossilien aus Kärnten, *Carinthia II*, Sh, 49: 1-108, Klagenfurt.

Igo, H., 1972. Fusulinacean fossils from Thailand. Part VI. Fusulinacean fossils from North Thailand. *Geology and Palaeontology of Southeast Asia*, 10: 63-116, pls. 9-19.

Kahler, F. 1986a. Ein Normalprofil der Fusuliniden-Stratigraphie im Oberkarbon und Unterperm der Karnischen Alpen. Carinthia *II*, 96: 1-17, Klagenfurt.

Kahler, F. 1986b: Eine neue Fusuliniden-Gemeinschaft in tiefen Oberkarbon-Schichten der Karnischen Alpen. *Carinthia II*, 96: 425-441, Klagenfurt.

Luppold, F. W. 1994. Conodontenfunde aus dem Ober-Karbon des Roßkofel (Karnische Alpen, Italien). *N. Jb. Geol. Paläont. Mh.*, 1994(9): 537-540, 2 Abb., Stuttgart.

Villa, E. 1996. Report of the Working Group to define a GSSP close to the Moscovian/Kasimovian boundary (formerly Project Group 5). *Newsletter on Carboniferous Stratigraphy*, 14: p. 8.

Villa, E., Alekseev, A. S., Barskov, I. S., Coquel., R., Davydov, V. I., Ginkel, A. C. van, Goreva, N. V., Isakova, T. N., Kabanov, P. B., Kononova, L. I., Lazarev, S. S., Lebedev, O. A., Makhlina, M. Kh., Mamet, B., Martínez-Chacón, M. L., Méndez, C., Rodríguez, R. M., Rodríguez, S. Sánchez de Posada, L. C , and Shkolin, A. V. (in press). Palaeontological analysis and comparison of the Moscovian/Kasimovian transition in the Moscow Basin (Russia) and in the Cantabrian Mountains (Spain). *Comptes Rendues XIII ICC-P*, Krakow, Poland.

PROJECT GROUP 4:

Zonation in Late Namurian successions: The Bashkirian Stage as a geochronological standard.

J. KULLMANN, Institut fuer Geologie und Palaeontologie, Universitaet Tuebingen, Germany (Project Leader) and S.V. NIKOLAEVA, Paleontological Institute of the Russian Academy of Science in Moscow, Russia.

Following the S.C.C.S. meeting on Global Subdivision of the Carboniferous System in Buenos Aires (1991) the senior author was asked to organize an international group to investigate the possibilities of defining the boundaries at the end of early Upper Carboniferous. The stratigraphical range and the boundaries of the middle and upper Namurian zones and their ammonoid faunas have been reviewed recently (Kullmann & Nikolaeva, 1995, Nikolaeva & Kullmann, in press). To provide a general framework for the early Upper Carboniferous stratigraphy we are presently engaged in additional studies focusing on well identifiable faunas of the early Upper Carboniferous zones in Bashkiria and their global distribution.

The geochronogical unit "Bashkirian" as the epoch between the Mid-Carboniferous boundary (MCB) and the base of the Moscovian Stage has been used in international stratigraphic schemes and geochronological scales in standard publications (e.g. Harland 1982 and 1989, Fossil Record 2, 1993, and many others). A detailed description of this time unit is given by Semikhatova *et al.* (1979). However Harland *et al.* (1989) pointed out that the Bashkirian is under review in respect to its boundaries.

In recent years the study of the Bashkirian Stage has made great progress as a result of successful collections and determinations of various fossil groups in the vicinity of the original type region of the Bashkirian Stage south-east of Ufa. The Ufa research group (e.g. Kulagina *et al.* 1992) have already presented valuable results for the recognition of the boundaries, subdivisions and potential type sections for the Bashkirian Stage by a careful bed by bed study and utilizing various fossil groups aimed at the definition of a stable chronostratigraphic scale in international correlations.

Co-operation with the Ufa research group (V.N. Pazhukhin, E.I. Kulagina and N.M. Kochetkova, Ufa Research Center RAS) , with O.L. Kossovaya (All-Union Research Geol. Inst. St. Petersburg) and I.S. Barskov (Moscow State University) involves a new attempt to define and subdivide the Bashkirian Stage of which plans are in progress. The major aim of this group is to provide a basis for the choice of type sections in the Bashkirian type area (western slope of Southern Urals). It is intended to provide the data for the choice of the Bashkirian as the Global Boundary stratotype sections and points (GSSP) by the International Commission on Stratigraphy (ICS) which meets the requirements of candidates set by the Guide-lines of the ICS.

In Bashkiria all the subdivisions of the Bashkirian Stage are recognizable, as well as its lower and upper boundaries. In its type area the Bashkirian Stage is represented by shallow water carbonates up to 250 m thick yielding a variety of marine invertebrates including ammonoids, corals, conodonts, foraminifers, brachiopods and ostracods. At present the Bashkirian Stage in Bashkiria (South Urals) includes two substages and six smaller units. The Early Bashkirian Stage comprises Bogdanovskii, Syuranskii (Yakhinskii), Akavaskii, and Askynbashskii horizons, the Late Bashkirian Stage comprises the Tashastinskii and Asatauskii horizons.

Outside the type region the correlation of the Bashkirian boundaries remains questionable because of the scarcity of data on integrated biostratigraphy in the type Bashkirian sections. At this stage of work detailed reference sections of the type region of the Bashkirian Stage have not yet been formed. They would allow precise identifications of the boundaries as well as comparisons with contemporary facial types.

In most European countries the period under consideration was studied in partly continental rock sequences which made global correlations difficult. In contrast, a continuous succession of marine rocks of this age is known from North Spain. The first worker to introduce Russian Upper Carboniferous Stage names in Spain was van Ginkel in his work on the fusulinid faunas and their significance in correlation studies (1965). He recognized six foraminiferal zones which are similar in the European part of Russia and the Cantabrian Mountains and presented for the first time a map showing the geographic relationship of the Bashkirian and Cantabrian successions in the Upper Carboniferous. On the basis of ammonoids Kullmann (1962) had pointed out the close relationship of the ammonoid faunas of the Cantabrian Mountains with those described form the Urals by Ruzhentsev and others, in contrast to the faunas in Central and Western Europe (Germany, England, Portugal). Studies of the Upper Carboniferous invertebrates in Spain were mainly concentrated on corals (Boll, Kullmann, Rodriguez), brachiopods (Martinez-Chacon, Winkler Prins), ostracods (Becker, Bless, Sanchez de Posada), and conodonts and foraminifers (van Ginkel, Villa, Ziegler and others).

A close co-operation with the Spanish research group in Oviedo (M.L. Martinez Chacon, L. Sanchez de Posada and E. Villa) and Madrid (S. Rodriguez) is also planned. It should result in a detailed comparison of Spanish sections with the corresponding successions of Bashkiria. A prime objective would be to provide fundamental data for the possible choice of auxiliary stratotype sections for the Bashkirian Stage boundaries in Spain. In summarizing, four biostratigraphical levels seem to be of primary importance. These are (1) the new base of the Bashikirian Stage, at the MCB, (2) the top of the Bashkirian Stage, at the base of the Moscovian, (3) the base of the *Reticuloceras* ammonoid zone, and (4) the Namurian-Westphalian boundary.

References

Ginkel, A.C. van. 1965. Spanish Carboniferous Fusulinids and their significance for correlation purposes.- *Leidse Geologische Mededelingen* 34: 173-225, Leiden.

Harland, W.B., Cox, A.V., Llewellyn, P.G., Pickton, C.A.G., Smith, A.G. & Walters, R. 1982. *A geologic time scale*.- 131 p., Cambridge (Cambridge Univ.Press).

Harland, W.B., Armstrong,R.L., Cox,A.V., Craig,L.E., Smith, A.G. & Smith, D.G. 1990. *A geologic time scale 1989*.- 263 p., Cambridge (Cambridge University Press).

Kullmann, J. 1962. Die Goniatiten der Namur-Stufe (Oberkarbon) im Kantabrischen Gebirge, Nordspanien.- *Abhandlungen math.- naturwiss. Klasse Akad. Wiss. Liter. Mainz*, 1962 (6), 1-119, Wiesbaden.

Semikhatova, S.V., Einor, O.L., Kireeva, G.G. et al. 1978. Bashkirskian Stage of the Urals (Stratotype), in *C.R. 8th Intern. Congr. Carbon Strat. Geol., Moscow, 1975,* vol. 1 (General Problems of the Carboniferous Stratigraphy): 112-118. [In Russian].

Korn, D. & Kullmann, J. 1996. GONIAT Database System, version 2.60; Tuebingen.

Kulagina, E.I., Rumyantseva, Z.S., Pazukhin, V.N., and Kochetkova, N.M. 1992. *Lower/Middle Carboniferous Boundary in the South Urals and Central Tien Shan.* Moscow (Nauka), 112 p. [In Russian].

Kullmann, J. & Nikolaeva, S. 1995. A Review of the Upper Namurian ammonoid biostratigraphy. *Newsletters on Stratigraphy* 32: 117-136, 10 figs., Berlin, Stuttgart.

Nikolaeva, S. & Kullmann, J. (in press): A Review of Middle Namurian ammonoid biostratigraphy. Newsletters on *Stratigraphy*, 10 p., 15 figs., Berlin, Stuttgart.

CONTRIBUTIONS TO THE NEWSLETTER

The Newsletter on Carboniferous Stratigraphy is published annually (in July) by SCCS. It is composed of written contributions from its members and provides a forum for short, relevant articles such as:

* reports on work in progress and/or reports on activities in your work place
* news items, conference notices, new publications, reviews, letters, comments
* graphics suitable for black and white publication.

Contributions for each issue should be timed to reach the Editor before 31 May in the year of publication. Material supplied well before this deadline would be appreciated. To facilitate setting up the Newsletter and to reduce typing errors, it would be of assistance if copy could be sent BOTH on paper and a computer disk. However, contributions without a disk are still acceptable.

The Newsletter is prepared using Microsoft Word on the Macintosh but contributions on most other word processing systems can be accommodated. Material should be forwarded on 3.5 inch disks in either Macintosh or IBM format. If you can supply a disk, you should observe the following requirements. Please include a printed copy and the name of the word processing package that you have used. Supply two copies of the file on disk. The first can be the normal output of your software which can include enhancements such as bolding and italics but NO indents or leading TABS please. Avoid any unusual formatting features of your package. The second copy of the file should be saved as a plain ASCII textfile (i.e. no enhancements). Please ensure that all typing is done with only ONE space after each full stop at the end of each sentence. Unless specifically requested the disk will not be returned since the cost of return postage is generally far greater than the original value of the disk. Please follow up your message with an air mailed, formatted, paper copy so that your special formatting (e.g. italics) can be restored by the Editor.

AIR MAIL your contribution to the Editor:

Dr Ian Metcalfe, Division of Earth Sciences, School of Physical Sciences & Engineering, University of New England, Armidale NSW 2351 Australia.
(Tel: +61 2 6773 2860; Fax: +61 2 6773 3300)

Files can also be included in an E-mail message or attached as a Rich-Text-Format (RTF) file or MS Word document compressed with BinHex 4 on the Internet. The Editor's E-mail address is:

sccs@une.edu.au

Light Entertainment on the WWW

Check this out!

Carboniferous Human Bones!

http://www.geo.ucalgary.ca/~macrae/t_origins/carbbones/carbbones.html

http://www.access.digex.net/~medved/conrad/conmain.htm

Revision of the Carboniferous part of the IUGS Global Stratigraphic Chart

Ian Metcalfe
Division of Earth Sciences, School of Physical Sciences & Engineering
University of New England, Armidale NSW 2351, Australia

In mid-March, 1997, the Chairman of SCCS, Professor John Roberts received a draft revision for the Carboniferous part of the IUGS Global Stratigraphic Chart (originally compiled by J.W. Cowie and M.G. Bassett of the Bureau of ICS and published in 1989) and a series of questions relating to this chart from the Chairman of ICS. The Carboniferous part of the chart sent to SCCS is reproduced in figure 1.

				GSSP
CARBONIFEROUS C	Late/Upper	*Gzhelian*		
		Kasimovian		
		Moscovian		
		Bashkirian		
				GSSP
	Early/Lower	*Serpukhovian*		
		Visean		
		Tournaisian		
				GSSP

Figure 1. Proposed revised version of Carboniferous part of IUGS Global Stratigraphic Chart received from the Chairman of ICS.

Along with the proposed chart revision, the Chairman of ICS sent a number of General Questions to be answered by the Chairs of Subcommissions. Question 2.8 was specific to the Carboniferous:

"2.8. Carboniferous

> The subdivision used in the draft of the Global Chart was the one proposed by Rich Lane, but other schemes seem to be used in parallel by the Carboniferous SC. This concerns also the status of classical W-European divisions like Westphalian and Stephanian.
>
> In addition, there are problems with the ranks of units. The Russian divisions used in the draft were originally conceived as stages. Is it really meaningful to elevate them to series rank, when no GSSPs for stage subdivisions are in sight?
>
> The mid-Carboniferous boundary, the only one within the Carboniferous having a GSSP, is meant to delimit two subsystems. What about their names, and how to handle the Bashkirian: is this a formal name following the definition of the mid-Carboniferous bdy by a GSSP?"

It was decided that the Voting Membership of SCCS should be consulted on this matter before a formal submission was made by the Chairman of the SCCS. Unfortunately, the deadline of 15 June set by the ICS did not allow us sufficient time to involve the wider corresponding membership. This article is, therefore, to provide the wider membership of SCCS with an overview of events and the ultimate submission made to the ICS. In order to provide a starting point for discussions, a possible (and provocative) alternative to the chart provided by ICS was circulated to all Voting Members in early May and their comments and suggestions requested. This resulted in a deluge of responses which varied from general to very specific comments and suggestions, and some quite emotive exchanges of correspondence! It soon became clear that general consensus could probably be reached on a global division of the Lower Carboniferous, where relatively cosmopolitan faunas and floras provide the necessary correlations, but that consensus on global division of the Upper Carboniferous (in fact from the base of the Namurian upwards) was not achievable in the short term due to the extreme provincialism of faunas and floras developed as a consequence of the glacially influenced world climate and cyclical depositional patterns which extended accross the broad platform regions of the world's continents. Some Carboniferous workers, R.H. Wagner, and more recently N. Riley (see article by Titus and Riley this issue) have suggested that in fact, for the peculiar conditions of the Upper Carboniferous, maximum flooding surfaces and faunal changes associated with these could form the framework for a global subdivision. This approach of using maximum flooding events in mixed siliciclastic-carbonate sequences as a key to global chronostratigraphic correlation is also gaining wider support in other parts of the geological collumn (see the recent paper by Mancini and Tew, 1997).

Many general and specific suggestions/comments were received from Voting Members and it is beyond the scope of this article to list or discuss all of these. It is clear however, that there exists a wide range of philosophies regarding prefered approaches towards the goals of SCCS. Preservation of historical subdivisions (at least in name), so as to be able to relate to the voluminous previous literature, seems to have some support. Alternatively, there is support for establishing a completely new chronostratigraphic scheme for the Carboniferous, without any historical "baggage", but at the same time preserving the historical regional schemes. A number of "technical" objections to the modifaction of existing terms, or the establishment of new or modified stratotypes for these units, were made. In fact, the new "Revised guidelines for the establishment of global chronostratigraphic standards by the International Commission on Stratigraphy (ICS)" (Remane *et al.*, 1996) does not preclude the use of traditional chronostratigraphic units or modification of the boundaries of these units, or stratotypes being established in areas other than the original area from which the unit name is derived. This very issue was highlighted in discussions on the names to be used in the IUGS chart for the two Sub-Systems defined by the Mid-Carboniferous Boundary (MCB) GSSP at Arrow Canyon and for the use of other traditional units that will require modification of their boundaries or the establishment of new stratotypes or parastratotypes. The Voting membership seems to be split down the middle regarding names for the Sub-Systems, "Mississippian" & "Pennsylvanian", and "Lower Carboniferous" & "Upper Carboniferous" having about equal support. The issue of the naming of these units will be tabled at the SCCS meeting in Australia in September and moves initiated towards a formal vote on this matter made. **In this respect, submissions on this matter are invited from all members of the SCCS.** I feel that it is unfortunate that the issue of naming these units was not formally resolved at the time of formal voting on the MCB GSSP. A number of Voting members commented on the facies sensitivity of the fusulines and reliance on this group for definition of GSSPs may have problems (as identified with the first appearance of *Beedeina* for instance — this appearance may not be synchronous in N. America and Europe). Elevation of stages to series rank also drew a significant level of response. For former Russian stages, this is no longer an issue, since the Russians have formally raised their stages to Series and the former "horizons" to stage rank (see article by Kagarmanov and Kossovaya this issue). The base of the Bashkirian has also been formally lowered by the Russian Commisssion on Carboniferous Stratigraphy to the base of the *Declinognathodus noduliferous* conodont zone and base of the *Homoceras* ammonoid zone.

With all this in mind, and taking into account more specific comments relating to individual stratigraphic units, John Roberts and I spent considerable time together in Sydney compiling a chart and comments for submission to the Chairman of ICS. We have insisted that we should not be "straight jacketed" by the new simplified format of the proposed revised chart which allows for only one collumn for series. We feel that at present, three collumns are necessary for the Upper Carboniferous (as presented in figure 2) pending identification of globally recognisable horizons that can be utilised for GSSPs. An alternative chart, with only two series collumns in the Upper Carboniferous (omitting the N. American scheme) was also submitted as a possible compromise if the more complex chart was unacceptable to the ICS. In his letter to the Chairman of the ICS, the SCCS Chairman, Professor John Roberts, summarised the recommendations of SCCS as:

1. The Carboniferous System/ Period is divided into the Lower Carboniferous and Upper Carboniferous.
2. The two lower series for the Carboniferous are the Tournaisian and Visean. Both can be recognised globally.
3. Two complementary sets of series are required for the interval between the base of the Namurian/Serpukhovian to the end of the Carboniferous (Figure 1) because a major glaciation in Gondwana during this interval induced extreme provincialism within the earth's biota.
4. The Russian Serpukhovian to Gzhelian Series are tentatively chosen to provide names applicable to the palaeoequatorial regions of Russian, Western Europe North America or China. However, an alternative set of series from North America (Figure 2) may soon become viable.
5. The Western European series, which are both non-marine

and marine in origin, are required because they are the only units in the palaeo-equatorial belt that have been comprehensively dated by Ar^{39}-Ar^{40} and U-Pb zircon methods. These series supply the only means by which successions of Namurian/ Serpukhovian-end Carboniferous age within the Gondwanan continents can be linked with the international timescale. The eastern Australian marine and non-marine sequence has been dated by SHRIMP U-Pb zircon methods and supplies necessary correlations within Gondwana.

6. Glaciation within Gondwana from the Namurian/ Serpukhovian to the end of the Carboniferous caused fluctuating sea levels, the development of cyclical patterns of deposition separated on platform regions by extensive unconformities, and was also responsible for a level of provincialism within the palaeoequatorial belt that has hindered correlation between the different regions of that province. An example of the difficulties of correlation is provided by the Working Group on the Moscovian-Kasimovian boundary, which after many years of work in Europe, Russia and North America is still searching for the necessary faunal evidence for an effective GSSP.

7. For these reasons, the names chosen for the Namurian/ Serpukhovian-end Carboniferous are tentative. Should a more widely applicable conodont-based set of GSSPs be established from North America it may be argued that the American Morrowan-Virgilian Series should take precedence because the boundaries of these units are located in quite different positions of the chart compared with those in Russia.

Whilst Figure 2 reflects the current status of research into the Namurian/Serpukhovian-end Carboniferous interval, and it would be preferable for all three columns of series to appear on the Global Stratigraphic Chart, the SCCS realises that it may be difficult to change the format of the chart to that extent. If this is impossible, the SCCS is prepared to compromise with the two columns of series as indicated in Figure 1. Because of the reasons advanced above, which clearly illustrate that the later part of the Carboniferous was different to other Phanerozoic periods, and that there are essential reasons for the existence of the two alternate columns, we cannot agree to the use of a single set of series names at this time. A single set can only be used if the Russian or North American successions were to be dated radiometrically or new methods became available for the precise correlation of Gondwanan and palaeo-equatorial sequences.

Explanatory notes on the chart were also submitted to the Chairman of ICS and these are reproduced below:

GLOBAL STRATIGRAPHIC CHART

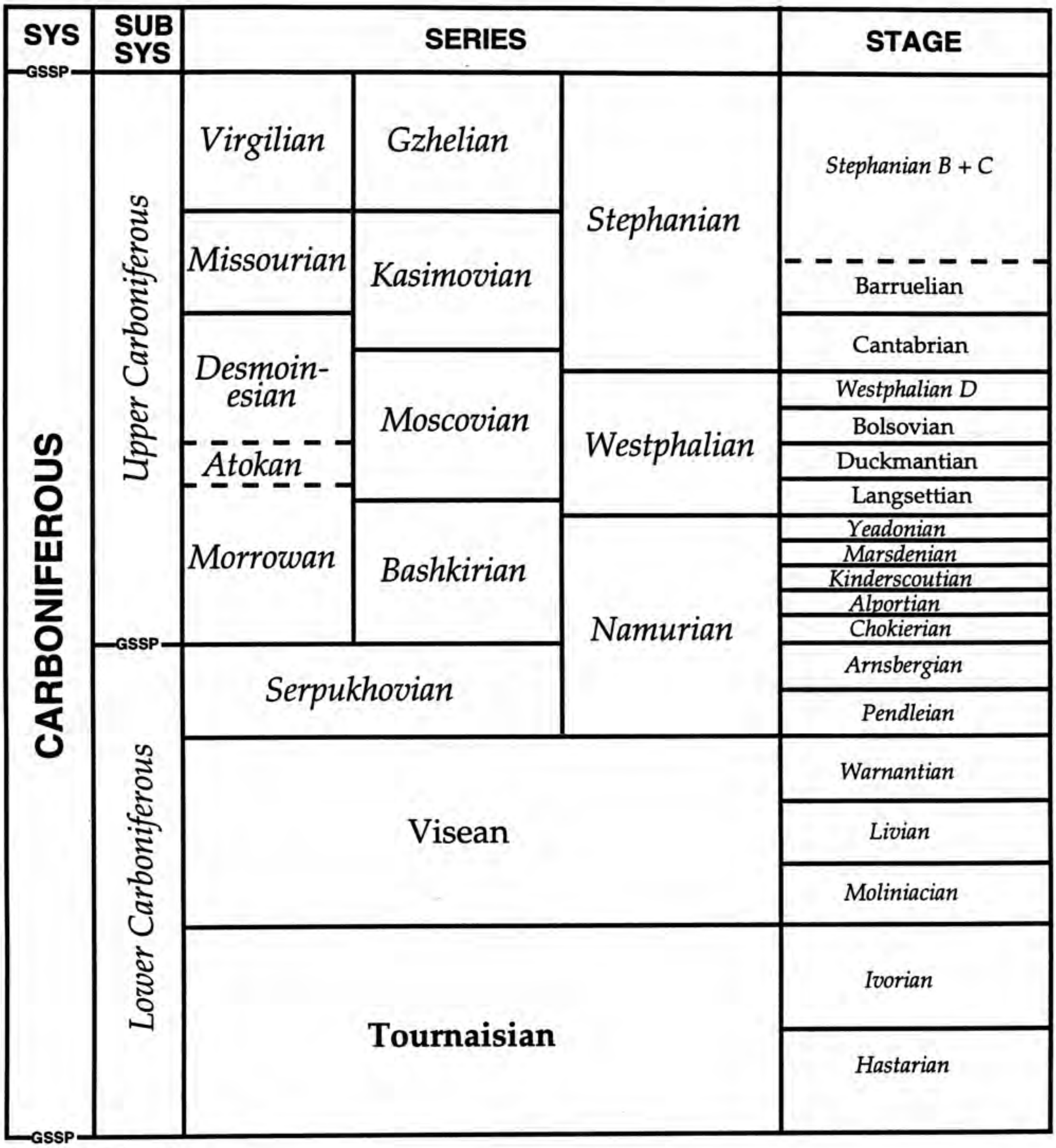
Sub-Periods/Systems

Lower Carboniferous and Upper Carboniferous are proposed as the two Sub-Period/System names because they are universally applicable. The base of the Upper Carboniferous is defined at a GSSP coinciding with the first appearances of the conodont *Declinognathodus noduliferus* and the ammonoid *Homoceras*.
These two names will be proposed to the next meeting of the SCCS in September 1997 and if approved a formal postal ballot of voting members of SCCS will follow.

Series/Epoch

The Carboniferous is one of the most difficult parts of the Phanerozoic record in which to establish a timescale of global significance. This stems from the rapid southward movement of Gondwana towards the end of the Visean and especially during the Namurian, and the development of a substantial icecap which influenced world climates and depositional patterns. The latter were characteristically cyclical, separated by unconformities, and extended across the broad platforms of Europe, Russia and North America from the Namurian/Serpukhovian throughout the remainder of the Carboniferous. The biota were particularly affected by the onset of glacial conditions. From a relatively cosmopolitan biota in the Tournaisian, during which there were widespread conodont, foraminifer, ammonoid, trilobite, brachiopod and plant biota, in the Visean there was the beginning of provincialism outside Palaeotethyan regions (e.g. brachiopod faunas of mid-western USA; conodonts of eastern Australia). In Gondwana, by the Namurian, virtually all of the previous biota had disappeared, being replaced by a cold-climate biota typified particularly by the *Levipustula levis* brachiopod assemblage.

In southeastern Australia, the *L. levis* Zone is confined to the early part of the Namurian, as indicated by SHRIMP zircon dates (Roberts et al. 1995a). Apart from a single specimen of *Cravenoceras kullatinensis* and a fauna from the lower part of the *L. levis* Zone containing *Gnathodus girtyi maxwelli* (which ranges up from Visean strata), *Hindeodus* cf. *minutus* and *Geniculatus* ? sp. (Roberts et al. 1993; Jenkins et al. 1993), ammonoids, conodonts and foraminifers are unknown from



GSSP = Global boundary stratotype

Figure 2. Chart submitted to the Chairman of ICS for the revised IUGS Global Chart. (It is likely that a simplified version with N. American series omitted will be used - Ed)

Gondwanan successions. None of the brachiopod species from the *L. levis* Zone is comparable with species from the palaeo-equatorial belt, though Roberts et al. (1993, p. 369) record five or six species that have been compared with elements of a fauna in the Baikal region of Asia. The latter appears to be part of a northern cold region, possibly Angara. No firm correlations between this cold region and the palaeoequatorial belt exist.

As eastern Australia possesses by far the biologically richest, marine, Carboniferous strata within Gondwana, the remainder having largely non-marine successions, it is clear that correlations even to series level cannot be made with the palaeoequatorial belt (North America, China, Russia and Europe). The only means of effective correlation is by the isotopic timescale, Upper Carboniferous successions of eastern Australia and Europe having been dated by SHRIMP U-Pb zircon and Ar^{39}-Ar^{40} sanidine ages (Roberts et al. 1995a,b; Hess & Lippolt 1986), respectively. There is also a single horizon based on a long term reversal in polarity at the base of the Kiaman Superchron. The age of the base of the superchron has been recently redefined within eastern Australia by Odyke, Irving, Roberts & Claoue-Long (unpublished data).

As all of the southern continents, India and parts of the Middle East contain Gondwanan successions it is essential that the Global Stratigraphic Chart contain a set of series applicable to the largely non-marine Upper Carboniferous successions of Gondwana. For this reason it is necessary that the Western European series be placed alongside the Russian marine sequence.

RUSSIAN SERIES

The Russian units previously termed stages have been recently elevated by the Russian Subcommission on Carboniferous Stratigraphy (RSCS) to the rank of series. Subdivisions of these original stages, termed 'horizons', have similarly been elevated to stage rank. The SCCS has chosen not to follow this practice until the exact nature of these 'horizons' is clarified.

Tournaisian and Visean

The Tournaisian and Visean Series are presently subdivided differently in Russia to that accepted throughout the remainder of the world, the *Dollymae bouckaerti* and *Scaliognathus anchoralis* conodont zones being assigned to the Visean instead of the Tournaisian.

The Working Group for a GSSP at this boundary has proposed the base of the Visean be taken at the first appearance of *Eoparastaffella* morphotype 2 of Hance & Muchez (1995). This is above the last appearance of *S. anchoralis*. The highly prospective South China region contains the evolutionary succession between Eoparastaffella morphotypes 1 and 2, but these cannot be found in a single section. Hence the search continues for a GSSP.

Serpukhovian

The Serpukhovian is essentially equivalent to the Pendleian and Arnsbergian Stages (E1 and E2) of the Namurian of Western Europe. In the Moscow Basin the Serpukhovian unconformably overlies Visean strata (i.e. the Tarussian horizon unconformably overlies the Venevian horizon). The Tarussian horizon contains ammonoids and conodonts of E1 age. Alexeev (letter of 26 May 1997) suggests that the first appearance of the conodont *Lochreia ziegleri* in the topmost Venevian may provide a GSSP. He also notes the good foraminifer record in the Visean-Serpukhovian transition.

Bashkirian

The base of the Bashkirian has recently been redefined by the RSCS to extend to the mid-Carboniferous boundary (ie. to the first appearance of *Declinognathodus noduliferus* and *Homoceras*.). In the type area the Bashkirian rests unconformably on Serpukhovian limestone, but deeper water sections in the Southern Urals have potential for correlation with the mid-Carboniferous GSSP. The limestone succession within the Cantabrian Mountains of Spain may also provide similar correlation.

Moscovian

In the Moscow Basin the base of the Moscovian rests unconformably on older strata. Alekseev (26 May 1997) suggests a possible GSSP could be located in the Southern Urals at the first appearance of the *Aljutovella aljutovica* fusulinid Zone above the uppermost Bashkirian *Verella spicta* Zone. Care must be taken to ensure that the overlap between the Veryan horizon of the Moscovian and the Melekesian horizon of the Bashkirian, recognised within the Moscow Basin (Nemirovskaya & Alekseev 1995) is taken into account when defining a GSSP. Jones (letter 3 June 1997) suggests that there may be a need to revise the fusulinids within the Veryan-Melekesian interval.

Kasimovian

A potential GSSP is located at the *Obsoletes obsoletes* Zone above the uppermost Moscovian *Fusulina cylindrica* Zone in the Moscow Basin, though Alexeev et al. (1996) indicate an unconformity in all except northern parts of the Basin. This level coincides with the change from the *Neognathodus roundyi* Zone of the uppermost Moscovian to the *Streptognathodus subexcelsus* Zone (Alexeev letter 26 May 1997; RSCS 1997)

Gzhelian

Whilst there is an unconformity at the base of the Gzhelian within the Moscow Basin the succession in the Urals appears to be continuous from the Kasimovian (Grigoreva et al. 1996). A potential GSSP is located at the boundary between the *Triticites rossicus* Zone of the lowermost Gzhelian and the *T. acutus* Zone at the top of the Kasimovian. Alexeev (letter 26 Jun 1997) states that this level coincides with the first appearance of the *Streptognathodus simulator* conodont Zone.

WESTERN EUROPEAN SERIES

Namurian to Stephanian successions of Western Europe contain both marine and non-marine strata, with the marine influence being more pronounced in Spain than elsewhere; in northern Spain there are extensive limestone successions of Bashkirian age and the marine influence extends into the Cantabrian, Barruelian and Stephanian B, though all latter three stages contain substantial non-marine successions.

NORTH AMERICAN SERIES

Conodont work in the marine Pennsylvanian of North America is beginning to indicate that this group could provide a means of defining GSSPs for a number of Upper Carboniferous series. The group lead by Phil Heckle of Iowa is about to name a number of conodont zones from mid-continental USA, and has indicated that there are a number of western basins that contain carbonate successions of Atokan-Virgilian age still to be examined. The North American units of the Midcontinent Basin may be superior to those of the Russian Platform in that they lack the unconformities and extremely shallow water facies that characterise the latter region. For this reason, it is important that the North American succession be considered equally with that from Russia in future work designed to establish GSSPs.

Morrowan and Atokan

No details have been provided for these units.

Desmoinesian

According to Jones (letter 3 June 1997), most foram workers take the base of the Desmoinesian at the base of the *Beedeina (Fusulina)* Zone, despite the absence of supporting fusulinid evidence from the type Desmoinesian region of Iowa. There is also confusion caused by *Fusulinella iowaensis* which is generally present below *Beedeina* but in some sections is found with *Beedeina*. Jones advocates that conodonts, in conjunction with the palynofloras, be used to redefine the base of the Desmoinesian. This suggestion is confirmed by Heckle (letter 29 May 1997) who indicates that the east-central Oklahoma sequence may yield an alternative section with a boundary based on conodonts. Jones suggests that the first species of Merrill's (1975) lineage of *Neognathodus bothrops-medadultimus-medexultimus-roundyi-dilatus*, present within the Desmoinesian, may mark the base of the Desmoinesian. *Neognathodus bothrops* succeeds the *N. atokensis* Zone, the youngest zone in the Atokan. He also argues that the base of the Desmoinesian correlates with the Duckmantian-Bolsovian (Westphalian) boundary at the *Donetzoceras aegiranum* marine band (between K6 and K7 limestone in the Dontez scale).

In terms of the Russian Platform the base of the *N. bothrops* Zone (with *Idiognathus obliquus*) lies in the Tsninskian horizon (Solovieva et al. 1985), which unconformably overlies the Veresian (*Idiognathoides tuberculatus-Declinognathodus marginodosus* Zone). This latter zone is correlated (Nemirovskaya & Alexeev 1995) with the *D. donetzianus* Zone in the Donbass (K2-K7), and the *Neognathodus atokensis* Zone in the southern Urals (Asatausky + lowermost Solontsovky), ie. uppermost Bashkirian and lowermost Moscovian. This correlation indicates an upper Bashkirian-lower Moscovian overlap and that the Atokan-Desmoinesian boundary may lie within the Tsninskian-Veresian unconformity (Jones letter 3 June 1997).

Missourian

The base of the Missourian is characterised by the first appearance of *Idiognathodus eccentricus* (Barrick et al. 1996), a species that Barrick has also recognised, but which is under another name, at an equivalent stratigraphic level in the Donetz Basin (Heckle letter 29 May 1997).

Virgilian

Heckle considers the base of the Virgilian is best recognised by the first appearance of *Streptognathodus zethus*, an eastern European species.

In summary, I would like to briefly provide you with the current status of the Carboniferous timescale in terms of global boundary stratotypes and working/project groups investigating levels for potential GSSPs.

Global Boundary Stratotypes

The present Carboniferous timescale is firmly based with GSSPs at three points:

1) The Devonian-Carboniferous boundary is taken at the first appearance of the conodont *S. sulcata* with the Global Boundary Stratotype (GBS) at La Serre (France), and Auxiliary Boundary Stratotypes at Hasselbactal (Germany) and Nanbiacun (China).

2) The mid-Carboniferous boundary is defined at the first appearance of the conodont *Declinognathodus noduliferus* with the GBS at Arrow Canyon (USA). This level approximates the transition between *Eumorphoceras* and *Homoceras*.

3) The Carboniferous Permian boundary established by the Permian Stratigraphic Subcommission at first appearance of the "isolated nodular" morphotype of *Streptognathodus "waubaunsensis"* conodont morphocline with the GBS at Aidaralash Creek, Aktyubinsk region of northern Kazakhstan.

Working/Project Groups

Six formal Project Groups were formed by the SCCS at the Provo Field and General Meeting, 1989. These were:

Project 1: A chronostratigraphic boundary in thc Middle to early Late Tournaisian.

Project 2: A chronostratigraphic level in the Late Tournaisian delimited by the appearance of *Scaliognathus anchoralis* in Late Tournaisian and by the appearance of primitive Archaediscidae within the Early Visean.

Proiect 3: A chronostratigraphic level around the Visean V3a/V3b boundary.

Project 4: A boundary at the base of the *Branneroceras branneri* Zone. (Base of G2).

Project 5: A boundary at the base of the *Fusulina - Beedeina* Zone. (Atokan-Desmoinesian; mid Moscovian).

Project 6: A boundary at the base of the *Protriticites* Zone (basal Kasimovian; basal Missourian; mid-Cantabrian).

Project Group 5 was abandoned at the SCCS Executive Meeting in Buenos Aires, 1991 and the former project Group 6 (A boundary at the base of the *Protriticites* Zone) was re-numbered as Project Group 5. Project Group 1, after failing to find any sections with demonstrated potential, was discharged at the SCCS Meeting in Krakow, 1995. At this same meeting, Project Group 2 was converted to a formal Working Group "to establish a boundary close to the existing Tournaisian-Visean boundary within the Lower Carboniferous", and Project Group 5 was converted to a formal Working Group "to establish a GSSP close to the Moscovian/ Kasimovian boundary". In addition to these Project/ Working Groups of SCCS, there are a number of other "working groups" (e.g. working group on the Middle Pennsylvanian of North America) with varying levels of activity and who's formal status within SCCS is not clear. The whole question of SCCS project/working groups will be discussed at a general meeting of SCCS this September. **If you have any comments/suggestions regarding these groups that you would like to be brought to the September meeting please let me know.**

I strongly believe that the global chart revision exercise has provided the SCCS with new impetus towards its goals, and a new urgency to realise those goals and both John Roberts and I look forward to working with you all towards a practical and acceptable global subdivision for the Carboniferous and establishment of the necessary GSSPs.

References

Barrick J. E., Boardman II, D.R. & Heckel P.H. 1996. Biostratigraphy across the Desmoinesian-Missourian Stage boundary in North American Midcontinent USA: Implication for defining the Middle-Upper Pennsylvanian Series Boundary. *Newsletters on Stratigraphy* 34, 161-175.

Grigoreva, A.D., Shchegolev A.K., Alexeeva I.A. & Shcherbakova 1996. Upper Carboniferous (Kasimovian and Gzhelian). *In* Wagner R.H., Winkler Prins C.F. & Granados L.F. eds *The Carboniferous of the World III The former USSR, Mongolia, Middle Eastern Platform, Afghanistan, & Iran*, pp. 98-122. Instuto Tecnologico Geominero de Espana, Madrid & Nationaal Natuurhistorisch Museum, Leiden.

Hance, L, and Muchez, P, 1995, Study of the Tournaisian-Visean transitional strata in South China (Guangxi). *XIII International Congress on Carboniferous-Permian, Krakow, Poland., 28 Aug. - 2 Sept. 1995. Abstracts*, p. 51.

Jenkins T.B.H., Crane D.T. & Mory A.J. 1993. Conodont biostratigraphy of the Visean Series in eastern Australia. *Alcheringa* 17, 211-283.

Lippolt H.J. & Hess J. C. 1983. Isotopic evidence for the stratigraphic position of the Saar-Nahe Rotliegend volcanism I. $^{40}Ar/^{40}K$ and $^{40}Ar/^{39}Ar$ investigations. *Neues Jahrbuch für Geologie und Paläontologie Monatscheft* 12, 713-730.

Mancini, E.A. and Tew, B.H. 1997. Recognition of maximum flooding events in mixed siliciclastic-carbonate systems: Key to global chronostratigraphic correlation. *Geology* 25, 351-354.

Merrill G.K. 1975. Pennsylvanian conodont biostratigraphy and paleoecology of northwestern Illinois. *Geological Society of America Microform Publication* 3. Microfiche.

Nemiroskaya T.I. & Alexeev A.S. 1995. The Bashkirian conodonts of the Askyn Setion, Bashkirian Mountains, Russia. *Bulletin de la Societe belge de Geologie* 103, 109-133.

Remane, J., Bassett, M.G., Cowie, J.W., Gohrbandt, K.H., Lane, H.R., Michelson, O. and Wang Naiwen. 1996. Revised guidelines for the establishment of global chronostratigraphic standards by the International Commission on Stratigraphy (ICS). *Episodes* 19, 77-81.

Roberts J. Claoue-Long J., Jones P.J. & Foster C.B. 1995b. SHRIMP zircon age control of Gondwanan sequences in Late Carboniferous and Early Permian Australia. *In* Dunnay R.E. and Hailwood E.A. eds. Dating and Correlating Biostratigraphically Barren Strata. *Geological Society Special Publication* 89, 145-174.

Roberts J., Claoue-Long, J. & Jones P.J. 1995. Australian Early Carboniferous time. *In* Berggren W.A., Kent D.V., Aubry M-P. & Hardenbol J. eds. Geochronology, Time Scales and Stratigraphic Correlation. *SEPM Special Publication* 54, 23-40.

Roberts J., Jones P.J. & Jenkins T.B.H. 1993. Revised correlations for Carboniferous marine invertebrate zones of eastern Australia. *Alcheringa* 17, 353-376.

Soloviella M.N. 1985. Correction of the USSR general Carboniferous scale in connection with restudying the Moskovian Stage stratotype and a new model for the correlation of the Lower Moskovian Substage. *Compte Rendu 10eme Congres International de* Stratigraphie *et de Geologie du Carbonifere, Madrid, 1983*, 1, 3-10.

CONTRIBUTIONS BY MEMBERS

***The data, viewpoints and interpretations expressed/presented in contributions by members are those of the individual authors/co-authors and are not necessarily those of the SCCS and carry no formal SCCS endorsement – Ed.**

Recognition and correlation of eustatic flooding events in the late Visean of Utah (SW USA) and Britain (NW Europe).

By Alan Titus[(1)] & Nick Riley[(2)]

(1) Department of Geology, Washington State University, Pullman, WA 99163.

(2) British Geological Survey, Keyworth, Nottingham, UK NG12 5GG.

This article serves as an interim summary of our main findings based on several years of collaborative research. Of particular importance is our discovery of the remarkable similarity between late Visean basinal sequences in both the eastern part of the Antler Foreland Basin, Utah, USA and the Craven Basin of NW England. Although both settings contain diverse macro- and microfaunas, ammonoid biostratigraphy has been most crucial for correlation of flooding events and sequence boundaries, providing a far higher resolution than that achieved using other biota over this interval.

Ammonoid sequence.

In both regions ammonoids are concentrated in distinct bands of black shale separated by strata barren of ammonoids. The studied ammonoid sequence falls within the *Beyrichoceras* Zone of Riley (1990a) and extends up to the base of the *Cravenoceras-Eumorphoceras* Zone of Ramsbottom and Saunders (1985). This encompasses the late Asbian to basal Namurian (Pendleian) interval of Britain and lies around the uppermost Meramec to lower part of the Chesterian Series of the USA. Schematic graphic sections of the ammonoid sequence for the studied regions of the USA and Britain are given on Fig. 1, as is a summary of the stratigraphic succession, position of major flooding events, and ammonoid biostratigraphy. Beyrichoceras is unknown from the American section. However, we are confident that the upper part of the B1 Zone is represented in the lowest faunas studied based on the presence of *Entogonites*, a short-ranged genus which evolved from *Nomismoceras*. Two species are present in Utah, *E. borealis* Gordon, known previously from the Brooks Range, Alaska (Gordon, 1957) and *E. grimmeri* Kittl. We are almost certain the former species is synonymous with *E. nasutus* (H. Schmidt), first described from the Kieselkalk of Germany, and thus indicates the B1 Zone. As in Germany, the two Utah forms closely succeed one another (Nicolaus 1963, Korn 1988). In the Craven Basin, only *E. grimmeri* is recorded, *E. nasutus* awaits discovery there. These Entogonites assemblages correlate with the upper part of the B1 Zone and the lowest part of the B2a Subzone of Riley (1990a). Evidence that the Utah Entogonites nasutus interval is younger than the *Bollandoceras-Bollandites* (BB) Zone of Riley is also indicated by the presence of very primitive *Paradimorphoceras* (slightly kinked lateral lobes, compared to the smooth lateral lobe of the parent genus *Dimorphoceras*). A new genus, with a mix of characters akin to *Parahammatocyclus, Bollandites* and *Girtyoceras* occurs with *Entogonites* in Utah. This form, possibly referred by Gordon (1957) to *Girtyoceras arcticum*, we believe, indicates that the girtyoceratids, an important late Mississippian clade which includes *Eumorphoceras*, originated from the pericyclids and not the beyrichoceratids as suggested by Riley (1996). The genus *Goniatites* is also present throughout the *Entogonites* bearing interval in Utah. In Europe *Goniatites* enters in the upper part of the range of *Entogonites*. The appearance of *Goniatites* in both Utah and Europe is cryptic, and no ancestor for this important late Mississippian clade is apparent. Conspecific with Europe is the presence of *Goniaties hudsoni* Bisat, however in Utah, unlike in Britain, primitive striatoid *Goniatites* is also present throughout the range of *Entogonites*, comparable with *Goniatites americanus* Gordon, 1957. Other cryptic entries accompanying *Entogonites* in Utah include the oldest known occurence of *Kazakhoceras*, which is rare and more primitive suturally than *K. scaliger* Schmidt. Its origin is probably from *Dimorphoceras*, which occurs in the Holkerian part of the underlying BB Zone in Britain (Riley, 1996). Previously, the oldest published entry of *Kazakhoceras* was from the P1c Subzone (early Brigantian) of Britain.

Uppermost *Beyrichoceras* Zone (B2b Subzone) assemblages are represented in both Utah and

Britain by an interval above the range of *Entogonites* characterised by *Goniatites globostriatus* and primitive true *Girtyoceras* (=*Saggitoceras*). This interval in Utah also contains rare *Kazakhoceras*, close to *K. scaliger*. *Dimorphoceras* and more advanced *Paradimorphoceras* are also present in both regions.

Genera missing from the entire *Beyrichoceras* Zone in the Utah sections, but present in Britain, include *Beyrichoceras*, *Beyrichoceratoides*, *Bollandites* ss, *Bollandoceras*, *Cowdaleoceras*, *Irinoceras*, *Nomismoceras*, *Michiganites*, *Praedarelites*, *Prolecanites* and *Pronorites*. Hemipelagic facies bivalves present in both regions include Posidonia becheri and P. kochi. The Utah section also contains a new coarsley ribbed rostraconch, referable to *Chaenocardiola*. Surprisingly, trilobites are not a component of the hemipelagic facies in Utah, whereas in Britain they are abundant.

The *Goniatites crenistria* Subzone (P1a) is poorly developed in Utah, as can be the case in Britain. Indeed the *Goniatites* Zone and succeeding *Neoglyphioceras* Zone are much thinner in Utah than in Britain. We have been able to recognise the upper part of the P1a Subzone, by the presence of *Goniatites fimbriatus* Ford and Crick. The succeeding P1b and P1c subzones are also recognisable in Utah by the successive entries of *Goniatites striatus* (P1b), *Arnsbergites* (P1b) and *Paraglyphioceras* (P1c). The P1d and P2a subzones are marked by the successive entries of *Neoglyphioceras* and *Lusitanoceras* respectively. Conspecific forms between Utah and Britain include *N. spirale* and *L. granosus*. Appearances of *Dombarites*, *Lusitanoceras*, *Pachylyroceras* and *Lyrogoniatites* indicates the presence of the P2b and P2c subzones. Advanced *Sulcogirtyoceras* also occurs in these latest Visean subzones. As in the *Beyrichoceras* Zone, there are some components present in Britain, but lacking in Utah. Most notable of all is the lack of *Hibernicoceras* and *Sudeticeras* in Utah. Species of these genera provide important subzonal marker species in Britain. *Beyrichoceratoides* is also absent from Utah. Prolecanitids are uncommon in both regions, the last appearance of which in Britain is in the P1d Subzone. In Utah they persist into the Namurian, but are always rare. The base of the *Cravenoceras-Eumorphoceras* Zone (E1 Zone) in both regions is marked by the entry of primitive cravenoceratid species (referred by Korn, 1988 to *Emstites*) and *Edmooroceras*.

Marine flooding events.

We recognise two major flooding events which we believe are isochronous on the basis of the ammonoid stratigraphy and associated facies changes. These events lie in the B1 Subzone and in the lower part of the P2 Zone. In Utah the B1 Zone flooding event is characterised by the coincidental loss of bioturbation and entry of black shales which introduce Entogonites and overly the Skunk Spring Limestone at the type locality in the Burbank Hills. The Skunk Spring Limestone is a pale weathering grey micrite, with an impoverished benthonic fauna of scattered solitary corals and productoid brachiopods. We wish to note that the interval at Granite Mountain referred by Webster et al (1984) to the Skunk Spring Limestone is younger than at the type section, as it lies within the range of Entogonites. It is also lithologically different, comprising peloid/ooid grainstones and cherts. At Granite Mountain a thin micrite occurs (approximately 1m thick), at the base of the ammonoid sequence which we strongly suspect to be the true Skunk Spring Limestone. The Skunk Spring Limestone probably represents a shallowing event, in a starved basin, where the substrate emerged above the carbonate compensation depth, allowing the slow accumulation of lime mud. Overlying the Skunk Spring Limestone is an interval of bioturbated siltstones, which indicate increased sediment supply, and enough oxygen available on the basin floor for infauna to develop. This bioturbated interval is the culmination of the regressive phase, or may represent the early part of a transgression. Sharp contact of these siltstones with the overlying black shales indicates a rapid drowning event which introduced the *Entogonites* bearing fauna. Stratification of the water column became intense with this deepening, resulting in black shale accumulation. The lack of carbonate, except as early diagenetic nodules, may well reflect deposition below the carbonate compensation depth, or an extremely low supply of carbonate compared to terrigenous clay.

In the Craven Basin of Britain the record in the B1 Zone is remarkably similar (Riley, 1990b). Packages of limestone turbidites, comprising the Pendleside Limestone, represent repeated high stand fill situations linked to minor relative sea level changes in the source area carbonate platforms surrounding the Craven Basin, with fine detrital carbonate being fed copiously into the basin, as accommodation space was lost repeatedly on these platforms. A major flooding event, marking the top of the Pendleside Limestone and the initiation of black shale deposition, as in Utah, represents a major deepening of the water column, stratification and dysoxia and the introduction of *Entogonites*. As in Utah there is a coincident loss of bioturbation. This B1 Zone flooding event closely coincides with the base of the D5b Mesothem of Ramsbottom (1977).

In Britain and Utah, more minor sea level oscillations are apparent throughout the succeeding black shale dominated succession in the late Visean. The detailed signature is still to be worked out, however, it is clear that a correlatable and prominent flooding event is associated with the base of the P2 Zone in both regions. In Utah, upper P1 strata are characterised by the presence of silty shales, indicating increased sediment supply. In the Craven Basin upper P1 strata contain the first major influx of sandstone turbidite clastics (Pendleside Sandstones). Sea level fall was responsible for the penetration of these clastics, which by-passed the exposed surfaces of the suronding platforms. In the Craven Basin the upper beds of the Pendleside Sandstone show hummocky cross stratification indicating shallowing sufficient enough for storm wave reworking of the substrate. This clastic dominated interval (lowstand system) is sharply truncated in both regions by a thin (less than 30cm thick) crinoid lag limestone rich in phosphate nodules, repesenting abandonment of clastic supply, and sediment starvation. Black shale deposition followed. In both regions this rapid deepening event lies in the P2a Subzone, with the introduction of *L. granosus*. The event coincides closely with the base of the D6b Mesothem of Ramsbottom (1977).

Discussion.

The recognition of the same marine eustatic events in two basins set in completely different tectonic provinces and separated during the Carboniferous by distances of more than 5,000km, not only shows the unique value and role of biostratigraphy in long distance correlation, but also the importance of studying deep water succesions in order to decipher truly global eustatic flooding events from those of more regional expression caused by local tectonic or autocyclic depositional effects, for which shallow water sections are particularly prone. We believe that a global classification of the Carboniferous and the selection of Carboniferous GSSPs should use such flooding events as its framework, as these are potentially correlatable into all environments and palaeolatitudes where the sediment has a marine signature.

Acknowledgement.

N. Riley publishes with the permission of the Director, British Geological Survey (NERC) and acknowledges travel support and facilities provided by the University of Arkansas, Fayetteville, AK and Snow College, Ephraim, UT.

References

Aitkenhead, N., Bridge, D. Mc. C., Kimbell, S. F. and Riley, N. J. 1992. Geology of the country around Garstang. *Memoir of the British Geological Survey*, 1:50000 sheet 67, England and Wales.

Earp, J. R., Magraw, D., Poole, E. G., Land, D. H. and Whiteman, A. J. 1961. Geology of the country around Clitheroe and Nelson. *Memoir of the Geological Survey of Great Britain, England and Wales*, Sheet 68.

Gordon, M. 1957. Mississippian cephalopods of northern and eastern Alaska. *United States Geological Survey, Professional Paper*, 283, 1-61.

Korn, D. 1988. Die Goniatiten des Kulmplattenkalkes (Cephalopoda, Ammonoidea; Unterkarbon; Rheinisches Schiefergebirge. *Geologie und Palaontologie in Westfalen*, 11, 1-291.

Nicolaus, H. J., 1963. Zur stratigraphie und Fauna der crenistria-zone im kulm des Rheinischen Schiefergebirges. *Berhefte zum Geologischen Jahrbuch*, 53, 1-246.

Ramsbottom, W. H. C. 1977. Major cycles of trangression and regression (mesothems) in the Namurian. *Proceedings of the Yorkshire Geological Society*, 41, 261-291.

Ramsbottom, W. H. C. & Saunders, W. B. 1985. Evolution and evolutionary biostratigraphy of Carboniferous ammonoids. *Journal of Paleontology*, 59, 123-139.

Riley, N. J. 1990a. Revision of the Beyrichoceras Ammonoid-Biozone (Dinantian), NW Europe. *Newsletters on Stratigraphy*, 21, 149-156.

Riley, N. J. 1990b. Stratigraphy of the Worston Shale Group (Dinantian), Craven Basin, north-west England. *Proceedings of the Yorkshire Geological Society*, 48, 163-187.

Riley, N. J. 1996. Mid-Dinantian ammonoids from the Craven Basin, north-west England. *Special Papers in Palaeontology*, 93, 1-87.

Webster, G.D., Gordon, M., Jr., Langenheim, R.L., and Henry, T.W. 1984. The Mississippian-Pennsylvanian Boundary in the eastern Great Basin (Field Trip1), In, Lintz, J., Jr. (ed.), Western Geological Excursions, v. 1: *Geological Society of America and Affiliated Societies, Reno, Field-Trip Guidebook*, p. 1-86.

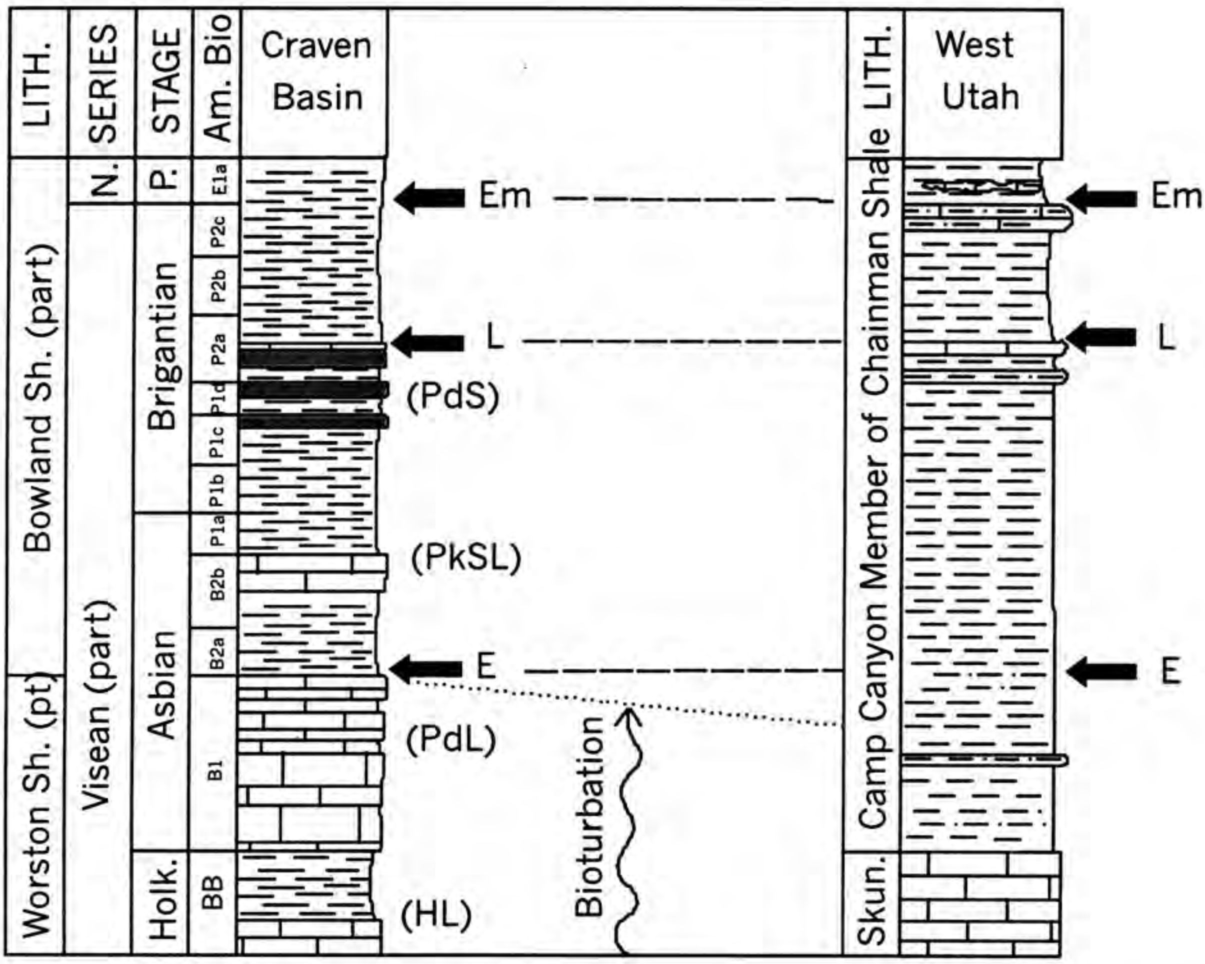


Figure 1. Summarised comparative late Visean stratigraphy between the Craven Basin, NW England and the eastern part of the Antler Foreland Basin, W. Utah, USA. No thicknesses are implied, and not all details are shown. Arrows represent flooding events associated with the entries of *Emstites* -Em, *Lusitanoceras* -L, and *Entogonites* -E. Members in the Craven Basin sequence (Aitkenhead et al. 1992, Earp et al. 1961, Riley 1990b) are; (PdS)- Pendleside Sandstone, (PkSL) -Park Style Limestone, (PdL)-Pendleside Limestone, (HL)-Hodderense Limestone. Ammonoid biozones are denoted by indices BB, B1 etc. Abbreviations for the British stages are as follows, P. -Pendleian (part), Holk. -Holkerian (part); N. -Namurian Series (part). In the Utah section Skun. = Skunk Creek Limestone. Brick ornament denotes limestones, stipple -sandstone, dash -shale, dot/dash -siltstone

Paleogeographic significance of a new upper Carboniferous macroflora locality in Bay St. George Basin, western Newfoundland, Canada

Arden R. Bashforth[1], Erwin L. Zodrow[2] and S. Henry Williams[1]

[1]Department of Earth Sciences, Memorial University of Newfoundland, St. John's, NF, A1B 3X5; [2]Department of Geology, University College of Cape Breton, Sydney, NS, B1P 6L2

A well preserved, allochthonous floral assemblage that includes plant adpressions and large tree petrifactions has recently been recovered from fluvial sediments of late Bolsovian to early Westphalian D age at a new locality in the Bay St. George Basin of western Newfoundland, Canada. Most major upper Carboniferous plant groups are represented in the sample, including taxa belonging to the pteridosperms, pecopterids, cordaites, lycopods and sphenopsids. Fertile foliage, seeds and other fructifications also are relatively abundant in the assemblage. Although earlier workers briefly noted the locality (e.g. Murray and Howley 1881; Bell 1948; Riley 1962), no detailed study of the macroflora has ever been attempted and thus the site remains somewhat "undiscovered". Palynological analysis of the site revealed a Bolsovian age (Hacquebard *et al.* 1961; Hyde *et al.* 1991), while Solomon and Hyde (1985) and Hyde *et al.* (1991) examined the petrology, sedimentology, stratigraphy and depositional environments of two associated coal seams. Ongoing investigation of these fossils is the focus of a master's dissertation by the senior author involving the description, taxonomy and biostratigraphic correlation of the plant remains, and paleoenvironmental setting within which they flourished. This preliminary report serves to introduce to the literature the macrofloral assemblage of the new locality, and summarizes the paleogeographic significance of biostratigraphic correlation with contemporaneous upper Carboniferous strata in eastern Canada (Fig. 1).

The adpression assemblage was recovered from meandering stream deposits in several horizons of grey, micaceous siltstones and mudstones. Fossiliferous sediments represent the upper portions of fining upward channel infills, generally are underlain by rooted underclay, and are associated with coaly horizons. Considering the fragmentary nature of specimens and diversity of species preserved on a single slab, the adpression assemblage is interpreted as allochthonous (sensu Bateman 1991). Adpressions typically are preserved as coalified impressions, although some are impressions or uncoalified compressions (sensu Schopf 1975). Intact cuticles were recovered from pteridosperm and cordaites specimens, while a pecopterid specimen produced only unidentifiable cuticles. Transported fossil trees, some of which represent ancient log jams, are abundant within brown, micaceous, coarse sandstones, pebbly sandstones and conglomerates deposited in channel bases. Preserved trees are large (up to 1.8 m in diameter and 4 metres long), partially compressed, and preserved as permineralized petrifactions (awaiting analysis).

Preliminary identification of 524 specimens of the adpression assemblage gives the following approximate proportions: pteridosperms (27.5%); pecopterids (23.3%); sphenopsids (22.1%); lycopods (13.7%); and cordaites (13.0%). Medullosan seed-fern foliage is dominated by species referable to neuropterids (including *Neuropteris semireticulata*, *Macroneuropteris scheuchzeri*, and *Laveineopteris rarinervis*); with less common linopterids(?) (*Linopteris* sp. cf. *L. neuropteroides*) and sphenopterids (*Sphenopteris* sp.); and extremely rare mariopterids (*Mariopteris*(?) sp.) and alethopterids (*Alethopteris* sp. cf. *A. lonchitica*). By comparison, in Sydney Coalfield *L. neuropteroides* is found only in lower Westphalian D strata (Bell 1938), while *M. scheuchzeri* and *L. rarinervis* have been recovered from Bolsovian to early Westphalian D strata of Mabou Basin (Zodrow and Vasey 1986). *Neuropteris semireticulata* ranges from latest Duckmantian to earliest Westphalian D in the Euramerian paleokingdom (Cleal 1991).

Pecopterids are represented by stem adpressions and sterile and fertile *Pecopteris* foliage. Tentative identifications of at least four species include *Pecopteris (Senftenbergia) plumosa-dentata*, *P. (Asterotheca) miltoni*, *P. micromiltoni* and *P.* sp. cf. *P. (Asterotheca) acadica*. Pecopterid abundance in the assemblage is significant, as members of this plant group only began to diversify and become an important mire component after the Duckmantian (DiMichele and Phillips 1994).

Sphenopsid adpressions include members of both shrubs, and trees and their foliage. Sphenopsids of the tree habit are represented by *Calamites* sp. axes, cone-like *Calamastachys* sp., and sterile foliage such as *Annularia sphenophylloides*, *A. stellata*, and *Asterophyllites equisetiformis* var. *jongmansi* (see Josten 1991). Shrub-like forms include *Sphenophyllum* sp. cf. *S. emarginatum* and *S. zwickaviense*. The latter is restricted to Bolsovian and Westphalian D strata in Europe (Batenburg 1977; Storch 1984) and Westphalian D strata in Sydney Basin (Zodrow 1989). *A. stellata*'s bottom range is near the Bolsovian/ Westphalian D boundary in Sydney Coalfield (Bell 1938; Zodrow 1986).

Lycopod floral elements include subaerial and subterranean axes (*Lepidodendron* sp., *Sigillaria* sp. cf. *S. rugosa*(?), and *Stigmaria ficoides*); leaves (*Lepidophyllum* sp.); isolated sporangia (*Lepidocystis* sp.); and cone and cone fragments (*Lepidostrobus* sp., *Lepidostrobophyllum lanceolatum*, *L. hastatum*, and *Sigillariostrobus* sp.). In Sydney Coalfield, Lepidostrobophyllum *lanceolatum*, *L. hastatum* and *Sigillaria rugosa* are restricted to Westphalian D strata (Bell 1938; Zodrow 1986). A single *L. hastatum* specimen was recovered from Bolsovian strata in Mabou Basin (Zodrow and Vasey 1986).

Although cordaites are the least frequently represented group in the assemblage, they are relatively abundant in comparison to floral compositions of other upper Carboniferous sites. They are represented by leaves (*Cordaites* sp. cf. *C. principalis*), female sporangia (*Cordaitanthus* sp.) and winged seeds (*Samaropsis* sp.). DiMichele and Phillips (1994) consider that cordaites were a significant component of lowland-wetland habitats only from the Bolsovian to mid-Westphalian D.

Preliminary analysis of the macrofloral assemblage provides ample biostratigraphic and paleoecological evidence to deduce a late Bolsovian or early Westphalian D age for the locality. The inferred age supports or extends slightly the Bolsovian age established by earlier palynological investigations (Hacquebard *et al.* 1961; Hyde *et al.* 1991). The composition and frequency of floral species suggests homotaxial correlation with upper Bolsovian to lower Westphalian D strata of the Morien Group of Sydney Coalfield and Mabou Mines section of Mabou Basin. Such biostratigraphic correlation provides substantial evidence to underpin the argument for a sedimentary connection of Bay St. George Basin with Mabou and Sydney basins of Nova Scotia, and supports earlier demonstrations of Howie and Barss (1975) that a thin veneer of sediment was deposited over the Cape Breton-Newfoundland Ridge during the upper Paleozoic.

References

Bateman, R. 1991. Palaeoecology, *in* C.J. Cleal (ed.), *Plant fossils in geological investigation - The Palaeozoic*, Ellis Horwood, England, 34-116.

Batenburg, L.H. 1977. The *Sphenophyllum* species in the Carboniferous flora of Holz (Westphalian D, Saar Basin, Germany), *Review of Palaeobotany and Palynology*, v. 24, 69-99.

Bell, W.A. 1938. Fossil flora of Sydney coalfield, Nova Scotia, *Geological Survey of Canada, Memoir* 215, 334 p.

Bell, W.A. 1948. Early Carboniferous strata of St. Georges Bay area, Newfoundland, *Geological Survey of Canada, Bulletin* 10, 45 p.

Cleal, C.J. 1991. Carboniferous and Permian biostratigraphy, *in* C.J. Cleal (ed.), *Plant fossils in geological investigation* - The Palaeozoic, Ellis Horwood, England, 182-215.

DiMichele, W.A. and T.L. Phillips. 1994. Paleobotanical and paleoecological constraints on models of peat formation in the Late Carboniferous of Euramerica, *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 106, 39-90.

Gibling, M.R., Calder, J.H., Ryan, R., van de Poll, H.W. and G.M. Yeo. 1992. Late Carboniferous and Early Permian drainage patterns in Atlantic Canada, *Canadian Journal of Earth Sciences*, v. 29, 338-352.

Hacquebard, P.A., Barss, M.S. and J.R. Donaldson. 1961. Distribution and stratigraphic significance of small spore general in the Upper Carboniferous of the Maritime provinces of Canada, *4th International Congress of Carboniferous Stratigraphy and Geology, Heerlan*, 237-245.

Howie, R.D. and M.S. Barss. 1975. Upper Paleozoic rocks of the Atlantic Provinces. Gulf of St. Lawrence and adjacent continental shelf, *in* W.J.M. van der Linden and J.A. Wade (eds.), *Offshore Geology of Eastern Canada, v.2*, Regional Geology, Geological Survey of Canada, Paper 74-30, 35-50.

Hyde, R.S. 1995. Upper Paleozoic rocks, Newfoundland, *in* H. Williams (ed.), Chapter 5 of *Geology of the Appalachian-Caledonian Orogen in Canada and Greenland*, Geological Survey of Canada, Geology of Canada, no. 6, 523-552.

Hyde, R.S., Kalkrueth, W.D. and J. Utting. 1991. Petrology, palynology, and depositional environments of coals of the Upper Carboniferous Barachois Group (Westphalian A and C), southwestern Newfoundland, *Canadian Journal of Earth Sciences*, v. 28, 1905-1924.

Josten, K.-H. 1991. Die Steinkohlen-Floren Nordwestdeutschlands, *Textband, Fortschritte in der Geologie von Rheinland und Westfalen*, Band 36, 434 p.

Murray, A. and J.P. Howley, 1881, *Report for 1873*, Geological Survey of Newfoundland, Edward Stanford, London, 298-350.

Riley, G.C. 1962. Stephenville map-area, Newfoundland, Geological Survey of Canada, Memoir 323, 72 p.

Schopf, J.M. 1975. Modes of fossil preservation, *Review of Paleobotany and Palynology*, v. 20, 27-53.

Solomon, S.M. 1986. Sedimentology and fossil-fuel potential of the Upper Carboniferous Barachois Group, western Newfound-land, M.Sc. thesis, Memorial University of Newfoundland, St. John's, Newfoundland, 256 p.

Solomon, S.M. and R.S. Hyde. 1985. Stratigraphy and sedimentology of some coal seams in the Carboniferous Bay St. George Basin, southwestern Newfoundland, *Newfoundland Department of Energy and Mines, Mineral Development Division, Current Research, Report* 85-1, 168-176.

Storch, D. 1984. Die stratigraphische verbreitung der europäischen *Sphenophyllum*-Arten, *Neuvieme Congres International de Stratigraphie et de Geologie du Carbonifere*, Washington and Urbana (1979), v. 2, 523-532.

van de Poll, H.W., Gibling, M.R. and R.S. Hyde 1995. Introduction: Upper Paleozoic Rocks,*in* H. Williams (ed.), Chapter 5 of *Geology of the Appalachian-Caledonian Orogen in Canada and Greenland*, Geological Survey of Canada, Geology of Canada, no. 6, 449-455.

Zodrow, E.L. 1986. Succession of paleobotantical events: evidence for mid-Westphalian D floral changes, Morien Group (Late Pennsylvanian, Nova Scotia), *Review of Palaeobotany and Palynology*, v. 47, 293-326.

Zodrow, E.L.. 1989. Revision of Silesian sphenophyll biostratigraphy of Canada, *Review of Paleobotany and Palynology*, v. 58, 301-331.

Zodrow, E.L. and G.M. Vasey. 1986. Mabou Mines section: biostratigraphy and correlation (Pennsylvanian Pictou Group, Nova Scotia, Canada), *Journal of Paleontology*, v. 60, no. 2, 208-232.

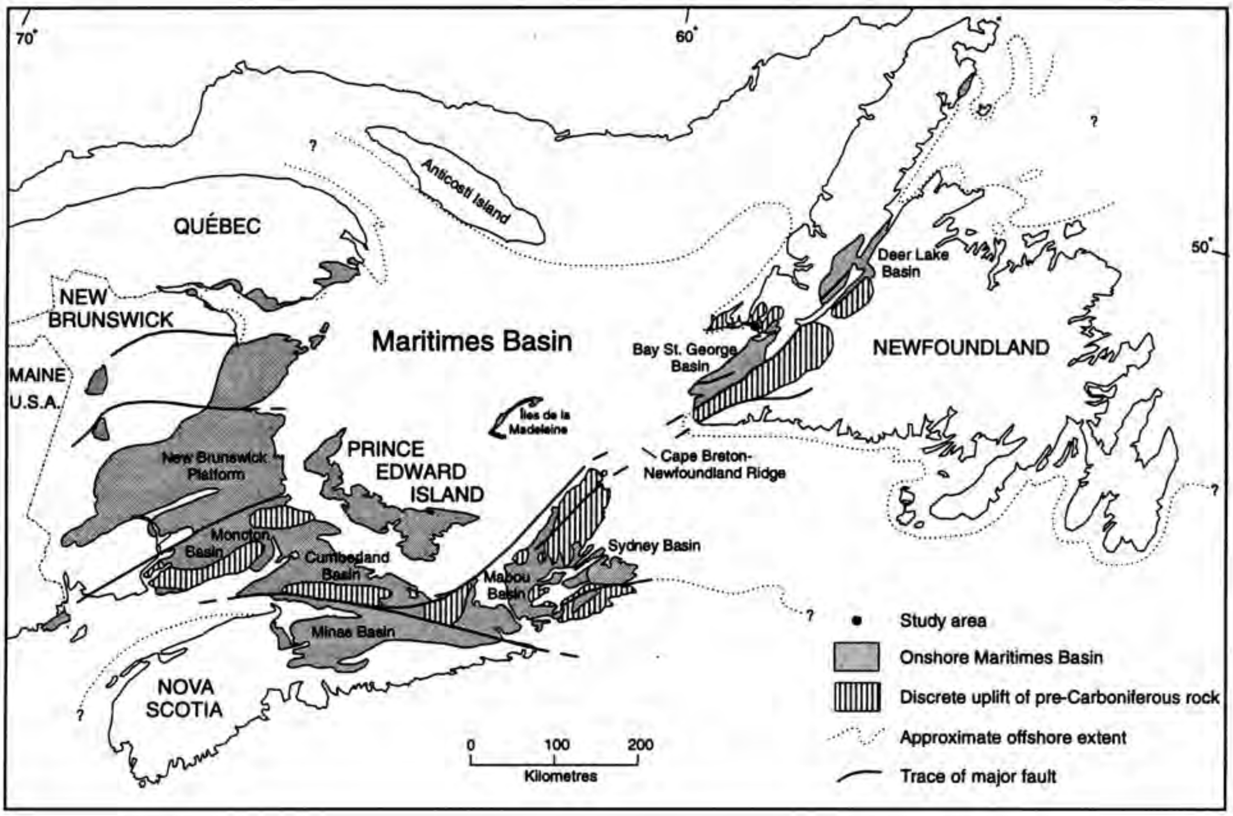


Figure 1. Maritimes Basin in eastern Canada and distribution of major faults, sedimentary basins and adjacent highlands. Note the position of the Cape Breton-Newfoundland Ridge. After Hyde (1995), Gibling *et al.* (1992) and van de Poll *et al.* (1995).

Finds of Viséan polyplacophorans from the Nízky Jeseník Mts.

(Czech Republic, Moravia)

J. KRÁL, Department of Genetics and Microbiology, Faculty of Science, Charles University, Vinicná 5, CZ - 128 44 Praha 2

J. MAREK, Institute of Geology and Palaeontology, Faculty of Science, Charles University, Albertov 6, CZ - 128 43 Praha 2

The Carboniferous of the Nízky Jeseník Mountains (Northern Moravia) is formed predominantly by deposits of the Culm facies. In this area, heterogeneous sediments of Upper Devonian (clastics, carbonates and radiolarites) pass upwards without a break into the Culm type of sedimentation which continues up to the lowermost Namurian. The lowermost Namurian and younger levels are developed as paralic mollasse sediments of the Ostrava-Karviná Coal Basin. On lithological grounds typical Culm sediments of the Nízky Jeseník Mts are allochtonous claystones, argillites, greywackes, and conglomerates which often exhibit Bouma cycles.

The Culm fauna of the Nízky Jeseník Mts is relatively monotonous with predominant and common goniatites, bivalves, and nautiloids. In the lower part of the sedimentary sequence, represetatives of other faunal groups (trilobites, brachiopods, gastropods etc.) occur rarely. In the upper part, in the*Goniatites* β Zone, faunal diversity increases and the composition of the assemblage changes too. Concomitant faunal groups are more abundant and diversified. These changes seem to reflect shallowing and some environmental diversification of the sedimentary basin. The dominant fauna of the Nízky Jeseník Mts. is relatively well investigated, but concomitant groups are rather omitted. Goniatite zonation allows reliable correlation with other areas of the mobil part of the European Variscan Zone.

During our extensive palaeontological research, the first tests of polyplacophorans have been obtained from the Nízky Jeseník Mts. The findings originate from three localities of different stratigraphical levels ranging from the Goα3 to the Goγ1 Subzone.

Locality Cermná near Vítkov (Moravice Fm., Goα3 - Goα4 Subzones and lower part of the Goβ Zone respectively). The fauna is dominated by various goniatites (*Goniatites, Girtyoceras, Nomismoceras*) and bivalves (*Posidonia becheri, Streblochondria*), concomitant groups are chonetid brachiopods, orthocone nautiloids, and archegonid trilobites. Polyplacophorans are represented by one poorly preserved and undeterminable head plate.

Locality Hermánky near Odry (Hradec Fm., Goβ_{spi} Subzone). The dominant faunal elements are represented by goniatites (*Sudeticeras crenistriatum, S. stolbergi, Girtyoceras, Neoglyphioceras*) and bivalves (*Posidonia becheri, P. trapezoedra, Streblochondria, Septimyalina, Selenimyalina, Parallelodon*). Other fauna includes orthoconic nautiloids, chonetid and inarticulate (*Orbiculoidea*) brachiopods, hyolithids, archegonid trilobites, gastropods, and crinoid columnalia.

Locality Jerlochovice near Fulnek (Kyjovice Fm., Goγ1 Subzone). This locality contains the richest and most diversified Culm faunal assemblage at Nízky Jeseník Mts. The dominant fauna is characterized by goniatites (*Goniatites striatus poststriatus, Dimorphoceras, Sudeticeras*), bivalves (*Anthraconeilo, Palaeoneilo, Parallelodon, Septimyalina, Selenimyalina, Posidonia corrugata, Streblochondria*), and nautiloids (*Brachycycloceras, Dolorthoceras, Stroboceras, Liroceras, Cyrtospyroceras*). Less common are brachiopods (*Chonetidae, Nudirostra, Schuchertella* and rare inarticulates), gastropods, coleolids, hyolithids, trilobites (*Kulmiella*), crinoid columnalia, bryozoans, and ostracods.

Our collection of polyplacophorans from localities Hermánky and Jerlochovice is represented by twelve isolated head plates and one tail plate of the genus *Rhombichiton*. They belong to the new species which differs from described species by outlines of plates and morphology of the mucro.

Up till now, Carboniferous polyplacophorans from Moravia have been known from Culm sediments of the Drahanská vrchovina Upland (Goβ_{el} - Goβ_{spi} Subzones (Lang, Marek & Pek, 1982) and a deep borehole near Frenstát pod Radhostem (Goγ; Rehor, 1976). Both finds, specimens were described as *Rhombichiton laterodepressus* (Bergenhayn, 1945).

The nearest other occurence of Carboniferous polyplacophorans is represented by a remarkable find of a complete specimen from the non-Culm Namurian A of the Slovak Republic (*Rhombichiton ochtinensis* Turek & Prokop, 1982; Turek & Prokop 1982).

Determination of polyplacophoran genera (and partly species) is principally based on morphology of the tail plate. Our study of the genus *Rhombichiton* have shown that the tail plate is not present in the type material of some species (eg. *R. laterodepressus*). Their definition is then rather imperfect. Thus, more detailed descriptions of these species and taxonomical revision of the genus *Rhombichiton* is needed.

References

Lang, V., Marek, J. & Pek, I. 1982. A find of the species Rhombichiton laterodepressus (Bergenhayn, 1945) in the Culm of the Drahanská vrchovina Upland. *Vest. Ústø. Úst. geol.*, **57**, 5: 299-302. Praha.

Turek, V. & Prokop, R. J. 1982. Two remarkable finds of molluscs in the Carboniferous of Slovakia. *Cas. Mineral. Geol.*, **27**, 3: 285-293. Praha.

Rehor F. 1976. Paleozoická makrofauna dvou hlubokych vrtù z okolí Ceského Tesína a Frenstátu pod Radhostem. *Sbor. Prací Pedag. Fak. Ostrava*, Ser. E-6, **49** :49-76. Ostrava.

Carboniferous Time Scales Revised 1997 Time Scale A (min. ages) and Time Scale B (max. ages) Use of geological time indicators

M. Menning*, D. Weyer, G. Drozdzewski*** & H.W.J. van Amerom*****

***GeoForschungsZentrum Potsdam, Telegrafenberg A26, D-14473 Potsdam, Germany**
****Naturkundemuseum Magdeburg, Otto-von-Guericke-Str. 68, D-39104 Magdeburg, Germany**
*****Geologisches Landesamt Nordrhein-Westfalen, De-Greiff-Str. 195, D-47803 Krefeld, Germany**

The aim of this contribution is to provide an improved and more detailed numerical time scale for the Carboniferous. Reasons for discrepancies between time scales include poor radiometric data and stratigraphic positions as well as insufficient consideration of time-relevant geological indicators. Since 1978 the Carboniferous is thought to begin between 368 Ma and 352 Ma, and it finishes between 300 Ma and 286 Ma. Thus, the suggested duration of the Carboniferous varies between 80 Ma and 55 Ma. The duration of the Tournaisian, Viséan, Namurian, Westphalian, and the Stephanian differ internally by up to 400%:

	Ma		Ma
Stephanian	5	-	21
Westphalian	6	-	23
Namurian	8	-	22
Viséan	10	-	35
Tournaisian	4.2	-	13

For any preferred interpretation a suitable time scale is available. We selected the stratigraphically best defined radiometric ages of highest quality as Radiogeochronometric Anchor Points (RAPs). The RAPs must be both consistent with each other and with geological time indicators. Based on the RAP's, the duration of small intervening stratigraphic units are estimated using time-relevant geological indicators: average thicknesses, number of biozones, and number of sequences. Additionally, the use of geological time indicators helps to clear up the deficiencies and inconsistencies within the radiometric data and to avoid condensed or stretched parts within a time scale. Radio-geochronometric data used here are exclusively from well investigated lithostratigraphic successions with accurate biostratigraphic control. Except of the 290.7 Ma (Lippolt & Hess, 1989) all ages are derived from ash layers. The dated crystals show evidence for rapid late crystallisation following eruptions and "subsequent diagenetic, metamorphic or tectonic processes did not influence either their chemical or their isotopic compositions" (Hess & Lippolt, 1986: 146). Time Scale A (minimum ages) was constructed using Pb/U, Rb/Sr and K/Ar data, and Time Scale B (maximum ages) uses mainly Ar/Ar data. Therefore, for geological purposes Pb/U, Rb/Sr, and K/Ar ages should be referred to the Time Scale A and Ar/Ar ages from any rock or mineral should be compared with the Time Scale B.

The combination of the Pb/U zircon ages of 314.4/314.5 Ma for the lower/middle Arnsbergian (Riley et al., 1994) and the Ar/Ar sanidine age of 310.7 Ma for the uppermost Westphalian B (Hess & Lippolt, 1986) results in only 2.5 or 2.6 Ma respectively for the time span Namurian B - Westphalian B (Korn & Kullmann, 1995; Jones, 1995). In contrast, in other time scales and referred to our geological time estimation, the durations of the four Westphalian subunits and the Namurian B and C vary mostly between 2 and 3.5 Ma. There is no geological evidence for a Westphalian B of 0.3 Ma and, in the same time scale, a Westphalian C of 3.0 Ma. In the correlation chart of Jones (1995) the mentioned 2.6 Ma results in a significant compression of all the litho- and biostratigraphic units of West/Central Europe, East Europe, North America for the Namurian B - Westphalian B time span; the stratigraphic units below and above are significantly stretched.

The RAPs available for time scale calibration are irregularly arranged in the Carboniferous. There is only one RAP for the Dinantian from Central/West Europe. In the Silesian, RAP's are lacking from the Namurian B and C, Westphalian A and D, Cantabrian, and Stephanian B, C, and D. All RAP's are shown relative to their stratigraphic position. The ages of the Time Scales A and B correspond totally to the ages of their RAP's with only as up to 1.0 Ma difference (except the Ar/Ar-age 319.5 Ma). This high consistency can never be attained when all RAPs are combined in the same time scale. In addition, the Time Scales A and B are consistent with the time ratios of the stratigraphic units derived using geological time indicators. The Stephanian/"Autunian"-boundary is significantly diachronous. The duration of the overlap between the Stephanian and the Rotliegend is in minimum about 2 Ma and in maximum 4 Ma. The Carboniferous/Permian-boundary is neither connected with the base of the Rotliegend nor "Autunian". Our integrative Time Scales A and B 'fitted by hand' should be more reliable than those made mainly using radiometric data of very different quality. The differences to the Harland et al. (1990) time scale are in part significant. We are very greatful to numerous colleagues and friends for information, fruitful discussion, and help . This contribution has been submitted in extended form to *Geologische Rundschau*, Stuttgart.

References

Bonhomme M., Philibert J., Roques M. & Vialette Y. (1961): Ages absolus dans le Viséen et dans le Stephanien du Massif Central francais. C. R. Acad. Sci. Paris 252: 3084-3086.

Claoué-Long J.C., Compston W., Roberts J., Fanning, C.M. (1995): Two Carboniferous ages: a comparison of SHRIMP zircon dating with conventional zircon ages and 40Ar/39Ar analysis. In: Berggren, W.A., Kent, D.V., Aubry, M.P., Hardenbol, J. (eds.) Geochronology, Time Scales and Global Stratigraphic Correlation. SEPM Spec Publ 54: 1-27.

Damon, P.E. & Teichm,ller, R. (1971): Das absolute Alter des sanidinf,hrenden kaolinischen Tonsteins im Fl^z Hagen 2 des Westfal C im Ruhrrevier. Fortschr. Geol. Rheinld. Westf., Krefeld 18: 53-56.

Harland, W.B., Armstrong, R.L., Cox, A.V., Craig, L.E., Smith, A.G. & Smith, D.G. (1990): A Geologic Time Scale 1989. Cambridge University Press, Cambridge, 1-263 Hess, J.C. & Lippolt, H.J. (1986): 40Ar/39Ar ages of tonstein and tuff sanidines: New calibration points for the improvement of the Upper Carboniferous time scale. Chem. Geol. (Isot. Geosci. Sec.) 59, 2/3: 143-154.

Jones, P.J. (1995): Timescales: 5. Carboniferous. Austral. Geol. Surv. Org., Record 1995/34: 45 pp.

Korn, D. & Kullmann, J. (1995): GONIAT Version 2.51. Geol.-Palaeontol. Inst. Univ. T,bingen/Germany, August 1995 Lippolt, H.J. & Hess, J.C. (1989): Isotopic evidence for the stratigraphic position of the Saar-Nahe Rotliegende volcanism. III. Synthesis of results and geological implications. N.

Jahrb. Geol. Palaeontol. Monatsh. 9: 553-559.

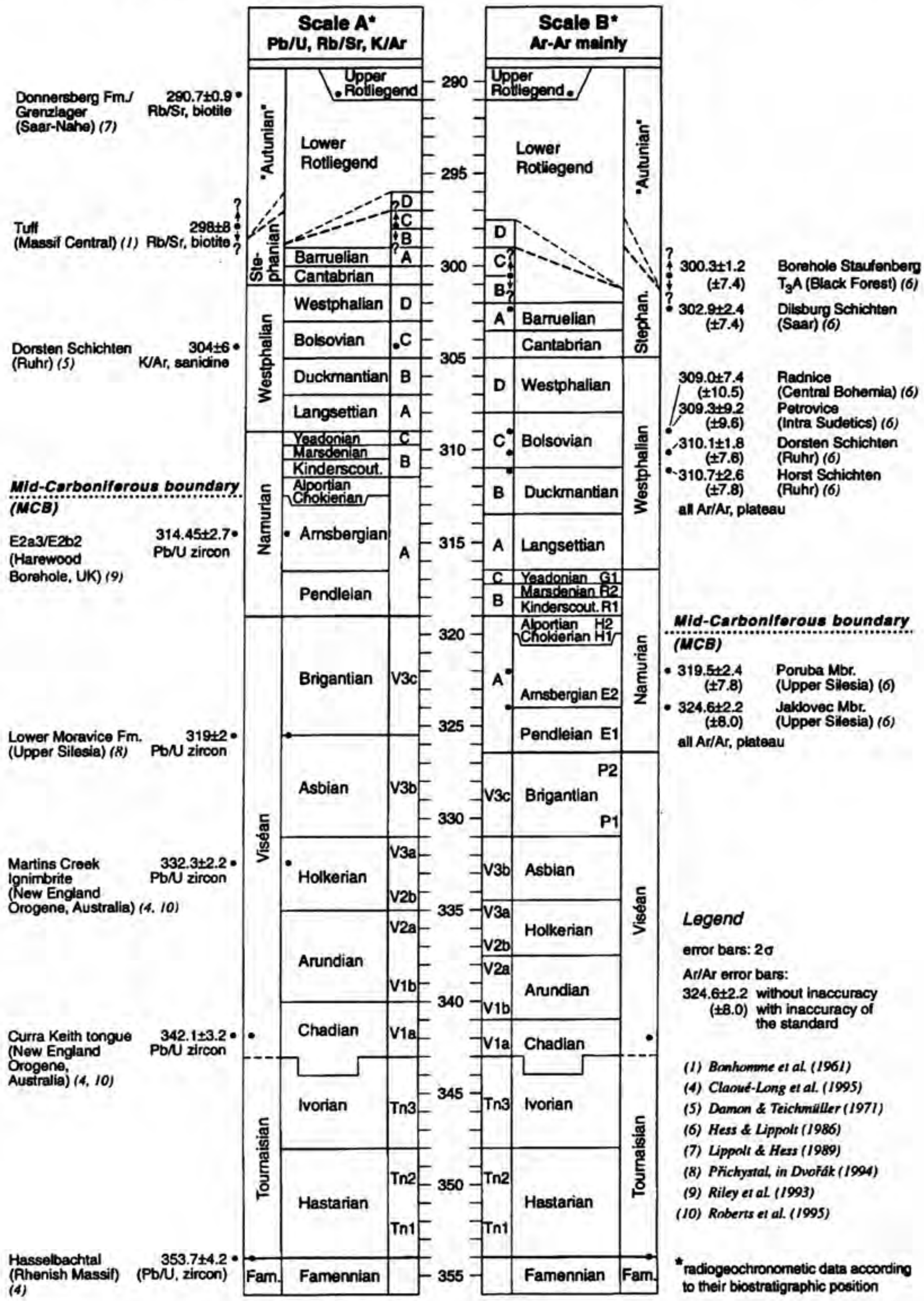
Menning, M, Weyer, D., Drozdzewski, G. & van Amerom, H.W.J. (eingereicht): Carboniferous Time Scales Revised 1997. Use of geological time indicators from Central and Western Europe. Geol. Rundschau.

Odin, G.S. (1994): Geological time scale (1994). C. R. Acad. Sci. Paris, 318, sèr. II: 59-71

Prichystal, A. (1994) in Dvor-k, J.: On the correlation of radiometric and biostratigraphic data in the Namurian. Newslett. Carbonif. Strat., Newcastle/Australia 12: 10.

Riley, N.J., Claoué-Long, J., Higgins, A.C., Owens, B., Spears, A., Taylor, L. & Varker, W.J. (1994): Geochronometry and geochemistry of the European mid-Carboniferous boundary global stratotype proposal. Stonehead Beck, North Yorkshire, UK. Annal. Soc. Gèol. Belgique, Liége 1993, 116, 2: 275-289.

Roberts, J., Claoué-Long, J.C. & Jones, P.J. (1995): Australian Early Carboniferous Time. SEPM Spec. Publ., Oxford 54: 23-40



Menning *et al.*, Figure 1. Carboniferous Timescales A & B.

Proposal for indexing the Westphalian D-Cantabrian boundary on the basis of macro- and micro-floral occurrences

C.J. CLEAL[1], G. DOLBY[2], J.-P. LAVEINE[3], P.C. LYONS[4], H.W.J. VAN AMEROM[5], R.H. WAGNER[6], and E.L. ZODROW[7]

1. National Museums & Galleries of Wales, Cathays Park, Cardiff, CF1 3NP, U.K. (Fax 01222 239829)
2. Dolby & Associates, Calgary, Canada
3. Université des Sciences et Technologies de Lille, France
4. U.S. Geological Survey, Reston, Virginia, U.S.A.
5. Geologisches Landesamt Nordrhein-Westfalen, Krefeld, Germany
6. Jardín Botánico de Córdoba, Cordoba, Spain
7. University College of Cape Breton, Sydney, N.S., Canada.

The working group on the recognition of the Westphalian D-Cantabrian boundary met on June 1, 1995 at the University College of Cape Breton, Sydney, Nova Scotia, as part of the 1st Walter A. Bell Memorial Symposium. In addition to the authors of this communication, also present at the meeting were W.H. Gillespie, M.J. Knaus, and E. Purkynova.

There are no widely accepted floral criteria for the recognition of the Westphalian D-Cantabrian (Stephanian Series) boundary worldwide. A biostratigraphical model of floral events, similar in concept to that used for indexing the Bolsovian (ex Westphalian C)-Westphalian D boundary (Laveine, 1977), was used to index the Westphalian D-Cantabrian boundary worldwide; see Wagner and Alvarez-Vazquez (1991) for events in the Cantabrian stratotype in NW Spain.

The following provisional list of floral events (in ascending order from 1 to 5) is suggested as a working model for the recognition of the Westphalian D-Cantabrian boundary worldwide.

We urge colleagues to provide to C.J. Cleal with suggestions for improving this model.

References

Laveine, J.-P. 1977. Report on the Westphalian D. In *Symposium on Carboniferous stratigraphy*. Edited by V. M. Holub and R. H. Wagner. Geological Survey of Prague (Prague, 1973), 71-81.

Wagner, R.H. and Alvarez-Vazquez, C. (1991). Floral characterisation and biozones of the Westphalian D Stage in NW Spain. *N. Jb. Geol. Palaeont. Abh.*, 183(1-3): 171-202.

TOP OF SEQUENCE OF EVENTS

5. lowest occurrence of *Sphenophyllum oblongifolium*, *Odontopteris cantabrica*, *Alethopteris bohemica*, and *Angulisporites splendidus*; and highest occurrence of *Mariopteris nervosa*, and *Linopteris obliqua*.

------------- Westphalian D-Cantabrian boundary-----------

4. highest occurrence of *Pecopteris micromiltoni*, *Mooreisporites inusitatus*, *Vestispora laevigata*, and *Schopfites dimorphus*; top of the epibole of *Lycospora* spp.
3. highest occurrence of *Vestispora colchesterensis* and *V. witneyensis*.
2. lowest occurrence of *Odontopteris* (other than *O. cantabrica*).
1. lowest occurrence of *Callipteridium* sensu lato and base of epibole of *Thymospora* spp.

BASE OF SEQUENCE OF EVENTS

The Carboniferous-Permian boundary in Argentina

Carlos R. Gonzalez &
Arturo C. Taboada

Recent field work on Permo-Carboniferous deposits of Argentina, has furnished new data on faunal distribution and on the sequence and stratigraphic ranges of significant guide fossils. This also includes finds of new fossil localities.

In western Argentina the Jarillal and Agua del Jaguel Formations consist of more than 1700 m of sediments that bear two marine members. The lowermost is a Late Carboniferous transgression, and yields an invertebrate association that is related to the *Buxtonia-Heteralosia* fauna. This fauna consists of elements linked with warmer water faunas of northern South America and the palaeoequatorial regions (Gonzalez, in press). The upper marine member is assigned to the post-glacial rise in sea level that happened in the earliest Permian (Dickins, 1985), and yielded *Costatumulus amosi* Taboada (in press) (ex *Cancrinella* aff. *farleyensis* (Eth. & Dun)) fauna. However, stratigraphic relationships are obscured by tectonic complications, and by the possibility that an unconformity might be present between these two marine members.

In eastern Argentina no Carboniferous sediments are known; deposition in the Sauce Grande Basin began with glacigene diamictites, which underlie marine strata bearing the Early Permian *Eurydesma* fauna (Harrington, 1955). A palaeogeographic link probably existed between this region and the Kalahari Basin of southern Africa, which were linked to perigondwanic seas of Australia and India, but not to western Argentina (Gonzalez, 1985).

In central Patagonia, the Tepuel Group (Suero, 1948) shows continuous deposition from the Early Carboniferous to the Early Permian. This is the most reliable sequence for the study of the Permo-Carboniferous boundary. From base to top the Tepuel Group consists of the Jaramillo, Pampa de Tepuel and Mojon de Hierro Formations. The Pampa de Tepuel Formation is the most conspicuous section of the Group, and consists of 2,900 m thickness (Page et al. 1984) of fine-grained sediments with intercalated sandstones and diamictites. In general terms, two great glacimarine episodes may be recognized in this Formation: the lower one is associated with the *Levipustula levis* fauna, which is confined to the Namurian by Roberts et al. (1995). That member is followed by a thick marine section of sandstones and siltstones that do not have strong evidence of glaciation, and furnished a younger Late Carboniferous fauna from the Pampa de Tepuel Formation, and encompasses paraconglomerates, diamictites and dropstone-siltstones and a striated surface (probable glacial floor) occurs in the paraconglomerates. Overlying this glacial member is the Mojón de Hierro Formation, which is made up of thick blue shales that grade upwards to marine-deltaic sandstones and conglomerates. The Mojón de Hierro Formation yielded *Costatumulus* and other brachiopods, and *Stutchburia*, *Cypricardinia*?, *Orbiculopecten* (or *Deltopecten*), and other bivalves, and is assigned to the Early Permian. This section is equivalent to the Gondwana-wide postglacial transgression (Dickins, 1985). The sequence finishes with a generalized uplift of the western border of the South American Gondwana area, and the uppermost strata bear the *Glossopteris* flora. This was followed by a period of no deposition that lasted until the Early Triassic. Erosion may have eliminated younger deposits of the Tepuel Group.

The Carboniferous-Permian boundary in Argentina occurs somewhere between the Late Carboniferous *Buxtonia-Heteralosia* fauna (or equivalent of the "intermediate fauna" in Patagonia) and the first appearance of *Costatumulus*. The stratigraphic interval between these faunas is being explored to provide more details and new evidence. Fossil assemblages are not completely known, and further field and laboratory work is required before any decision in this regard. However, it is possible to anticipate that the remarkable similarities that existed between Australia and Argentina during the Carboniferous *Levipustula* fauna, may be equaled by similarities during the Early Permian, especially between Tasmanian and Patagonian sequences. The latest absolute ages obtained by Roberts et al. (1995) and the discovery of new fossil localities in Argentina, foreshadows a more precise assessment of the Permo-Carboniferous boundary in Argentina.

REFERENCES

Amos, A.J., 1961. Algunos Chonetacea y Productacea del Carbonífero inferior y superior del "Sistema de Tepuel", prov. de Chubut. *Rev. Asoc. Geol. Arg.*, 15 (1): 81.107, Bs. Aires.

Dickins, J.M., 1985. Late Paleozoic glaciation. *BMR Journ. Austral. Geol. & Geophys.*, 163-169, Canberra.

Gonzalez, C.R., 1985. Esquema bioestratigrafico del Paleozoico superior marino de la Cuenca Uspallata-Iglesia, Repzblica Argentina. *Acta Geol. Lilloana*, 16 (2): 231-244, Tucuman.

Gonzalez, C.R. Late Carboniferous Bivalvia from western Argentina. *Geologica et Palaontologica*, Marburg. In press.

Harrington, H.J., 1955. The Permian Eurydesma fauna of eastern Argentina. *J. Pal.*, 29 (1): 112-128.

Page, R.F.N., C.O. Limarino, O. Lopez Gamundi & S. Page, 1984. Estratigrafia del Grupo Tepuel en su perfil tipo y en la region de El Molle, provincia del Chubut. *Actas 9 Congreso Geol. Arg.*, S.C. de Bariloche, 1:619-632.

Roberts, J., J. Claoue-Long, P.J. Jones & C.B. Foster, 1995. SHRIMP zircon age control of Gondwanan sequences in Late Carboniferous and Early Permian Australia. In Dunnay, R.e. & Hailwood, E.A. (eds.) *Non-biostratigraphical Methods of Dating and Correlation*. Geol. Soc. Spec. Pub., 89: 145-174.

Suero, T., 1948. Descubrimiento del Paleozoico superior en la zona extraandina de Chubut. *Bol. Inf. Petrol.*, 287: 31-48, Bs. Aires.

Taboada, A.C., Dos nuevas especies de Linoproductidae (Brachiopoda) y algunas consideraciones sobre el neopaleozoico sudementario de las cercanias de Uspallata, Mendoza. *Acta Geologica Lilloana*, vol 18. Tucuman. In press.

Elevation of atmospheric CO_2 near the Westphalian-Stephanian boundary: evidence from stomatal densities

CHRISTOPHER J. CLEAL, National Museums and Galleries of Wales, Cardiff, UK, ROBERT M. JAMES, Barry High School, Barry, Vale of Glamorgan, UK & ERWIN L. ZODROW, University College of Cape Breton, Sydney, Nova Scotia, Canada

There has been considerable recent interest in the use of variations in stomatal density and index as a proxy for fluctuations in atmos-pheric CO_2. We have been looking at the cuticles of neuropterid pteridosperms from the Sydney Coalfield in the Canadian Maritimes, and the Saarland Coalfield in Germany, which have yielded a set of data on the variation in these parameters over the Westphalian D and lower part of the Cantabrian stages. This was a crucial time for the evolution of the Late Carboniferous tropical 'coal' forests, which were undergoing a dramatic contraction, probably as a secondary effect of Variscan tectonic activity. Would there be any measurable variation in the stomatal parameters indicating CO_2 enhancement as a result of the collapse of the forest ecosystem?

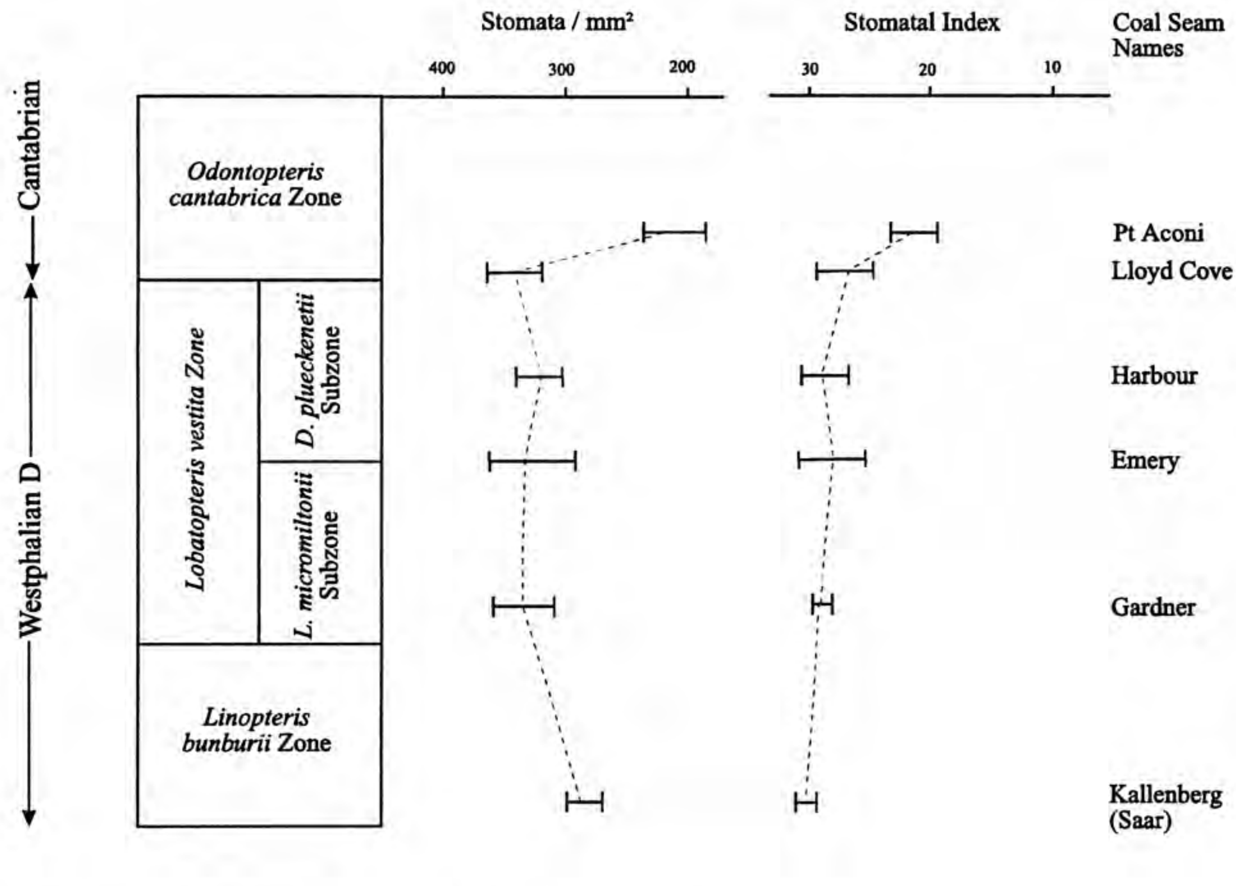


Figure 1. Stomatal density and index in the Westphalian D and early Cantabrian.

We concentrated on just one species in the first instance, *Neuropteris ovata*, one of the most widely occurring neuropterids of the palaeequatorial belt. Full details of the work will be published elsewhere, but the results are summarized in figure 1. This shows a dramatic drop in both stomatal density and index in the very early Cantabrian, and is thus evidence of a marked increase in atmospheric CO_2, coinciding with the collapse of the tropical 'coal' forest ecosystem.

It is now widely accepted that enhanced atmospheric CO_2 can result in an increase in global temperatures through a 'greenhouse-effect' and this is in agreement with the Carboniferous evidence. In the southern high latitudes, the Gondwana ice-sheet underwent a major regression in the Late Carboniferous. Current evidence suggests that the onset of this interglacial was in the early Stephanian, thus coinciding with the apparent increase in atmospheric CO_2. The timing of the warm Mazurovskaya interval in the northern high palaeolati-tudes (Angara) is less easy to relate to the European chronostratigraphy, but the available evidence suggests that it could also be equivalent to the very early Stephanian. Improved stratigraphical correlations between the high and low latitudes in the Late Carboniferous are essential if the model is to be confirmed, but on balance the available evidence suggests that tropical deforestation in the very Early Stephanian caused an enrichment of CO_2 in the atmosphere, which in turn caused global climatic warming and the melting of polar ice.

A provisional list of GEOSITES for Carboniferous palaeobotany

CHRISTOPHER J. CLEAL, National Museums and Galleries of Wales, Cardiff, UK & BARRY A. THOMAS, Department of Geography, University of Wales Lampeter, UK.

GEOSITES is a new project initiated by the IUGS to develop an inventory of globally important geological sites. As part of this project, we have been asked to provide a provisional list of candidate Carboniferous palaeobotany sites. The 24 sites are intended to show the broad pattern of evolution in land floras during the Carboniferous, constructed around the standard palaeophytogeographies and biostratigraphies. The sites may range in size from a small outcrop showing a particularly significant feature to a larger area with many individual outcrops demonstrating a range of floras. We invite comments on this list from all our colleagues. Are any globally-important sites omitted, are there better alternatives to those sites listed, or are some of the listed sites simply not up to scratch? When a consensus has been obtained, the revised list will be presented to the IUGS Global Geosites Working Group.

A longer comparative analysis of the importance of the sites can be found on the *International Organization of Palaeobotany* home page (http://ibs.uel.ac.uk/ibs/palaeo/pfr2/geosites.htm).

Southern Allegehny Mountains, Virginia, USA: The most diverse known *Adiantites* and *Triphyllopteris* Zone floras (Price and Pocono Formations; Tournaisian - lower Visean).

Horton Bluffs, Canada: Upper Visean Horton Group yielding the best available adpressions of the upper *Triphyllopteris* and *Neuropteris antecedens* Zones.

Berwickshire and East Lothian, Great Britain: Late Tournaisian petrifactions, especially important for gymnosperms.

Montagne Noire, France: Late Tournaisian plant permineralizations, especially important for lycophytes and early 'ferns'.

Pettycur, Great Britain: The classic site for Visean plant petrifactions.

Kilpatrick Hills, Great Britain: Sites yielding both petrifactions and adpressions, at several levels between the upper Tournaisian and lower Visean. They are especially important for lycophytes, sphenophytes, progymnosperms and early seed plants.

Huadong, China: Tseishui Formation yielding typical Visean floras for the far eastern part of the palaeoequatorial belt.

Minusa Basin, Russia: Classic examples of Lower Carboniferous Angaran floras, dominated by lycophytes and progymnosperms, with very few seed-plants.

Washington County, Arkansas, USA: Early Namurian petrifactions of trigonocarpaleans, lycophytes, coeonopterids and calamites.

Meuse Valley, Belgium: The most complete sequence of Namurian floras in Europe.

Glynneath-Ammanford, UK: The most complete sequence of Westphalian floras in Europe.

Guardo Coalfield, Spain: The best area for transitional Westphalian-Stephanian floras.

Sabero Coalfield, Spain: The best area for late Barruelian to Stephanian B floras, including assemblages reflecting both wet and drier habitats.

Grand'Croix, France: Barruelian-aged petrifactions, especially important for ferns, cordaites, sphenophytes and pteridosperms.

New River Gorge, West Virginia, USA: A diverse set of adpression floras ranging from near the top of the Lower Carboniferous and through most of the Upper Carboniferous.

Joggins Cliffs, Canada: *In situ* stumps from the Late Carboniferous palaeoequatorial coal-forests, including lycophytes, sphenophytes and cordaites.

Point Aconi, Canada: The best site for late Westphalian D and early Cantabrian adpression floras, with fossils yielding well preserved cuticles and pollen/spores.

Mazon Creek, Illinois, USA: Classic early Cantabrian nodule flora.

Rock Island, Illinois, USA: The best example of a so-called 'upland' or extra-basinal flora preserved in local palaeovalley-fills.

Steubenville road cutting, Ohio, USA: The best available site for (Stephanian) Upper Pennsylvanian coal balls.

Hamilton Limestone Quarries, Kansas, USA: Late Stephanian (Virgilian) extra-basinal vegetation preserved as petrifactions. Includes the oldest known anatomically preserved conifers, as well as a range of other gymnosperms (peltasperms, trigonocarpaleans), lycophytes and sphenophytes.

Northern Utah, USA: Manning Canyon Shale yielding the best preserved flora (probably late Namurian or possibly early Westphalian in age) from the Carboniferous of western North America.

Southern Kuznetsk Basin, Russia: The classic area for Carboniferous and Permian Angaran floras.

Rio Blanco, Argentina: The best preserved pre-glossopterid floras from western Gondwana.

Carboniferous of Barai River (West Verchoyanie)

Igor V.Budnikov[1], Aleksandr G. Klets[2], Yevgeniy S. Sobolev[3] and Vitaly S. Grinenko[4].

1. Siberian Research Institute of Geology, Geophysics and Mineral Resources, Novosibirsk, Russia
2. United Institute of Geology, Geophysics and Mineralogy, Novosibirsk, Russia
3. United Institute of Geology, Geophysics and Mineralogy, Novosibirsk, Russia
4. State Yakutsk Exploration-Survey Expedition, Yakutsk, Russia

The Upper Palaeozoic terrigenous strata of West Verkhoyanie were deposited in a marine palaeobasin along the flank of a passive continental margin. One of the most important sections of Carboniferous deposits is in the upper basin of the Barai River, where Permian rocks are also exposed (Budnikov *et al.*, 1995, 1996). The cyclical Solonchan Suite comprises a succession of transgressive-regressive sediments as thick as 1250 to 1300 m. As a whole these are deposits of the frontal part of a thick delta complex, consisting of alternating inequigranular and banded prodelta siltstones ranging from 2060 m to as little as 80 m thick. The marine fossil fauna appears to be confined to these units. The siltstones alternate with thick beds ("wedges") of medium and fine-grained sandstone. Cephalopods from layers 6026, 24 and 25 form a rich and varied assemblage. It includes the following species: ammonoidea - *Yakutoceras aldanicum* Libr. in Popov, 1965, *Orulganites trianguliumbilicatus* (Popov), *Bisatoceras solominae* Popov, *Paraschartimites sakhaensis* Sobolev sp. nov., *Syngastrioceras* sp., *Glaphyrites* sp., Nautiloidea - *Adnatoceras boreale* Sub. sp. nov. Brachiopods appear to be useful in correlating local and regional stratigraphic units and for defining the stratigraphical position of the Solonchan Suite more clearly. In contrast to ammonoidea, their remains are more regularly distributed through the section, permitting their use not only as stratigraphic bench marks, but also for general characterization of litho-units and definition of boundaries. *Cancrinella alazeica* Zav., *Rhynchopora arctica* Lich. *et* Einor, *Rhynoleichus triangulatum* Abr. *et* Grig., *Alispirifer dmitrii* Abr. *et* Grig., as well as *Neochonetes* cf. *carboniferus* Keys., which are present in layers 24 (Rost Brook - I) and 6026 (Birandya River - II), are also present in the lower Solonchan subsuite (layers 24 and 25). The upper Solonchan subsuite (layer 35) contain the brachiopods *Verchojania* cf *ursovi* Abr. et Grig., *Rhynchopora* cf. *arctica* Lich. et Einor, and *Verchotomia tukulaensis* (Kasch.). Along the Rost and Birandya Rivers brachiopods in the underlying Imtandzha Suite (*Muirwoodia martianovi* (Ser. in Lipina) - layers 4 and 5 and in the lowermost part of the overlying Kygyltass Suite (*Taimyrella pseudodarwini* (Einor) layer 40) are consistent with the middle Carboniferous age of the Solonchan Suite.

Plant remains point to this conclusion also. In the over lying Kygyltass Suite, layer 44 (see fig.1), S. G. Gorelova has identified *Angarodendron obrutschevii* Zal., *Demetria asiatica* Zal., *Stigmaria* sp., *Annularia* cf. *astericus* Zal., *Paracalamites crassus* Gorel., *Mesocalamites* sp., *Angaropteridium cardiopteroides* (Schm.) Zal., *A* cf. *lingulatum* Neub., *Cardiopteridium cf. parvulum* (Schm.) Tschirk., *Cordaites* sp., *Rufloria subangusta* (Zal.) S. Meyen, *R. theodorii* (Tschirk. et Zal.) S. Meyen, *R. derzavinii* (Neub.) S. Meyen, *Tschernovia* sp., *Cardiocarpus krapivinoensis* Such., *Samaropsis tcheremitchkiensis* Such., *S. pauxilla* Zal., *S. auriculata* Neub., *S. tasichinii* Rassk., *S.* cf. *mungatica* Neub., *S. euryptera* Such., *S.* cf. *jurabaensis* Rassk.,*Angarocarpus* cf. *ungensis* (Zal.) Radcz., *Rhabdocarpus* (?) *tomiensis* Zal., *Cardaicarpus tomiensis* Radcz., *Holcospemum* (?) *chelchetensis* Such., *Carpolithus rastribortis* (Neub.) Parf. This assemblage is similar to the Mazurovsky and Alykaevsky horizon assemblages from Kuzbass and Kata horizon assemblage from the Tunguska basin.

References

Budnikov, I.V., V.S. Grinenco, A.G. Klets, and Sobolev, Y.S. 1995. Bench Mark Level of the Middle Carboniferous in Western Verkhoyanye. *Proceedings of the International conference on Arctic margins* (Magadan, Russia, September. 1994) Magadan , pp. 33-35.

Budnikov, I.V., A.G. Klets and V.S. Grinenco. West Verkhoyanye is the key region to solve the main stratigraphic problems of Upper paleozoic of Siberia. *Abstracts of XIII International Congress on Carboniferous - Permian.* Warszawa, 1995. P.16.

Budnikov, I.V., A.G.Klets, R.V.Kutygin and V.S. Grinenco. 1996. Permian of East Yakutiya. *Permophiles*. A news-letter of SCPS, +28, June, . pp. 27-29.

I.V.Budnikov, A.G.Klets, R.V.Kutygin, V.S.Grinenco. Carboniferous of East Yakutiya. *Newsletter on Carboniferous Stratigraphy*, V.14, July, 1996. P.12-14 .

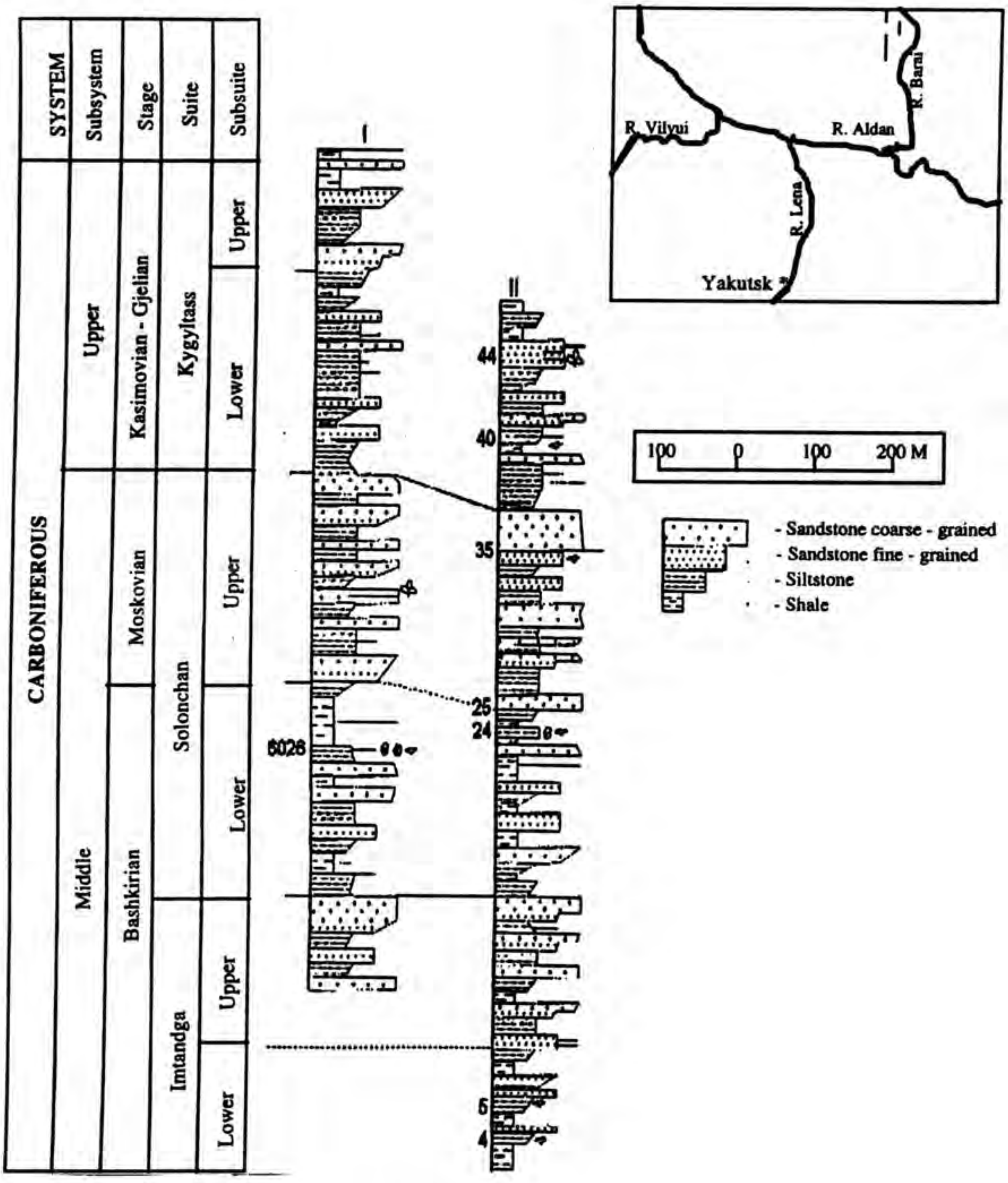


Figure 1. Carboniferous deposits of the Barai River.

Russian Comission for the Carboniferous system: Information on Resolutions of the Commission for the Carboniferous System

A. Kh. Kagarmanov, Chairman of the ISC Commission for the Carboniferous System &;

O.L. Kossovaya, Scientific Secretary

In recent years, the Interdepartmental Stratigraphic Committee (ISC) Commission for the Carboniferous System repeatedly considered a number of issues, connected with a more precise delineation of stratigraphic of boundary units. Special meetings were held on the Visean (Lower Carboniferous), Lower/Middle Carboniferous boundary, increasing the rank of regional units of the Middle and Upper Carboniferous and distinguishing the new Melekhov Horizon (Gzhelian Stage) in the Russian Platform.

1. On February 12-15, 1990, a Plenary Session of the ISC Commission for the Carboniferous system was held, dealing with substage division of the Visean. The Plenary session of the Commission took the following resolution:

   "Taking into account the difference in the rank of substage boundaries in case of triple division of the Visean, it would be reasonable to subdivide this stage into two substages with the boundary between them drawn at the base of Zone *Endothyranopsis compressa -Archaediscus krestovnikovi*. To ask the ISC Bureau to approve the present resolution, after which to introduce the relevant changes into the general scale of the Carboniferous system."

2. The ISC Commission for the Carboniferous System held an enlarged Bureau Meeting on May 17, 1995, at which the results of questioning were summed up, connected with the necessity of raising the problem of revision of the officially drawn Lower/ Middle Carboniferous boundary and drawing it at the base of the ammonite Genozone *Homoceras*. Work of the international Group on the Middle Carboniferous boundary has shown, that this level is traced globally and corresponds to the Mississipian/Pennsylvanian boundary. As is known, in the latest unified chart of the Carboniferous of the Urals, the boundary of the Middle and Upper series of the Carboniferous is drawn at the base of Zone H, which conforms to the commonly accepted opinion of the Uralian geologists, through it contradicts its official position adopted in our country. In the course of questioning, the members of the Commission had to answer the following questions:

   1. Do you agree, that it is necessary to change the boundary of the Lower and Upper series of the Carboniferous system and draw it at the base of Zone *Homoceras* (yes, no) ?
   2. Can this boundary be drawn and traced using the fossil group which you are studying?
   3. Is it possible to reliably indicate the position of this boundary in the regional and local stratigraphic charts of the region (or regions) which you are studying?

   25 members of the Commission, specialists in different faunal groups, responded to the questions posed. Among them, 18 members of the Commission agreed to change the position of the Lower/Middle Carboniferous boundary. A specific opinion was put forward by A.V.Durkina and P.K. Kostygova.

   As a result, it was resolved to draw the lower boundary of the Bashkirian at the base of the ammonoid zone *Homoceras/Hudsonoceras*, foraminiferal zone *Plectostaffella bogdanovskensis*, and conodont zone *Declinignathodus noduliferous*. The lower boundary of the Syuran Horizon in the Urals, as well as the lower boundary of the Voznesensk Horizon in the sections of the southern Russian Platform and the base of Kaeza Horizon in southern Siberia correspond to this boundary. This boundary is marked by the change in the taxonomic composition of rugose corals but the change in the composition of brachiopods is recorded earlier. This boundary is characterized by the change of macroflora remains following the succession from thermophile lepidophyte flora to the primitive pteridosperm one. Generally, the considered problem has been developed in sufficient detail using material from the Southern Urals, Donetz Basin and Tien Shan, which is reflected in numerous publications of recent years.

3. On February 1, 1996 a meeting of the Enlarged Bureau of ISC Commission for the Carboniferous was held. The main issue on the agenda was that of increasing the rank of regional units of the Russian Platform. In view of detailed development of the International Scale of the Carboniferous system, particularly urgent is to provide grounds for it and incorporate domestic stratigraphic units of the Middle and Upper Carboniferous, which will make it possible

to consolidate the priority of the Russian science. During the last decade, many versions of the General Scale of the Carboniferous system (Harland, et al., 1982, 1990; Cowie, Basset, 1989; Wagner, Winkler Prins, 1994), utilised the Carboniferous horizons of the unified scale of the Russian Platform (fully or partly) as stages. Most of these horizons correspond to several foraminiferal, conodont and other fossil zones and do not principally differ from the Lower and Upper Carboniferous stages of Western Europe, distinguished in England and Belgium.

Taking into account the appeal of RISC of Central regions and the results of previous questioning, the Enlarged Bureau of the Carboniferous Commission of the ISC took the resolution to distinguish, as an exception, substages with their own names within the Moscovian stage of the General Scale of the Carboniferous, using names of regional horizons: (in ascending order): Vereyan substage, Kashirian substage, Podolskian substage, Myachkovian substage. The RISC of the Central regions were required to submit material on stratotype sections of units of the Moscovian to the Carboniferous Commission.

The word SUBSTAGE should be used in the English translation of the names of horizons of the Bashkirian and Upper Carboniferous for the sake of mutual understanding.

4. In connection with the ISC Bureau Resolution of March 2, 1992, the position of the Carboniferous/Permian boundary in the General Scale has been changed and, thus, the position of the upper boundary of the Gzhelian in the regional scale of the Russian Platform. The Melekhov Horizon was approved as the upper horizon of the Gzhelian in the regional scale of the Russian Platform; its stratotype is in the Melekhov-Fedorov Quarry and exposures of the Moshechikhin Ravine, as well as near the Klyazmensky Gorodok village. The range of the fusulinid corresponds to the fusulinid zone *Daixina bosbytauensis, D. robusta* (M. Kh. Makhlina, T.N.Isakova, in press).

CARBONIFEROUS OF BRAZIL

A.C. Rocha-Campos and L.E. Anelli, Instituto de Geociências, Universidade de São Paulo, e-mail: acrcampo@usp.br

Contribution to the Late Paleozoic stratigraphy of the Parnaíba Basin

Lima Filho, F.P. [1]
Anelli, L.E. [2]

[1] Departamento de Geologia - Universidade Federal do Rio Grande do Norte - UFRN, Campus Lagoa Nova, Cx. Postal 1639, CEP 59072-970 - Natal - RN, Brazil; e-mail: pinheiro@geologia.ufrn.br

[2] IG/USP, anelli@usp.br

The late Paleozoic-Triassic stratigraphic sequence of the Parnaíba Basin, Northeastern, Brazil, represents a transgressive-regressive cycle bounded by strong unconformities. The lower one occurs between the Poti (Mississippian) and Piauí (Pennsylvanian) formations and the upper one separates the Sambaíba formation (Triassic) from the overlying Passos Bons formation. Marine regression at the end of the Mississipian has been assigned to the eohercinian orogeny (Goes *et al.*, 1990) as well as to the Gondwana glaciation in Southwestern Brazil (Lima Filho, 1991). This orogeny resulted in extensive erosion and disconformity between the Poti and Piauí formations. Wide sea connection between the Parnaíba and Amazonas basins became discontinuous during the Pennsylvanian. Analysis of depositional systems in the Piauí Formation allowed reconstruction of the Pennsylvanian paleogeography (Lima Filho, 1991). The lowest beds of the Piauí Formation were deposited in a desert environment associated with secondary fluvial and lacustrine systems (Lima Filho & Rocha-Campos, 1992; Lima Filho & Rocha-Campos, 1993). In the middle portion of the section eolian sands pass transitionally to mudstones and evaporites. Rising of sea level and resulting transgression led to development of an extensive evaporite basin around 400 km in length, containing thicknesses of up to 15 m of sediments associated with marine carbonate platforms at the northeastern part of the Parnaíba Basin. On the northeastern portion of the basin the eolian coastal sands intercalate with marine carbonate, small deltaic fans reworked by storms and beach sands constituting shallowing upward cycles (Lima Filho *et al.*, 1995, Fig. 1). Towards the top of Piauí Formation, eolian sediments and evaporites expand in areal extent but form thinner sequences. Carbonates yielded a rich marine invertebrate fauna comprising bivalves, gastropods, cephalopods, brachiopods, trilobites, crinoids, forams and other microfossils of Morrowan-Atokan age (Kegel, 1951, Campanha & Rocha-Campos, 1979; Lima Filho, 1991; Anelli et al., 1992; Anelli et al., 1993; Anelli, 1994). They represent the latest marine environment in the basin. A subsequent regressive phase in the Permian is record by the deposition of evaporites, sand seas, tidal flats and small deltas of the Pedra de Fogo Formation. The paleogeographic evolution was accompanied by a climate change towards arid conditions during the Permian that culminates with extensive desert environments in the Triassic.

References

Anelli, L.E.1994, São Paulo, 148p. (Dissertação de Mestrado, Instituto de Geociências/USP).

Anelli, L.E.; Rocha-campos, A.C. & Lima Filho, F.P. 1992, *37th Congr. Bras. Geol.*, São Paulo, *Boletim de Resumos Expandidos*, 1, Sessões Temáticas, p.502.

Anelli, L.E.; Simões, M.G. & Lima Filho, F.P. 1993, *Cong. Bras. Paleontol.* São Leopoldo, Sociedade Brasileira de Paleontologia. *Resumos*. p. 108.

Campanha, V.A. & Rocha-Campos, A.C. 1979. Boletim do Instituto e Geociencias da Universidade de Sao Paulo, 10:57-67.Kegel, W. 1951, *Boletim*. Divisão de Geologia e Mineralogia, 153, p.1-38.

Goes, A.M.O.; Souza, J.M.P. & Teixeira, L.B. 1990. Boletim de Geociencias da Petrobras, 4:55-63.Lima Filho, F.P. 1991, *XII Cong. Bras. Paleont.* São Paulo, Sociedade Brasileira de Paleontologia, *Resumos*, p.44.

Kegel, W. 1951, *Boletim*. Divisão de Geologia e Mineralogia, 153, p.1-38.

Lima Filho, F.P.; Rocha campos, A.C. 1992, Bol. IG_USP, *Instituto de Geociências, Universidade de São Paulo, Pub. Especial* 12 p. 67-68.

Lima Filho, F.P. & Rocha Campos, A.C. 1993, *Resumos. Acad. Bras. Ci.*, 65(3) p.324-325.

Lima Filho, F.P.; Machado, M.F.; Córdoba, V.C. & Souza, D.C. 1995, *XVI* Simpósio de Geologia do Nordeste. Recife, 1995. *Boletim 1*, p. 370-373.

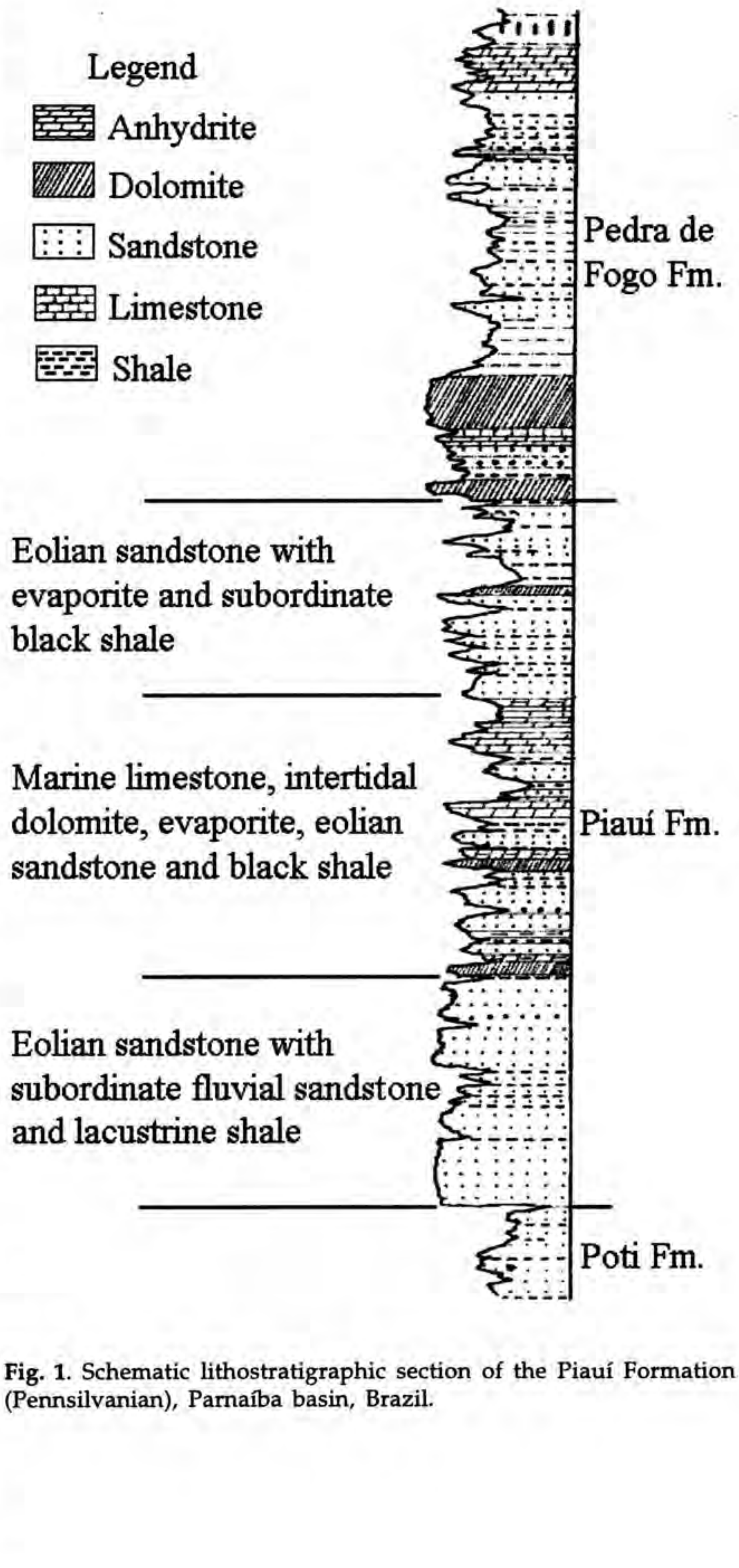


Fig. 1. Schematic lithostratigraphic section of the Piauí Formation (Pennsilvanian), Parnaíba basin, Brazil.

Carboniferous spores sequence from the Southwest part of Tarim Basin, Xingjiang, China

Gao Lianda
Institute of Geology, Chinese Academy of Geological Sciences

Carboniferous rocks of the Tarim Basin, Xingjiang, China have attracted economic interest for many years as a possible source of mineral and petroleum deposits. Exploration throughout the area has been hindered by insufficient biostratigraphic information for precise age determination and correlation of the succession. However, both at the surface and in the subsurface, palynology is especially valuble for resolving such problems in this area.

Cuttings and cores from four wells in the Southwest Tarim Basin have been investigated and despite the discontinuity and the heterogeneity (cores and cutting) of sampling, sediments of Late Famennian, Tournaisian, Visean, Namurian, Westphalian, Stephanian and Early Permian (Autunian) are recognized. The new data add milestones to a better understanding of the stratigraphy of the Late Devonian, Carboniferous and Early Permian of the Southwest Tarim Basin.

This paper is preliminary results of palynological studies of the Carboniferous from the Southwest Tarim Basin.

The oldest group concerns the two lowest samples 2530-2540m and 2477-2480m of Ba-cen I borehole. Among the miospores recorded are *Retispora lepidophyta, R. cassicula, Retusotriletes communis, Aneurospora gregisii, A.* sp. cf. *perinatus, Apiculiretusispora verrucosa, A. nitida, Rugospora flexuosa, Grandispora garcilis, G. uncata, G. cornuta, G. echinata, Ancyrospora involucra, Hystrichosporites* sp., *Auroraspora macra, Hymenozonotriletes explanatus, Asperispora acuta,* and *Discernisporites micromanifestus*. The composition of the miospore assemblages indicates they belong to the *Reftspora lepidophyta-Dictyotriletes literatus* (LL) zone and *Retispora lepidophyta-Hymenozonotriletes explanatus* (LE) zone. The LL and LE zones correspond to the middle and upper *Costatus* and lower *Praesulcata* conodont zones (Higgs and Streel, 1984), and may be equivalent to Fa2d-Tn I a in the Dinant Basin of Belgium.

The next assemblage is based on a single sample at 2477-2480m, the best known is *Retispora lepidophyta*, the assemblage is rather rare in composition with species such as *Knoxisporites literatus, Retusotriletes* spp., being the most commonly occurring element. The co-occurrence of *R. lepidophyta, Knoxispoirtes literatus* and *Retusotriletes* spp. corresponds to the middle to upper *Praesulcata* conodont zone of Western Europe. Level 2477-2480m belongs thus to the highest part of the Famennian (late Strunian), very near, but just below, the Devonian/ Carboniferous boundary.

The third association concerns the three highest samples cored from 2433m, and*Auroraspora macra, Grandispora echinata* and *Verrucosisporites nitidus* are still present, but the presence of some new species gives a clear Lower Carboniferous aspect to the assemblages when compared with the former. These species appear in an ascending chronological order as follows: *Schopfites claviger, Auroraspora macra, Grandispora echinata, G. senticosa, Dictyotrletes trivilis, Verrucosisporites fimis, Crassispora trychera* etc. They may be approximately correlated with the PC, CM zone of Western Europe, which is considered to be middle to late Tournaisian (Tn2-Tn3) in age.

Of the eight macerated samples from 3511-3536.5 m in borehole Ba-Dong-2, Western Tarim Basin, Xingjiang, this assemblage contains more than 40 species among which the following are considered to be stratigraphically significant:

Punctatisporites irrasus, P. larbitus, P. hongtugouensis, Raistrickia clavata, Schopfites claviger, Lophozonotriletes excisus, Verrucosisporites irragulus, V. similis, Corbulispora cancellata, C. subleavelenris, Knoxisporites literatus, Umbonatisporites distinctus, Rugospora minuta, R. polytycha, Auroraspora macra, A. trilobata, Grandispora uncata, G. notiensis, G. echinata, Spelaeotriletes pretiosus, Fastisporites minuta, F. proelegans, Hymenozonotriletes explanatus and *Discernisporites micromanifestus*. Accordong to Clayton *et al.*, (1977) and Higgs *et al.*, (1988), this would indicate HD, BP,PC or CM zone (Tn2-Tn3).

Miospore zonations of the Visean have been obtained from Ba-Dong 2 well (3508-3400m) and He 4 well (1339-1410m) in Western Tarim Basin, Xingjiang. These assemblages (PU, PC zone) are composed of abundant and well preserved spores. The presence of *Lycospora pusilla, L. rotunda, L. subtriquetra, L. noctuina, Crassispora maculosa, C. kosankei, Knoxisporites literatus, Tripartites vetustus, Densosporites anulatus, Verrucosisporites baccata, Murospora Lycospora pusilla, L. subtriquetra, L. rotunda,* and *Triquitrites maginatus*. The following species are recorded in assemblages from He 4 well (1390m):. *Calamospora hartungina, Waltzispora planiangulata, Anapiculatisporites minor, Cyclogranisporite multigrans, Simenozonotriles intortus, Crassispora kosankei, Apiculatispores latigranifer*. The preceding list includes mainly the representative elements of the Namurian of west Europe.

The four samples of He 4 well (1364-1175m) are close together, and contain very rich and well preserved spores, among which *Lycospara* is especially abundant, occupying 38-45% of the total. Species include *Lycospora pusilla, L. rotunda, L. subtriquetra, Tripartites nonquerckei, Crassispora maclosa, C. kosankei, Murospora kosankei, Verracosisporites verrucosus, V. microtuberculatus, Acanthotriletes subtriquetra, Calamospora microrugosa, Vestispora lucida, V. pseudoreticulata, Cristatisporites perminutus, Convolutispora venusta, Cirratriradites rarus, C. saturnii,* and *Florinites junoir*. These samples are assigned to the SS,RA, NJ and SL zone (Clayton *et al.*, 1977) corresponding to the Westphalian of Westem Europe.

Miospore assemblages which can be positively assigned to the Late Carboniferous have, to date, only been recorder from core material from Ba-Cen I well . Assemblages of Stephanian age were recorded from the interval 2000-2033m. Assemblages recorded from sediments in the 2000-2033m in BawCen I well were dominated by *Angulisporites, Cirratriradites* and *Cristatisporites*, these species appear in an ascending chronological order as follows: *Angulisporites splendidus, Cristatisporites indinabundus, Cirratriradites saturnii, C. rarus, Lycospora pusilla, L. rotunda, L. subtriquetra, Microreticulatisporites nobilis, Endosporites ornatus, E. globiformis Spackmanites* cf *facierugosus, Crassispora kosankei, Torispora securis, Laevigatospoprites vulgaris, L. perminutus.*

The Early Permian spore assemblages of Southwest Tarim Basin, Xingjiang, contain typical Permian elements of Western Europe, Northern America and Australia.

The samples from Ba-Cen I well were obtains from between 1930-1976m and Yu I well 3506- 3570m. This assemblages are characterised by abundant specimens of Pteridosperms and Gymnosperms pollen which make up 90-95%. This assemblages include Platysaccites papillionis, *Limitisporites rectus, Pityosporites communis, Alisporites splendens, Pteruchipollenites gracilis, Vitreisporites signatus (=V. pallides* Riess), *Lunatisporites noviaulensis, Hamiapollenites perisporites, Schopfipolenites cf. teunis, Wilsonites delicatus, Potonieispoirtes simplex, Corisaccites alatus, Anticapipollus sp., Guthoerisporites magnificus, Striatoabietes multistriatus, Cordiatina ornata, C. marginata, C. spongiosa, Vittatina vittifer* and *V. striata.*

The Devonian, Carboniferous and Permian Miospore of Southwest Tarim Basin Xingjiang, can be correlated with those of China, Westem Europe and North America.

***No references were supplied with this article — Ed**

REPORT ON RESEARCH ACTIVITY AT AMOCO

John Groves
Amoco Production Co., P.O. Box 3092, Houston, TX, 77253, U.S.A.

Paul Brenckle and I analyzed Carboniferous and Lower Permian stratigraphy in China's western Tarim Basin by applying Shaw's (1964) graphic correlation technique to published paleontologic data sets from five outcrop sections. We graphically correlated the Tarim Basin data against Amoco's "Old World" composite standard designed specifically for the Late Paleozoic Eurasian-Arctic faunal realm (Ross, 1967). Results show that Permo-Carboniferous sedimentation in the Tarim Basin was not continuous, as suggested in the literature, but punctuated by several hiatuses lasting from two to 15 million years.

The "Old World" composite standard consists of more than 3,100 fossil taxa, primarily smaller foraminifers, fusulinaceans, conodonts and palynomorphs, with subordinate numbers of ammonoids, brachiopods and corals. The ranges of these taxa are correctly sequenced relative to one another and to the stadial boundaries of the international chronostratigraphic scale. Much of the data comes from stratotype and other reference sections in the Urals and Moscow Basin. The composite standard is linearly calibrated to geologic time so that composite standard units are of equal duration and stadial boundaries correspond to their associated mega-annum ages as reported by the Australian Geological Survey Organization's time scale (Young and Laurie, 1995). Our study is due to be published later this year (Groves and Brenckle, in press).

REFERENCES

GROVES, J. R., AND P. L. BRENCKLE, in press, Graphic correlation in frontier petroleum provinces: Application to Upper Paleozoic sections in the Tarim Basin, western China. American Association of Petroleum Geologists Bulletin.

ROSS, C. A., 1967, Development of fusulinid (Foraminiferida) faunal realms. Journal of Paleontology, v.41, p. 1341-1354.

SHAW, A. B., 1964, Time in Stratigraphy. McGraw-Hill Book Company, New York, 365 p.

YOUNG, G. C., AND J. R. LAURIE, Eds., 1995, An Australian Phanerozoic Timescale. Oxford University Press, 279 p., plus 13 charts.

Facies and biostratigraphy of the Late Carboniferous sequence in the Carnic Alps (Austria/Italy)

Karl KRAINER, University of Innsbruck (Austria) and Vladimir DAVYDOV, Boise State University (USA)

In the Carnic Alps (S-Austria/N-Italy) the folded Variscan basement is unconformably overlain by a thick succession of shallow-marine clastic and carbonate sediments of the Late Carboniferous Bombaso Formation and Auernig Group, and of the Early Permian Rattendorf and Trogkofel Group. The sediments were deposited in discrete basins formed by block and wrench faulting subsequent to the Variscan orogenic phase. Biostratigraphy of this succession is mainly based on fusulinids. The Bombaso Formation is up to 200 m thick and consists of poorly sorted, immature breccias and conglomerates which are interpreted as fan-delta deposits. Breccias of the Bombaso Formation yielded the oldest fusulinid fauna of the Carnic Alps (*Quasifusulinoides quasifusulinoides* - *Protriticites ovatus* zone) indicating latest Moscovian age. The overlying Auernig Group is up to 1200 m thick and consists of shallow-marine, cyclic clastic and carbonate rocks. The succession is divided into Meledis-, Pizzul-, Corona-, Auernig- and Carnizza Fms. The Meledis-,-Corona- and Carnizza Fms. predominantly consist of clastic sediments, Pizzul- and Auernig Fms. contain substantial quantities of fossiliferous limestones. The main lithofacies types are (a) quartz-rich conglomerates, (b) trough-crossbedded sandstones, c) hummocky-crossbedded sandstones, (d) bioturbated, locally fossiliferous siltstones and shales, and (e) well bedded and massive fossiliferous limestones. In the upper part of the succession these lithofacies are arranged to form prominent cycles ("Auernig Cyclothems") with thicknesses of 10 - 40 m. The conglomerates are interpreted to have been deposited during relative sea-level lowstands in a nearshore environment, and fossiliferous limestones were deposited during periods of relative sea-level highstands. The formation of these cycles is related to eustatic sea-level changes caused by the Gondwanan glaciation. The basal Meledis Fm. contains fusulinids of the *Protriticites pseudomontiparus* zone, in the middle part fusulinids of the *Montiparus montiparus* zone are present, thus indicating a Kasimovian age. The uppermost part of the Meledis Fm. is characterized by the appearance of *Ferganites ferganensis*, *Rauserites* sp. and *Rauserites rossicus* pointing to an early Gzhelian age. Limestones of the Pizzul Fm. and Corona Fm. contain fusulinid species from which a middle Gzhelian age can be estimated. The rich fusulinid fauna of the Auernig Formation and that of the Carnizza Fm. (*Daixina alpina* and *Dutkevitchia dastarensis*) indicate a late Ghzelian age. The overlying Rattendorf Group comprises a succession of sediments deposited in nearshore, inner shelf and outer shelf environments. The succession is up to 450 m thick and is divided into Lower *Pseudoschwagerina* Limestone, Grenzland Fm. and Upper *Pseudoschwagerina* Limestone. The Lower *Pseudoschwagerina* Limestone (LPL) is composed of three depositional cycles consisting of fossiliferous limestones and thin intervals of clastic sediments. According to the identified fusulinid species the lowermost part of the LPL can be correlated with the uppermost part of the *Daixina sokensis* zone, and the main part with the *Schwagerina robusta* - *Ultradaixina bosbytauensis* zone. From the top of depositional sequence 3 *Schwagerina versabile*, *Schellwienia bornemani*, *Zigarella panjiensis* and *Likharevites inglorius* were identified, which already indicate an Asselian age. Based on fusulinids, the C/P boundary in the Carnic Alps lies within the uppermost part (HST) of the Lower *Pseudoschwagerina* Limestone. In the Aidaralash Creek section (the GSSP of the C/P boundary) the C/P boundary perhaps also coincides with a highstand of sea-level.

EOPARASTAFFELLA, ITS EVOLUTIONARY PATTERN AND BIOSTRATIGRAPHIC POTENTIAL

LUC HANCE
Geological Survey of Belgium. 13, Jennerstr., B1000 Brussels, Belgium
Catholic University of Louvain, Geography-Geology Department, 3, L. Pasteur pl., B1348 Louvain-la-Neuve, Belgium.
Hance@page.ucl.ac.be

As already pointed out by Vdovenko (1954), the evolutionary pattern of the foraminifer *Eoparastaffella* provides a good criterion permitting the improvement of the biostratigraphy of the Tournaisian-Viséan transition, mainly in platform carbonates. Two morphotypes can be distinguished by simple measurements in good axial sections, combined with morphological characters. The e/r ratio is used for calibrating the evolution, with r corresponding to the radius of the largest circle which can be included in the axial section above the umbilici, and e the portion of the axial plane above the circle (Fig. 1). The factor e reflects the elevation of the last whorl. The ratio of the elevation (e) to the radius (r) ranges between 0 (primitive specimens) to 0.8. The main species of *Eoparastaffella* are briefly discussed and tentatively placed within the evolutionary pattern.

Morphotype 1 (M1) is characterised by a well-rounded outer periphery, a low to moderate expansion, an irregular coiling of the initial stages and an e/r ratio < 0.5. Examples : *E. rotunda* Vdovenko 1971, *E. ovalis* Vdovenko 1954. Morphotype 2 (M2) has a more regular coiling and an e/r ratio ≥ 0.5 that reflects the rapid elevation of the last whorl. Examples : *E. simplex* Vdovenko 1954, *E. pseudochomata* Vdovenko 1954, *E. evoluta* Vdovenko 1971. Range zones of M1 and M2 are overlapping.

Three sections from South China (Guangxi), representative of platform, slope and basin settings, serve as a test for evaluating the biostratigraphic potential of *Eoparastaffella*. The evolutionary pattern is well documented with the "M1 assemblage" coexisting with the conodont *Scaliognathus anchoralis europensis* and of Tournaisian age. Correlation of the incoming of M2 succeeding to M1 is more satisfactory than using the first appearance of the genus *Eoparastaffella*, undetermined, which reveals in many places to be cryptogenic.

In the Lower Viséan of the Dinant type area, M1 and M2 are associated, but the representatives of M1 preceeding M2 are lacking. Evidence of a Tournaisian age of the oldest representatives of *Eoparastaffella* makes it necessary to reconsider former interpretations and will give a new insight to the T-V transition in Belgium. Associations lacking *Eoparastaffella* and assigned to the Viséan referring to their "Viséan" character in particular, should be used with caution.

The appearance of *Eoparastaffella* M2 within its evolutionary lineage to define the T-V boundary was proposed during the 13th Carboniferous-Permian Congress in Krakow, 1995. This proposal has received the support of the T-V Working Group after a field trip in South China in November 1996, however, it must be tested on other sections. Data are being gathered and a synthesis is in progress.

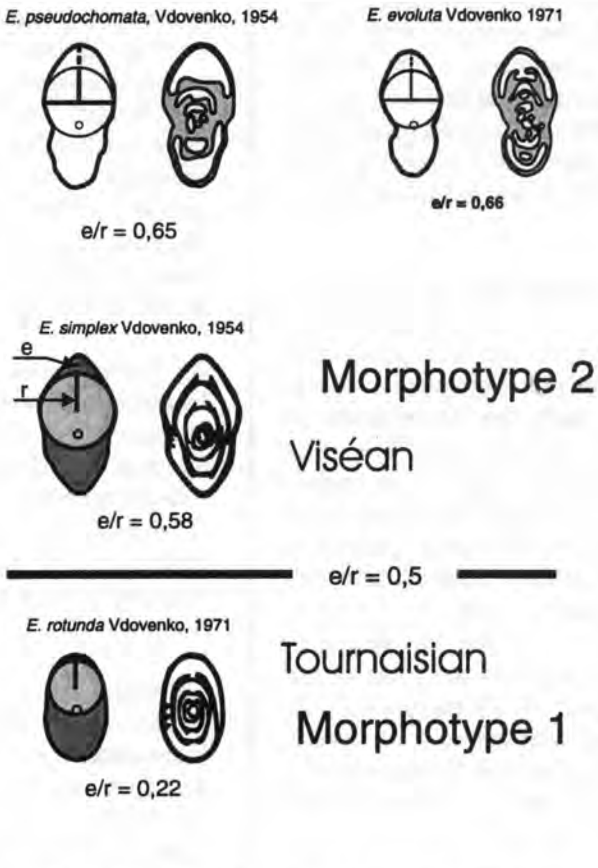


Figure 1. Line drawing and peripheral outline of typical *Eoparastaffella*. See comments in text. Line drawing of E. *simplex* and *E. rotunda* retaken from Vdovenko (1964).

BOOK REVIEWS

Recent advances in Lower Carboniferous geology.

P.Strogen, I. D, Somerville and G. Ll. Jones (eds). 1996. Geological Society Special Publication No. 107.

Upon opening this volume, my memory was jogged back to 1984. when I attended the first European Dinantian Environments meeting in Manchester and, I think to the slight consternation of some of those present, gave a research presentation whilst in an advanced state of pregnancy. Well, some things have changed since then...

Ten years later (1994), this time in Dublin, a second E.D.E. meeting took place, and this volume is a tangible result. The thirty papers are by a fair mixture of old hands and newcomers, and overall one has a good impression of the 'hot' topics of the Dinantian subsystem. What slightly surprised me was the longevity of some of them - many topics from the 1984 meeting resurface here to report the progress made in ten years. Let me pick out a few plums of a more palaeontological nature.

Seven papers under the theme, 'Faunas, floras and biostratigraphy' fall into two sets, one Russian and one Irish. Of the Russian set, two papers are on fish, with some nice photographs of teeth, scales, and other bits, and the description of several species including four new ones. The other two papers are stratigraphic, with some useful-looking charts showing biostratjgraphy and correlation, including some Western European equivalents. They are closely linked, and the authors refer to each other's paper. Unfortunately, there are some minor, but irritating, inconsistencies, such as the form of the horizon names: 'Cherepet' or 'Cherepetsky"? In addition, on checking out Vdovenko *et al.* (1990), which is referred to in one paper, 'Gumerovo' or 'Gumerovsky' of these papers was there called 'Humerovsky'!

Moving on swiftly to the Irish set, again there are biostratigraphy and palaeontology subsets. Jones and Somerville have a go at the biostratigraphy: rather them than me. They have a Gumerovsky horizon too. The boundaries on their chart do not wholly coincide with those of the Russians, despite showing largely the same things. This is perhaps symptomatic of the general state of difficulty in determining the correlation of the Dinantian subsystem on anything wider than a regional basis. Somerville gives a succinct summary of the particular difficulties in placing the Dinantian Stage boundaries in Ireland.

In the other two Irish papers, brachiopod biofacies have a look-in, with some nice photos of delicate-looking silicified brachiopods; and palynology pokes its nose in, in the form of some rather difficult-sounding borchole material which is nevertheless licked into shape with an environmental interpretation.

Other papers with a strong palaeontological link are found in the section on carbonate buildups and Waulsortian mudmounds. Three of these are closely related and concern the mounds and surrounding sediments of early Mississippian age in New Mexico. The meeting was evidently not rigidly European! These three papers are written clearly and have plenty of meat, but sorting out the overall story is not easy: different assemblage schemes are used and it's not obvious how they relate to each other, nor to the assemblages proposed for Europe by Lees *et al.* (1985), and related to mounds in North America by Lees & Miller (1985).

A fourth paper on buildups takes us back to Ireland and some late Viséan mounds in the Dublin area, while a coral-reef bioherm from Spain is described and discussed in another. The role of 'microbes' in the development of bioherms is lucidly discussed and illustrated by Neil Pickard. If I had to pick one paper from this volume to take to a desert island, this would be the one.

To round off with some general comments, the index has the usual inaccuracies and inconsistencies, but is overall fairly reasonable, and I would like to have been told the location for the cover photograph. The overall visual impression is a consistent high standard; even the density of the photographs is well-matched from paper to paper. I should say that if you need to know anything about the Dinantian subsystem or its constituent parts, this volume is an excellent place to start.

References

LEES, A., HALLET, V. & HIBO, D. 1985. Facies variation in Waulsortian buildups, Part 1: A model from Belgium. *Geological Journal* 20, 133-58.

LEES, A. & MILLER, J. 1985. Facies variation in Waulsortian buildups, Part 2: MidDinantian buildups from Europe and North America. *Geological Journal* 20. 159-80.

VDOVENKO, M. V., AISENVERG, D. Y., NEMIROVSKAYA, T. I. & POLETAEV, V. I. 1990. An overview of Lower Carboniferous biozones of the Russian Platform. *Journal of Foraminiferal Research* 20, 184-94.

Amanda Chapman
Department of Earth Sciences, University of Cambridge

*Review reproduced with permission from Palaeontology Newsletter No 33 — Ed

The Carboniferous of the World, III.

Martinez Diaz, C., R.H. Wagner, C.F. Winkler Prins and L.F. Granados (eds). 1996. *The Carboniferous of the World, III: The former USSR, Mongolia, Middle Eastern Platform, Afghanistan, & Iran.* I.T.G.E., Madrid - Natl. Natuurhist. Mus., Leiden; I.U.G.S. Publ. 33: 521 pp., 80 pls.

Obtainable from the Instituto Tecnologico Geominero de Espana, Servicio de Publicaciones, Rios Rosas 23, 28003 Madrid, Spain; Backhuys Publishers, Warmonderweg 80, 2341 KZ Oegstgeest, The Netherlands; and the IUGS Bureau.

This latest volume in the series on Carboniferous of the World covers the former USSR, Mongolia, Middle Eastern Platform, Afghanistan and Iran. It follows Volume I (China, Korea, Japan and SE Asia) and Volume II (Australia, Indian subcontinent, South Africa, South America and North Africa) and is a compendium of stratigraphic and palaeogeographic information on the Carboniferous.

The volume is the result of ten years of editing and compilation, and apart from "The Carboniferous of the USSR" (Wagner et al., 1979) it contains the only comprehensive summary of the Carboniferous of the former USSR in the English language. Carboniferous stratigraphy in the volume (as was originally decided for all volumes in the series) is discussed within a framework of a three-fold subdivision of the Carboniferous. This is a little unfortunate since we now have a formal two-fold subdivision for the system, but since the biostratigraphy is discussed mainly in terms of formal or well known/used stages/series this does not detract from the value of the book. Testimony to the volume's value is the exceedingly "thumbed" state of my own copy following the Subcommission on Carboniferous Stratigraphy's recent intense discussions on the Carboniferous timescale and the current revision of the IUGS Global Stratigraphic Chart. There is a wealth of information in this book, most of it being detailed stratigraphical and biostratigraphical in nature. For the former USSR, information is presented separately for the European, Tianshan-pamirs, Kazakhstan and Angara regions. For each of these regions there are generalised lithological and chronostratigraphical correlation charts. Detailed fossil range charts are are also presented in terms of the "standard" Russian stages and "horizons" (which have in fact very recently been elevated in rank to Series and Stages respectively by the Russion Commisssion on Carboniferous Stratigraphy - see article by Kagarmanov and Kossovaya this issue). Groups covered in the fossil charts include conodonts, foraminifera, brachiopods, miospores, ammonoids, bivalves, corals, bryozoans, algae and plant megafossils. Lithological collumns are presented for the type sections of stages (now series) and, where appropriate, palaeogeographical/facies maps are provided for particular time slices. The volume contains eighty plates of a wide variety of fossil groups. These are of variable, but generally high quality. Conodont plates are unfortunately mainly produced from optical photographs but this reflects the general non-availability of SEM micrographs of these fossils from these regions.

As a person particularly interested in regional palaeogeography and tectonics of the Carboniferous, I was particularly happy to see that the Carboniferous stratigraphy was discussed in terms of major tectono-structural units and palaeogeography where appropriate. In this respect, the sections on the Middle Eastern Platform (Monod and Weissbrod), Afghanistan (Vachard and Montenat) and Iran (Vachard) were particularly successful.

I found very few textual errors in the volume and this is testimony to the excellent editing. The editors are to be highly congratulated on this latest volume in the series. The difficulties of dealing with "translated" contributions is well known to all of us that have been involved with editing such, and this volume has benefitted immensely from the dedication of its editors.

In summary, this is an excellent volume that should be on every Carboniferous worker's bookshelf and which will be an immensely valuable reference work for all those interested in the Carboniferous for decades to come.

Ian Metcalfe
Division of Earth Sciences
School of Physical Sciences and Engineering
University of New England
Armidale NSW 2351, Australia

VALE:
DAGMARA MAXIMILIANOVNA RAUSER-CHERNOUSOVA (1895 - 1996)

An eniment micropaleontologist of our time with an international audience, a winner of Karpinsky prizes and Kashmen fund laureate, an honoured Soros Professor Dagmara Maximilianovna Rauser-Chernousova passed away on June 12 1996 at the age of 102. Rauser-Chernousova was born on March 19 1895 in Moscow into a family of an engineer. In 1918 she graduated from the Natural department of Physics and Mathematics Faculty, Moscow University. Her early contributions testified to the diversity of her interests. With equal-success Dr. Rauser-Chernousova investigated Middle Asian Carboniferous ammonoids, Recent sediments and the Black Sea mollusks. Since the early 30-th, she focused her interests on micropaleontology and biostratigraphy. In her research, characterized by an extremely broad and deep insight into the problem, she used the pioneer techniques. Most of her studies were aimed to elaborate the Upper Paleozoic stratigraphic scale. In her numerous publications, well-known to the international scientific community, Professor D.M.Rauser-Chernousova treated the systematics and zoogeographical distribution of foraminifers, fundamentals of zonal stratigraphy and ecosystemic analysis. Dr. D.M.Rauser-Chernousova was always interested in the general problems of biology of protozoans, their intricate shape-formation, the species formation and structure, and the intraspecies categories. She also studied ontogeny and phylogeny. The present-day micropaleontologists frequently use many of her works as guidebooks since they provide a generalized knowledge on many problems, introducing a specialist directly into the range of his interests. About 200 publications of Dr.D.M.Rauser-Chernousova - a product of her long activity in science - are basic for the development of home micropaleontology and at the same time have a world-wide significance. We remember D.M.Rauser-Chernousova as an extremely kind, sweet and open-hearted person. She was lavish in sharing her knowledge and experience and strived to teach her students to be keen and honest in their research. Pr. D.M.Rauser-Chernousova was a non-compromised person of high scientific principles - she demanded much and was also strict to herself. Not only her talent, intuition, enthusiasm and a gift to organize people, inherent to distinguished scientists, promoted the success of home micropaleontology but also her power to unite her research team where everybody was kind, clear of purpose and mutually responsive. Her vigorous capacity for work did not fade as she was growing older. Pr. D.M.Rauser-Chernousova was a person of versatile gifts: in her wondefully fine persiption. She loved and knew art: painting, graphics, sculpture and architecture and was talented in music, playing the piano and violin in her spare time. Dagmara Maximilianovan Rauser-Chernousova lived through a long and inspiring life. Those who met this wondeful woman will remember her as an example of human honesty, kindness and selfless devotion to science.

T.N.Isakova, E.A.Reitlinger, E.Ya.Leven, N.V.Goreva.

ABSTRACTS

Lower Carboniferous miospore assemblages from the Longba formation in Gengma, west Yunnan, China and their phytogeographic significance

(From: Palaeoworld 1997, Number 7, pp. 1-17)

Yang Weiping (1), Roger Neves (2) and Liu Ben-pei (3)

1)Nanjing Institute of Geology and Palaeontology, Academia Sinica, 210008 Nanjing, PR. China;
2) Centre for Palynological Studies, Sheffield University, Mappin Street, Sheffield Sl 3JD, U.K;
3) Department of Geology, China University of Geosciences, 100083 Beijing, P.R. China.

The palynology of thc Lower Carboniferous succession from the Longba Formation, a new formation for thc lower horizons of the original Nanpihe Formation in Gengma West Yunnan, S. W. China is descnbed. The miospore floras from 56 samples are discussed and tentatively correlated with those in West Europe and Australia respectively. An attempt is made to correlate these Gengma assemblages with the standard West Europe miospore zones and the LE, BP, PC(?) and Pu biozones of Higgs et al. (1988) could be found in the Longba Formation, Gengma. The discovery of Retispora lepidophyta assemblage, a Grandispora spiculifera assemblage (originally described by Playford 1976) and a Lycospora pusilla assemblage changed these abundantly microfloral bearing strata of the Longba Formation from upper Permian to uppermost Devonian (Strunian) and Lower Carboniferous (Tournaisian and Visean). This palynological also modified the fundamental phytogeography in this Changning- Menglian Belt from solely Cathaysian (Lobatannularia? sp.) to a mixture of Gondwana and Laurasia flora.

Mid Carboniferous boundary and the conodonts across this boundary in south Guizhou and north Guangxi

(From: Acta Micropalaeotologica Sinica, 1996, 13 (3): 261-276 (in Chinese with English abstract)

Wang Zhi-hao

Nanjing Institute of Geology and Pataeontology, Academia Sinica, 210008 Nanjing, PR. China

Abstract; This paper descnbed the conodonts of 10 genera referred to 29 species and subspecies from mid-Carboniferous boundary strata of South Guizhou and North Guangxi. In descending order, the Idiognathoides sinuatus, I. sulcatus, Declinognathodus noduliferus and Gnathodus bilineatus bollandensis Zones can be recognized in these areas. The mid- Carboniferous boundary is marked by the first occurrence of Declinognathodus noduliferus.

Discovery of Leyitusla from Guilin, Guangxi and its stratigraphic significance

(From: Acta Palaeontological Sinica, 1996, 35 (5): 511-527 (in Chinese with English summary)

Liao Zhuo-ting (1) and Li Zhen-liang (2)

1)Nanjing Institute of Geology and Palaeontology, Academia Sinica, 210008 Nanjing, PR. China;
2)Regional geological Survey Team of Guangxi, 541003 Guilin, P.R. China.

Levitusia of special morphology and structure is a common genus in the lower part of the Lower Carboniferous Visean Stage in the Europe and middle Asia. This genus has been found for the first time from the lower part of the Datang Stage in Guilin, Guangxi of China. This paper deals detailedly with its morphology and structure, affinity, geographic and stratigraphic distribution, structure, and paleoecological characters, pointing out that bccause Levitusia has a basically stable has provided the new evidence for the correlation of the Levitusia were found chiefly from the margins of the carbonate platforms and from the paleoslope belt where the platform joins basin. Thus, it has great facies significance. Three new species of Levitusia are described in this paper.

A camerate-rich Late Carboniferous (Moscovian) crinoid fauna from volcanic conglomerate Xinjiang, People's Republic of China

(From: J. Paleont, 1996, 70(1):117-128).

N. Gaty Lane (1), Johnny A. Waters (2), Christopher G. Maples (3), Sara A. Marcus (3), and Liao Z- T (4)

1) Department of Geological Sciences, Indiana University, Bloomington 47405, USA;
2)Department of Geology, West Georgia College, Carrollton 30118, USA;
3)Kansas Geological Survey, University of Kansas, Lawrence 66047, USA;
4) Nanjing institute of Geology and Palaeontology, Academia Sinica, 210008 Nanjing, P.R. China.

A low- diversity camerate-rich crinoid fauna from the Qijiagou Formation, Taoshigo Valley near Turpan, Xinjiang-Uygar Autonomous Region, China was collected during field work in May, 1993. The crinoid fauna is dominated by specics of Platycrinites. Other camerate crinoids include a species in the Paragaricocrinidae, Actinocrinites, a hexacrinitid, and an acrocrinoid. Thc only other non-North American occurrence of this latter family is Springeracrocrinus from the Moscovian of Russia. In addition to the camerates, there are several advanced cladid inadunates more typical of Upper

Carboniferous crinoid faunas, including an erisocrinoid (possibly Sinocrinus), Graphiocrinus, ?Cromyocrinus, and an agassizocrinoid (Petschoracrinus) represented by partly fused infrabasal cones. A single radial plate with angustary facet may represent a cyathocrinoid. There also is a catillocrinoid, assigned here to Paracatillocrinus. The fauna, which resembles Moscovian crinoids described from Russia, is preserved in graded volcanic conglomeratic debris flows that overlie a carbonate mound and contain clasts up to 3mm in dimension. The crinoids are fragmentary, with many calyces seemingly torn into two or three pieces and dumped in with the pyroclastic debris. Camerates are represented by large thecal scraps consisting of numerous plates, or by large individual plates or circlets. Other fossils include rare solitary rugose corals, tabular bryozoans, Neospirifer, and other fragmentary brachiopods. We suspect that the crinoids may have been swept off of a nearby carbonate mound and deposited as debris-flow bedload.

Late Paleozoic phyiogeographic provinces in China and its adjacent regions

(From: Review of Palaeobotany and Palynology, 1990, 90: 41-62).

Li Xingxue and Wu Xiuyuan

Nanjing Institute of Geology andPalaeontology, Academia Sinica, 210008 Nanjing, PR. China

China's tectonic history is complex. The country consists of a number of amalgamated plates, microcontinents and terranes, and consequently contains a wide diversity of floras representing all of the major biogeographic provinces of the late Paleozoic- the Angaran, Cathaysian, Gondwanan, Euramerican. The boundary of the late Palaozoic phytogeographic provinces are mostly coincident with the fold belt and deep fault zones that mark the sutures between the four major tectonic blocks within the country. These areas are known as the Junggar-Hinggan Region (a part of the Angaran Realm), the Sino-Korean-Tarim (North China) Block (in the North China Cathaysian Subrealm), the South China block (in the South China Cathaysia Subrealm), and the Southern Xizang (Tibet)-Western Yunnan Region (in the Gondwanan Realm).

The Cathaysian Floral province consists of two major tectonic blocks (the Sino-Korean Tarim (North China) Block and the South China Block) and several floral subzones. The Iack of provincial differentiation between the Visean floras on the two blocks suggests that collision between them occurred during the Devonian. North and South China were vegetated by Euramerican floras until the Late Carboniferous when Cathaysian elements first began to differentiate in response to differences in the paleogeographic position of the blocks and possible to tectonic factors. The two major Cathaysian provinces were established by the Permian. The Cathaysian flora is interpreted to have developed in a tropical, probably ever-wet climate zono. Tropical conditions persisted in South China throughout the Permian, but in North China, by early Late Permian, climatic conditions alternated between wet and dry, and by late Late Permian most of the Northern Hemisphere was experiencing extreme arid conditions.

The S. Tibet-W. Yunnan Regions (Gondwanun Floral province) contain sediments with diamictites, a cold- water Stephanoviella fauna during the Iate Carboniferous and a Glossopteris flora during the Early Permian time.

Reference book of systematics of Paleozoic foraminifera (Endothyroida, Fusulinoida).

D.M. Rauser-Chernousova, F.R. Bensh, M.V. Vdovenko, N.B. Gibshman, E. Ya. Leven, O.A. Lipina, E.A. Reitlinger, M.N. Solovieva, I.O. Chedija. Responsible Editors: D.M. Rauser--Chernousova, T.N. Isakova, E.A. Reitlinger. Moscow, Nauka, 1996, 207p.

Reference book contains the results of revision and generalization of various classifications of Endothyroida and Fusulinoida superorders at the generic level. In this country, the summary classification of foraminifers was published in 1959. Since that time, it was not revised at such a scale. The suggested publication offers a generalized review of home and foreign data up to 1993. One of the main objectives of the Reference book was to identify foraminiferal groups of close affinity on the basis of their ontogenic and phylogenic evolution and to have them joined into a uniform taxonomic system. Revised on a generic level, the suggested systematics of Paleozoic foraminifers is based on the critically studied literature and domestic collections. It resembles the classification accepted in "Fundamentals of Paleontology" (Osnovy paleontologii, M., 1959), but differs from it by being more complete, offering a higher rank of taxa (the family and order categories) and specifying systematic position for many taxa. The edition continues "Reference book of systematic for small Paleozoic foraminifera", Moscow, Nauka, 1993, 128p. Reference book contains the definitions of more that 320 generic taxa belonging to the superorders Endothyroida and Fusulinoida, it presents the taxonomic hierarchy, a list of references with more than 600 items, alphabetic index of some 600 Latin names, 48 paleontological plates and 17 text drawings. This is a jubilee edition of the Reference book marking the centenary from birthday of a prominent scientist Professor D.M.Rauser-Chernousova, initiatorof Reference book of foraminifers.

FORTHCOMING CONFERENCES

8th Coal Geology Conference, Prague, 1998

Coal-Prospecting, Exploration and Evaluation, Utilization, Energy policy, Trace elements, Coalbed methane and Environmental impact of mining and combustion of coal.

Date: June 22-27, 1998
Venue: Faculty of Science, Charles University, Prague, Czech Republic

Contact: Professor Jiri Pesek, Faculty of Science, Charles University, Albertov 6, 128 43 Praha 2, Czech Republic

XIV-International Congress on Carboniferous-Permian AUGUST 14-25, 1999 CALGARY, ALBERTA, CANADA

HONORARY CHAIRMAN: Dr. Bernard Mamet, University of Montreal

CHAIRMAN: Dr. Charles Henderson, University of Calgary

Interested individuals are invited to meet at Calgary in August 1999 to discuss the Carboniferous and Permian and enjoy some fine western hospitality.

This meeting will be hosted by The University of Calgary. The sessions at the University campus are currently scheduled for August 17-21, 1999 with at least three days of pre- and post-conference fieldtrips. The conference will focus on the many global aspects of Carboniferous and Permian biota, environments, and resources. Carboniferous and Permian rocks contain hydrocarbon reservoirs in Western Canada and considerable core is available for display; a core workshop may be held. The local committee is almost in place and will be announce in the first circular. The Canadian Society of Petroleum Geologists has agreed to lend their name as a supporting agency of this conference.

The City of Calgary is a city of almost 800,000 people with excellent cultural and recreational facilities that is located only one hour drive east of the Rocky Mountains where exposures of Carboniferous and Permian rocks may be seen, as well as some of the most spectacular scenery in all of Canada. The city is also close to the Cretaceous Badlands and the Royal Tyrrell Museum of Palaeontology with its first class displays of dinosaurs and other fossils and to the weird and wonderful creatures of the Burgess Shale. Fieldtrips to these latter two areas are anticipated.

The University has excellent lecture and recreational facilities, including the Olympic speed skating oval. Laboratory space will be available in the Department of Geology and Geophysics for small groups to do comparative work on thin sections or micropaleontology. The University has a conference office that has successfully hosted numerous international meetings, and will serve as the primary agent of this meeting.
Details regarding symposia and fieldtrips are still in a formative stage and the chairmen would welcome any input from interested individuals. Most of the fieldtrips will be in the Front Ranges of the Rocky Mountains west of Calgary. Rocks that are readily accessible in this area include thick exposures of Lower Carboniferous carbonates and siliciclastics as well as thinner Upper Carboniferous and Permian lithofacies that range from coastal aeolian dunes to condensed phosphatic siltstone. These fieldtrips will look at well exposed sections that encompass the Devonian-Carboniferous boundary, the sub-Permian unconformity, and the Permian-Triassic boundary. Presently, other fieldtrips include Carboniferous and Permian rocks in parautochthonous and allochthonous terranes (Kamloops area of Central British Columbia) and a pre-conference trip organized by Phil Heckel to look at Upper Pennsylvanian cyclothems from northern Illinois to Kansas. The proceedings of the Conference will be published in a volume that may be part of the Canadian Society of Petroleum Geologists Memoir Series.

A first circular is planned for late 1997, but if you would like to insure that your name is on our mailing list for future announcements please contact:

Dr. Charles Henderson
Associate Professor
Department of Geology and Geophysics
The University of Calgary, N.W.
Calgary, Alberta, CANADA
T2N 1N4
Phone: 403-220-6170
FAX: 403-284-0074
E-mail:
henderson@geo.ucalgary.ca

Also look for World Wide Web updates associated with the home page for the

Department of Geology and Geophysics at the University of Calgary beginning in July, 1997 (http://www.geo.ucalgary.ca/iccp).

PUBLICATIONS BY SCCS MEMBERS

Brauckmann, C., Brauckmann, B. & Gröning, E. 1996. The stratigraphical position of the oldest known Pterygota (Insecta. Carboniferous,Namurian). *Annales de la Société géologique de Belgique* 117 (1), 47-56, figs. 1-4; Liège.

Brauckmann, C. & Gröning, E. 1996. Ein neuer oberkarbonischer Insekten-Flügel aus Süd-Limburg (Palaeodictyoptera: Breyeriidae, Westfalium, Niederlande). [A new Upper Carboniferous insect wing from South Limburg (Palaeodictyoptera: Breyeriidae, Westphalian, the Netherlands).] *Neues Jahrbuch für Geologie und Paläontologie Monatshefte* 1996 (2), 72-82, figs. 1-4; Stuttgart.

Brauckmann, C., Gröning, E. & Thiele-Bourcier, M. 1997. Kopf- und Schwanz-Region von Arthropleura armata JORDAN, 1854 (Arthropoda; Ober-Karbon). [Head and tail region of Arthropleura armata JORDAN, 1854 (Arthropoda; Upper Carboniferous).] *Geologica et Palaeontologica* 31: xxx-xxx, figs. 1-3, pls. 1-3; Marburg/Lahn.

Brauckmann, C. & Schneider, J. 1996. Ein unterkarbonisches Insekt aus dem Raum Bitterfeld/Delitzsch (Pterygota, Arnsbergium, Deutschland). [A Lower Carboniferous insect from the Bitterfeld/Delitzsch area (Pterygota, Arnsbergian, Germany).] *Neues Jahrbuch für Geologie und Paläontologie Monatshefte* 1996 (1), 17-30, figs. 1-5; Stuttgart.

Baesemann, J. F., Brenckle, P. L., and Gruzlovic, P. D. 1997. Composite standard correlation of the Mississippian-Pennsylvanian (Carboniferous) Lisburne Group from Prudhoe Bay to the eastern Arctic National Wildlife Refuge, North Slope, Alaska. In, *Short Notes on Alaskan Geology*: Alaska Division of Geological and Geophysical Surveys.

Brenckle, P. L. 1997. Upper Tournaisian foraminifers from the Middle Urals and their use in Russian horizon definition: *PaleoForams '97, Extended Abstracts Volume*, Cushman Found. Foram. Res., Spec. Pub.

Brenckle, P. L. 1997. What is *Urbanella*?: *PaleoForams '97, Extended Abstracts Volume*, Cushman Found. Foram. Res., Spec. Pub.

Brenckle, P. L., and Page, W. R. 1997. Day 1-The Mid-Carboniferous (Mississippian-Pennsylvanian) boundary at Arrow Canyon and Day 2-Lower Mississippian (Tournaisian) beds at Hidden Valley, *in* Post-Conference Field Trip to the Arrow Canyon Range, Southern Nevada, U. S. A.: *PaleoForams '97 Guidebook*.

Chermnykh V., Mikhailova E. and Kalashnikov N. 1996. The biostratigraphy Carboniferous deposits of the Upper Petchora River. In *Geology and Mineral Resources of the South Regions of Komi Repub;ic.*- Syktyvkar: pp 56-59.

Chesnut, D. R., 1996, Geologic framework for the coal-bearing rocks of the Central Appalachian Basin. International Journal of Coal Geology, v. 31, p. 55-66.

Coen, M., Hance, L. and Hou, H.F. (eds). 1996. Papers on the Devonian-Carboniferous transition beds of central Hunan, South China. Mémoires de l'Institute Géologique de l'Université de Louvain, Tome XXXVI, 229pp.

Claoué-Long, J.C., Compston, W., Roberts, J. and Fanning, C.M. 1995. Two Carboniferous ages: A comparison of SHRIMP zircon dating with conventional zircon ages and $^{40}Ar/^{39}Ar$ analysis. SEPM Special Publication No. 54, 3-21.

Eagar, R.M.C. 1994. Non-marine bivalve assemblages in the Asker Group, Oslo Graben and its correlation with a late Pennsylvanian assemblage from North America. *Journal of the Geological Society of London*, 151, 669-680.

Ehiro, M. and Araki, H. 1996, Early Carboniferous ammonoid Irinoceras from the Onimaru Formation in the Southern Kitakami Massif, Northeast *Japan. Jour. Geol. Soc. Japan*, v. 102, p. 755-757.

Filipovic, I. (ed). 1995. The Carboniferous of northwestern Serbia. *Memoires du Service Geologique "Gemini"*, Tome XXV, 104pp, 69 plates.

Greb, S.F., and Chesnut, D.R., Jr., 1996, Lower and lower Middle Pennsylvanian fluvial to estuarine deposition, central Appalachian basin: Effects of eustasy, tectonics, and climate. Geological Society of America Bulletin, v. 108, no. 3, p. 303-317.

Groves J. R., and Brenckle, P. L. 1997. Graphic correlation in frontier petroleum provinces: Application to Upper Paleozoic sections in the Tarim Basin, western China: *AAPG Bulletin*.

Groves, J. R., and Brenckle, P. L. 1997. Graphic correlation of Upper Paleozoic outcrop sections in the western Tarim Basin, China:

Paleoforams '97, Extended Abstracts Volume, Cushman Found. Foram. Res., Spec. Pub.

Harris, A. G., Brenckle, P. L., Baesemann, J. F., and Krumhardt, A. P. 1997. Conodont and calcareous microfossil biostratigraphy of the Lisburne Group (Carboniferous), Sadlerochit Mts., NE. Brooks Range, Alaska : *Abstracts with Programs, Geol. Soc. Amer.,* South-Central and Rocky Mountain Meeting, El Paso.

Harris, A. G., Brenckle, P. L., Baesemann, J. F., Krumhardt, A. P., and Gruzlovic, P. D. 1997. Comparison of conodont and calcareous microfossil biostratigraphy and lithostratigraphy of the Lisburne Group (Carboniferous), Sadlerochit Mountains, northeast Brooks Range, Alaska , *in* Dumoulin, J. A., and Gray, J. L., eds., *Geologic Studies in Alaska by the United States Geological Survey:* U. S. Geological Survey Bulletin.

Johnston, Kurt W., Merrill, Glen K., and Brown, Lewis M., 1997, Conodont biostratigraphy of the Derryan type section (Pennsylvanian, Morrowan-Desmoinesian), Sierra County, New Mexico (Abstract). Geological Society of America, Abstracts with Programs 29-2:17.

Kalashnikov N. and Mikhailova E. 1996. The palaeontological characteristics of Moscovian and Kasimovian stages of the Zauka Peninsula (Pai- Choi). In Syntyvkarian Palaeontological Collection No.1- Syktyvkar: p 70- 79. (*Tr. Inst. Geology Komi Sci. Centre.* Vol. 89).

Kalashnikov N. 1996. Kaninospiriferinae, a new subfamily of the Spiriferidae (Brachiopoda) - In *Brachiopods-* A. A. Balkema (Rotterdam) Brookfield. Pp 133-134 (Proceedings of the Third International Brachiopod Congress. Sudbury, Ontario, Canada, 2-5 September 1995).

Kalashnikov N. 1996 (in press). the trace "life" in the Upper Palaeozoic deposits of the European North.- In Syktyvkarian Palaeontological Collection No.2., Syktyvkar (*Tr. Institute of Geology K. Sci. Centre.,* Vol 91).

Kanev G.and Kalashnikov N. 1996. The biostratigraphical researchs by G. N. Fredericks in the Petchorian regions- In Syktyrkarian Palaeontological Collections No. 1. Syktyvkar p. 91- 94 (*Tr. Institute of Geology K. Sci. Centre,* Vol. 89).

Karev G., Kalashnikov N., Koloda N. and Chermnykh V. 1996. The palaeontological basing of the Kungurian and Ufimian parastratotypes on Kozhim River (Prepolar Urals)- In *30th (IGC)* :2, p. 84- China.

Korn, D. & Kullmann, J. (1996): GONIAT Database System, version 2.60; Tuebingen.

Kulagina, E.I., Rumyantseva, Z.S., Pazukhin, V.N., and Kochetkova, N.M. (1992): Lower/ Middle Carboniferous Boundary in the South Urals and Central Tien Shan. Moscow (Nauka), 112 p. [In Russian].

Kullmann, J. & Nikolaeva, S. (1995): A Review of the Upper Namurian ammonoid biostratigraphy.- Newsletters on Stratigraphy 32: 117-136, 10 figs., Berlin, Stuttgart.

Legrand-Blain M., Delvolve J.J. and Hansotte M. 1996. Carboniferous brachiopods from the Arize Massif (Ariège), French Pyrénées. *Geobios,* 29 (2) pp. 177-207.

Legrand-Blain, M. 1997. Strunian-Tournaisian brachiopod faunas from Morvan, N. Massif Central, France. *XIII International Congress on the Carboniferous-Permian. August 28th - September 2nd 1995. Krakow, Poland. Abstract,* p. 87. [the whole text has been submitted to the Congress Proceedings].

Legrand-Blain M. 1997. In preparation. Les brachiopodes carbonifères, elements du benthos marin contemporain de l'orogenèse varisque un exemple de paléobiogéographie dynamique. "De la Biostratigraphie à la Paléoblogéographie", Réunion spécialisée APF - SGF, Lyon, novembre 1997.Qian, W.L. and Roberts, J. 1995. Brachiopods of the Early Carboniferous *Schellwienella burlingtonensis* Zone in eastern Australia. *Alcheringa* 19, 255-289.

Nikolaeva, S. & Kullmann, J. (in press): A Review of Middle Namurian ammonoid biostratigraphy.- Newsletters on Stratigraphy, 10 p., 15 figs.,Berlin, Stuttgart.

Rexroad, Carl B., and Merrill, Glen K., 1996, Conodonts from the Reelsville, Limestone (Chesterian, Lower Carboniferous) in Indiana and adjacent Kentucky, U.S.A. Geologica et Palaeontologica, 30:225-238.

Rexroad, Carl B., and Brown, Lewis M., 1996, Idiognathodus and the conodont biostratigraphy of the Holland Limestone Member, Staunton Formation (Pennsylvanian, Desmoinesian) from the Illinois Basin, U.S.A. (Abstract) Sixth European Conodont Symposium (ECOS VI), Abstracts, 1. Instytut Paleobiologii PAN, Warszawa, 51.

Roberts, J., Claoué-Long, J.C. and Foster, C.B. 1996. SHRIMP zircon dating of the Permian System of eastern Australia. *Australian Journal of Earth Sciences* 43, 401-421.

Roberts, J., Leitch, E.C., Lennox, P.G. and Offler, R. 1995. Devonian-Carboniferous stratigraphy of the southern Hastings Block, New England Orogen, eastern Australia. *Australian Journal of Earth Sciences* 42, 609-634.

Tazawa, J. 1996. Rotaia (Rhynchonellida, Brachiopoda) from the Lower Carboniferous of northeast Japan and its palaeogeographical significance. *Sci. Rep., Niigata Univ., Ser. E,* no. 11, p. 1-11.

SCCS VOTING & CORRESPONDING MEMBERSHIP 1997

Please check your entry and report any changes to the Secretary

ALGERIA

Mrs Fatma Abdesselam-Rouighi
Centre de Recherche et Developpement
Ave du 1er Novembre
35000 Bounerdes
ALGERIE

ARGENTINA

Dr S. Archangelsky
URQUIZA 1132
Vicente Lopez
1638 Buenos Aires
Rep. ARGENTINA
Fax: 54-1-982-4494
E-mail: sarcang@atila.overnet.com.ar

Dr Carlos Azcuy
Depto. de Ciencias Geológicas
Pabellón 2, Ciudad Universitaria
1428 Núñez, Buenos Aires
Rep. ARGENTINA
Fax: 54-1-638-1822
E-mail: azcuy@aspapa.org.ar

Dr Silvia Césari
Div. Paleobotanica
Museo de Cs. Naturales 'B.Rivadavia'
Av. A. Gallardo 470
1405 Buenos Aires
Rep. ARGENTINA

Dr N. Rubén Cuneo
Palaeontological Museum 'E. Feruglio'
Av. 9 de Julio 655
9100 Trelew, Chubut
Rep. ARGENTINA

Dr Carlos R. González
Instituto de Paleontologia
Fundación Miguel Lillo
Miguel Lillo 251
4000 S.M. deTucumán
Rep. ARGENTINA
Fax: 081-330868

Dr Arturo C. Taboada
Instituto de Paleontologia
Fundación Miguel Lillo
Miguel Lillo 251
4000 S.M. deTucumán
Rep. ARGENTINA

Dra M.S. Japas
Depto. de Ciencias Geológicas
Pabellón 2, Ciudad Universitaria
1428 Núñez, Buenos Aires
Rep. ARGENTINA

Dr Nora Sabattini
Universidad Nacional de la Plata
Facultad de Ciencias Naturales Y Museo
Paseo del Bosque
1900, La Plata
Rep. ARGENTINA

AUSTRALIA

Prof. N.W. Archbold
School of A.S. & N.R.M.
Deakin University, Rusden Campus
Clayton VIC 3168
AUSTRALIA
Fax: 03-9244-7480
E- mail: narchi@deakin.edu.au

Dr J.C. Claoué-Long
Aust. Geol. Survey Organisation
P.O. Box 378
Canberra City, A.C.T. 2601
AUSTRALIA
Fax: 06-249-9983
E-mail: jclong@agso.gov.au

Dr J.M. Dickins
Aust. Geol. Survey Organisation
P.O. Box 378
Canberra City, A.C.T. 2601
AUSTRALIA
Fax: 06-249-9999

Dr B.A. Engel
Department of Geology
University of Newcastle
Callaghan NSW 2308
AUSTRALIA
Fax: +61-049-216-925
E-mail:
bengel@geology.newcastle.edu.au

Dr T.B.H. Jenkins
89 Eton Road
Lindfield, NSW 2070
AUSTRALIA

Dr P.J. Jones
Aust. Geol. Survey Organisation
P.O. Box 378
Canberra City, A.C.T. 2601
AUSTRALIA

Dr I. Metcalfe
Division of Earth Sciences
University of New England
Armidale, NSW 2351
AUSTRALIA
Fax: 02-6773-3300
E-mail: imetcalf@metz.une.edu.au

Prof. G. Playford
Department of Earth Sciences
The University of Queensland
Queensland 4072
AUSTRALIA
Fax: 07-365-1277
E-mail:
geoff@sol.earthsciences.uq.edu.au

Prof. J. Roberts
School of Applied Geology
The University of New South Wales
Sydney, NSW 2052
AUSTRALIA
Fax: 61-2-9385-5935
E-mail: J.Roberts@unsw.edu.au

Dr Guang R. Shi
School of A.S. & N.R.M.
Deakin University, Rusden Campus
Clayton VIC 3168
AUSTRALIA
E-mail: grshi@deakin.edu.au

S. Stojanovic
71 Barracks Road
Hope Valley
Adelaide, SA 5090
AUSTRALIA
Fax: 373-4098

Dr G.A. Thomas
40 Waterdale Road
Ivanhoe, VIC 3079
AUSTRALIA

Dr S. Turner
Queensland Museum
P.O. Box 3300
South Brisbane, QLD 4101
AUSTRALIA
Fax: 61-7-3846-1918
E-mail: s.turner@mailbox.uq.oz.au

AUSTRIA

Dr F. Ebner
Institut für Geowissenschaften
Montanuniversität Leoben
A-8700 Leoben
AUSTRIA

Dr K. Krainer
Inst. für Geol. und Paläontologie
Universität Innsbruck
Innrain 52
A-6020 Innsbruck
AUSTRIA
Fax: 0043-512-507-5585
E-mail: Karl.Krainer@uibk.qc.at

Prof. Dr H.P. Schönlaub
Geol. Bundesanstalt Wien
Postfach 127
Rasumofskygasse 23
A-1031 Wien
AUSTRIA
Fax: +431-712-5674-56
E-mail: hpschoenlaub@cc.geolba.ac.at

BELGIUM

Dr A. Delmer
16 Av Col Daumerie
B-1160 Bruxelles
BELGIUM

Dr E. Groessens
Service Géologique de Belgique
13 rue Jenner
B-1040 Bruxelles
BELGIUM

Dr Luc Hance
Service Géologique de Belgique
13 rue Jenner
B-1040 Bruxelles
BELGIUM
Fax: 322-647-7359
E-mail: hance@page.ucl.ac.be

Prof. E. Poty
Service de Paléontologie animale
Universitè de Liège
Place du XX Août 7
B-4000 Liège, BELGIUM
Fax: 32-41-66-5700

Dr M. Streel
Lab. Paléont., Univ.de Liège
Place du XX Août 7
B-4000 Liège
BELGIUM
Fax: 32-41-66-5700
E-mail: streel@geo.ulg.ac.be

Dr Rudy Swennen
Fysico-chemische geologie
Katholieke Universiteit Leuven
Celestijnenlaan 200C
B-3001 Heverlee, BELGIUM

BRAZIL

Mr L.E. Anelli
Instituto de Geosciências
Universidade de São Paulo
CP 11348 CEP 05422-970
São Paulo
BRAZIL
Fax: 55-011-818-4129
E-mail: anelli@usp.br

Dr U.G. Cordani
Instituto de Geosciências
Universidade de São Paulo
CP 11348 CEP 05422-970
São Paulo
BRAZIL

Dr Marleni Marques Toigo
Rua Domingos
José de Almeida 185
90420 Porto Alegre
BRAZIL

Dr A.C. Rocha-Campos
Instituto de Geosciências
Universidade de São Paulo
CP 11348 CEP 05422-970
São Paulo
BRAZIL
Fax: 11-818-4129
E-mail: acrcampo@usp.br

BULGARIA

Dr Y.G. Tenchov
Geol.Inst. ul. Acad.
Bonchev bloc. 24
Sofia 1113
BULGARIA
E-mail: geoins@bgearn.acad.bg

CANADA

Dr Wayne Bamber
Geol.Surv.Canada, Calgary
3303-33rd St. N.W.
Calgary AB, T2L 2A7
CANADA
Fax: 403-292-6014
E-mail: bamber@gsc.emr.ca

Dr B. Beauchamp
Inst.Sed.Pet., Geol.Surv.Canada
3303-33rd St. N.W.
Calgary AB, T2L 2A7
CANADA

Dr A.R. Berger
Geological Survey of Canada
Room 177, 601 Booth Street
Ottawa ON, K1A 0E8
CANADA

Dr P.H. von Bitter
Royal Ontario Museum
100 Queen Park
Toronto ON, M5S 2C6
CANADA

Dr W.R. Danner
University of British Columbia
Dept Earth & Ocean.Sciences
6339 Stores Rd.
Vancouver B.C., V6T 1Z4
CANADA

Dr Martin Gibling
Department of Geology
Dalhousie University
Halifax N.S., B3H 3J5
CANADA

Prof. Charles Henderson
Department of Geology & Geophysics
The University of Calgary
2500 University Drive, N.W.
Calgary, Alberta, T2N 1N4
CANADA
E-mail: henderson@geo.ucalgary.ca

Prof. Bernard L. Mamet
Department of Geology
University of Montreal
Montreal P.Q., H3C 3J7
CANADA
Fax: 514 343 5782
E-mail: geologie@ere.umontreal.ca

Dr W. Nassichuk
Geological Survey of Canada
3303-33rd St. N.W.
Calgary AB, T2L 2A7
CANADA

Dr Sylvie Pinard
7146 - 119 Street N.W.
Edmonton, Alberta T6G 1V6
CANADA
Fax: 403-436-7136

Dr B.C. Richards
Geological Survey of Canada
3303-33rd St. N.W.
Calgary AB, T2L 2A7
CANADA
Fax: 403-292-5377
E-mail: brichards@gsc.emr.ca

Dr J. Utting
Inst.Sed.Pet., Geol.Surv.Canada
3303-33rd St. N.W.
Calgary AB, T2L 2A7
CANADA
Fax: 403-292-6014
E-mail: utting@gsc.emr.ca

Dr Erwin L. Zodrow
Univ. College of Cape Breton
Dept Geology, Glace Bay H'way
Sydney N.S., B1P 6L2
CANADA
Fax: 902-562-0119

CZECH REPUBLIC

Dr J. Dvorák
Cesky geologicky Ustav
Leitnerova 22
65869 Brno
CZECH REPUBLIC
Fax: 425-4321-2370

Dr Jirí Kalvoda
Dept. Geol. Paleont.
Kotlárská 2
61137 Brno
CZECH REPUBLIC
E-mail: dino@sci.muni.cz

Dr Jirí Král
Dept Genetics & Microbiology
Fac. Science, Charles University
Vinicná 5
128 44 Praha 2
CZECH REPUBLIC

Dr Ilja Pek
Department of Geology
Palackého University
Svobody 26
771 46 Olomouc
CZECH REPUBLIC

Dr Jirí Pesek
Dept. Geol. Paleontol., Fac.Science
Charles University
128 43 Praha 2, Albertov 6
CZECH REPUBLIC
Fax: +02-296-084 or +02-297-425

EGYPT

Dr Mahmoud M. Kholief
Egyptian Petroleum Research Inst
Nasr City, 7th Region
Cairo, EGYPT
Fax: 202-284-9997

FRANCE

Dr J-F. Becq-Giraudon
BRGM-BP 6009
F-45060 Orleans, Cédex
FRANCE
Fax: 33-38-64-36-52

Dr Robert Coquel
Lab. Paléobotanique (SN5)
Univ. des Sciences et Techn. de Lille
F-59655 Villeneuve d'Ascq
FRANCE

Dr G. Lachkar
Labor.Micropal., Univ.Paris VI
4 Place Jussieu
F-75252 Paris CJdex 05
FRANCE

Dr J.P. Laveine
Lab.Paléobot.,UFR Sci.de la Terre
Univ. des Sci. et Techn. de Lille
F-59655 Villeneuve d'Ascq CJdex
FRANCE
Fax: 33-2043-6900
E-mail: Jean-Pierre.Laveine@univ-lille1.fr

Dr Marie Legrand-Blain
Institut de Géodynamique
Université Bordeaux 3
Av. Des Facultés
F-33405 Talence
FRANCE
Fax: 56-848-073

Dr S. Loboziak
Lab.Paléobotanique U.R.A. A36
U.S.T.L.F.A.
F-59655 Villeneuve d'Ascq Cédex
FRANCE

Dr M. Lys
36, rue de Buzenval
F-92210 Saint-Cloud
FRANCE

Dr D. Mercier
Ecole des Mines de Paris
35, Rue Saint-Honoré
F-77305 Fontainebleau
FRANCE

Dr G.S. Odin
Lab.Géochron.et Sedim.Oceanique
Univ. P.& M.Curie, 4 Place Jussieu
F-75252 Paris Cédex 05
FRANCE
Fax: 33-1-4427-4965

Dr M.F. Perret
Université Paul-Sabatier
Labo.Géol.Structurale
38 rue des 36 Ponts
F-31400 Toulouse
FRANCE
Fax: 61-55-82-50
E-mail: perret@cict.fr

Dr P. Semenoff Tian-Chansky
Institut de Paléontologie
8 Rue de Buffon
F-75005 Paris
FRANCE

Dr D. Vachard
Univ.des Sciences et Techniques
Science de la Terre
F-59655 Villeneuve d'Ascq Cédex
FRANCE
Fax: 00-33-20-43-69-00
E-mail: Daniel.Vachard@univ-lille1.fr

Dr M. Weyant
Dept.Géologie
Université de Caen
Esplanade de la Paix
F-14032 Caen
FRANCE

GERMANY

Dr H.W.J. van Amerom
Geol.Landesamt Nordrh.-Westfalen
De Greiff Str.195
D-47803 Krefeld
GERMANY
Fax: 2151-897-505

Dr Z. Belka
Inst.und Mus.für Geol.und Paläont.
Universität Tübingen
Sigwartstr. 10
D-72076 Tübingen
GERMANY
Fax: +49-7071-610259
E-mail: belka@ub.uni-tuebingen.de

Prof. Dr Carsten Brauckmann
Technische Universität Clausthal
Institut für Geologie und Paläontologie
Leibnizstrasse 10
D-38678 Clausthal-Zellerfeld
GERMANY
Fax: 05323-722903
E-mail: braukmamm@geologie.tu-clausthal.de

Dr Peter Bruckschen
Ruhr-Universität Bochum
Geologisches Institut
Universitätsstr. 150
D-44801 Bochum
GERMANY

Prof. Dr G. & Dr R Hahn
Inst. für Geologie und Paläontol.
Philipps-Universität Marburg
Hans-Meerwein Str.
D-35032 Marburg
GERMANY

Dr Holger Forke
Institut für Paläontology
Loewenichstr. 28
D-91054 Erlangen
GERMANY
E-mail: forke@pal.pal.uni-erlangen.de

Mr Chr. Hartkopf-Fröder
Geol.Landesamt Nordrh.-Westfalen
De Greiff Str.195
D-47803 Krefeld
GERMANY
Fax: 021-511-897-505

Prof. Dr Hans-Georg Herbig
Lehrstuhl. für Paläontol. u. Hist. Geologie
Geologisches Inst., Universität zu Köln
Zülpicher Str. 49a
D-50674 Köln
GERMANY
Fax: 0221-4705-080
E-mail: schwarkl@geocip.geo.uni-koeln.de

Prof. Dr Hans Kerp
Westfälische Wilhelms-Universität
Abt.Paläobot.am Geol-Pal.Inst. u Mus.
Hindenburgplatz 57-59
D-48143 Münster
GERMANY
Fax: 49-251-834-831
E-mail: Kerp@uni-muenster.de

Dr J. Kullmann
Inst.und Mus.für Geol.und Paläont.
Universität Tübingen
Sigwartstr. 10
D-72076 Tübingen
GERMANY
Fax: +49-7473-26768
E-mail: Juergen.Kullman@uni-tuebingen.de

Dr Manfred Menning
GeoForschungsZentrum
Telegrafenberg A26
D-14473 Potsdam
GERMANY
Fax: +49-331-288-1302
E-mail: menne@gfz-potsdam.de

Dr Klaus-Jürgen Müllek
Institut für Paläontologie
Nussallee 8,
D-53115 Bonn
GERMANY

Dr E. Paproth
Schwanenburgstr. 14
D-47804 Krefeld
GERMANY
Fax: +49-2151-710774

Dr M. von Sperber
DMT-Gesellschaft f.Forsch.u.Prüf.mbH
Inst.für Lagerstätte u.Vermessung
Hernerstr. 40
D-44791 Bochum
GERMANY
Fax: +49-968-3420

Dr D. Stoppel
Bundesanst.für Geowissen. u. Rohstoffe
Postfach 51 0153
D-30631 Hannover
GERMANY
Fax: 511-643-2304

Dr E. Thomas
Rhsbergstr. 22
D-58456 Witten-Herbede
GERMANY

Dr Matthias Zeller
Geol.Landesamt Nordrh.-Westfalen
De Greiff Str.195
D-47803 Krefeld
GERMANY
Fax: +49-2151-897-505

Dr W. Ziegler
Senckenbergisches Museum
Senckenberganlage 2
D-60325 Frankfurt 1
GERMANY

HUNGARY

Dr.sc. Heinz Kozur
Rézsü u. 83
H-1029 Budapest
HUNGARY
Fax: +36-1-204-4167

IRELAND

Dr Geoff Clayton
Department of Geology
Trinity College
Dublin 2
IRELAND
Fax: 3531-6711199
E-mail: gclayton@tcd.ie

Dr Ken Higgins
Department of Geology
University College
Cork
IRELAND

Dr G.D. Sevastopulo
Department of Geology
Trinity College
Dublin 2
IRELAND
E-mail: gsvstpul@tcd.ie

ITALY

Prof. Mario Pasini
Universitarà delle Studi di Siena
Dipartimento di Sienza della terra
I-53100 Siena
ITALY

JAPAN

Dr Shuko Adachi
Institute of Geosciences
University of Tsukuba
Tsukuba, Ibaraki
JAPAN 305

Dr Masayuki Ehiro
Institute of Geology and Paleontology
Tohoku University
Aoba, Aobaku
Sendai
JAPAN 980-77
Fax: +81-22-263-9279

Dr Yoichi Ezaki
Dept Geosciences, Fac. Science
Osaka City University
Sumiyoshi-ku
Osaka
JAPAN 558

Mr. T. Haikawa
Akiyoshi-dai Sci.Museum Nat.Hist.
Shuhou-chou, Mine-gun
Yamaguchi
JAPAN 754-05

Dr Y. Hasagawa
Dept Earth Sciences, Fac.Science
Niigata University
Niigata
JAPAN 950-21

Dr Hisaharu Igo
Dept Earth Sciences
Tokyo Gakugei University
Koganei, Tokyo
JAPAN 184

Dr Hisayoshi Igo
Sakae-chou 1-31-7
Tachikawa City
Tokyo
JAPAN 190

Dr K. Ishida
Dept. Material Science
Fac. Integrat. Arts & Science
Tokushima University
Tokushima
JAPAN 770

Dr Kunihiro Ishizaki
Inst. Geology & Paleontology
Faculty of Science
Tohoku University, Aobaku
Sendai
JAPAN 980

Mr Atsushi Kaneko
30-18 Nishikinya 2 chome
Hirakata City
JAPAN 573

Dr K. Kanmera
3-20-24, Maimatsubara
Higashi-ku
Fukuoka
JAPAN 813

Dr Naruhiko Kashima
Dept Earth Sci., Fac.Gen.Education
Ehime University, Matsuyama
Ehime
JAPAN 790

Dr M. Kato
(Professor Emeritus of Hokkaido Univ.)
1-15, Miyanomori Ije, 18 chome
Sapporo 064
JAPAN
Fax: 81-11-644-1426

Dr T. Kawamura
Dept Earth Sci., Fac.Education
Miyagi Univ. Education, Aoba-ku
Sendai
JAPAN 980
Fax: +81-22-211-5794
E-mail: t-kawa@ipc.miyakyo-u.ac.jp

Dr T. Kimura
Inst. Natural History
3-14-24 Takada, Toshima-ku
Tokyo
JAPAN 171
Fax: 81-3-5992-9154

Dr T. Koike
Dept Geology, Fac. Education
Yokohama National University
Hodogaya-ku
Yokohama
JAPAN 240
Fax: 045-333-1536

Ms Yuko Kyuma
1-36-20, Daiyalando
Nagasaki
JAPAN 850

Dr K. Mori
Inst. Geol.& Paleont.,Fac.Science
Tohoku University, Aoba-ku
Sendai
JAPAN 980

Dr M. Musashino
Dept Earth Sciences
Kyoto Univ. Education
Hushimi-ku
Kyoto
JAPAN 612

Dr K. Nagai
Dept Earth Sci.,Fac.Gen.Education
Ryukyu University, Nakagami
Nishihara, Okinawa
JAPAN 930-01

Dr Koji Nakamura
Inst. Geology, Fac.Gen.Education
Hokkaido University, Kita-ku
Sapporo, Hokkaido
JAPAN 060

Dr T. Nishida
Dept Earth Sci., Fac. Education
Saga University
Saga
JAPAN 840

Dr Yuji Okimura
Inst. Earth & Planetary Science
Faculty of Science
Hiroshima University
Higashihiroshima
JAPAN 724

Dr M. Ota
Kitakyushu Museum Nat.History
Yahatahigashi-ku
Kitakyushu
JAPAN 805
Fax: 093-661-7503
E-mail: ota@human-net.city.kitakyushu.jp

Dr Yasuhiro Ota
Dept Earth & Planetary Science
Faculty of Science
Kyushu University 33
Hakozaki, Fukuoka 812-81
JAPAN
Fax: 092-643-1198
E-mail: yasuota@planet.geo.kyushu-u.ac.jp

Dr Tomowo Ozawa
Dept Earth & Planetary Sci.
Faculty of Science
Nagoya Univ., Chigusa-ku
Nagoya
JAPAN 464-01

Dr Kimiyoshi Sada
Dept Environ. Studies
Fac.Integ. Arts & Sci.
Hiroshima University
Higashihiroshima
JAPAN 724

Dr Sumio Sakagami
(Prof. Emeritus of Chiba Univ.)
Konakano 48, Akiruno-shi
Tokyo 190-01
JAPAN
Fax: 0425-96-0459

Dr K. Sashida
Institute of Geosciences
University Tsukuba
Tsukuba, Ibaraki 305
JAPAN

Mr. A. Sugimura
Akiyoshi-dai Sci.Museum Nat.Hist.
Shuhou-chou, Mine-gun
Yamaguchi 754-05
JAPAN

Dr Tetsuo Sugiyama
Dept Geology, Faculty Science
Fukuoka University, Jonan-ku
Fukuoka 814-80
JAPAN
Fax: 81-92-865-6030
E-mail: sugiyama@ssat.fukuoka-u.ac.jp

Dr Jun-ichi Tazawa
Dept of Geology, Fac. of Science
Niigata University
Niigata 950-21
JAPAN
Fax: 025-262-7278

Dr Katsumi Ueno
Institute of Geoscience
University of Tsukuba
Ibaraki 305
JAPAN
Fax: 81-298-51-9764
E-mail: katsumi@arsia.tsukuba.ac.jp

Dr Kozo Watanabe
1-26-12-108, Shinjuku
Shinjuku-ku
Tokyo
JAPAN 160

Dr N. Yamagiwa
Dept Earth Science
Osaka Kyoiku University
Kashiwabara, Osaka 582
JAPAN

Dr Juichi Yanagida
Izumi 3-60
Kasuga-shi
Fukuoka-ken 816
JAPAN

Mr Y. Yoshida
39-4-505, Suzugamine
Nishi-ku
Hiroshima 733
JAPAN

KAZAKHSTAN

Dr V. Koshkın
KazIMS
ul. K. Marx, 105
480100 Almaty
REP. KAZAKHSTAN

Dr M.M. Marfenkova
Inst. Geol. Nauk
ul. Kananbai batyra 69A
480100 Alma Ata
REP. KAZAKHSTAN

Dr M.I. Radchenko
ul. Shagabutdinova 80 kv. 39
480059 Alma-Ata
REP. KAZAKHSTAN

NEW ZEALAND

Dr J.B. Waterhouse
274 Princes Drive
Nelson
NEW ZEALAND

PEOPLES REP. CHINA

Dr Gao Lianda
Inst. Geol., Chinese Acad.Geol. Sciences
Baiwanzhuang Road
Beijing
PEOPLES REPUBLIC OF CHINA

Dr Guo Hongjun
Changchun College of Geology
6 Ximinzhu Street
Changchun, Jilin
PEOPLES REPUBLIC OF CHINA

Dr Li Xingxue
Nanjing Inst. Geol. Paleont.
Academia Sinica, Chi-Ming-Ssu
Nanjing 210008
PEOPLES REPUBLIC OF CHINA
Fax: 86-25-3357026
E-mail: lixx@njnet.ihep.ac.cn

Dr Ouyang Shu
Nanjing Inst. of Geol. & Palaeont.
Academia Sinica, Chi-Ming-Ssu
Nanjing 210008
PEOPLES REPUBLIC OF CHINA
Fax: 86-25-335-7026
E-mail: lixx@njnet.nj.ac.cn

Dr Ruan Yiping
Nanjing Inst. Geol. Paleont.
Academia Sinica, Chi-Ming-Ssu
Nanjing 210008
PEOPLES REPUBLIC OF CHINA

Dr Wu Wang-shi
Nanjing Inst. Geol. Paleont.
Academia Sinica, Chi-Ming-Ssu
Nanjing 210008
PEOPLES REPUBLIC OF CHINA

Dr Yang Shipu
China University of Geosciences
Chengfu Lu
Beijing 100083
PEOPLES REPUBLIC OF CHINA

POLAND

Prof. Jerzy Fedorowski
Institute of Geology
Adam Mickiewicz University
Maków Polnych 16
PL-61601 Poznan
POLAND
Fax: 48-61-536-536
Email: jerzy@vm.amu.edu.pl

Dr Tadeusz Peryt
Dept of Chemical Resources
Panstwowy Instytut Geologiczny
Rakowiecka 4
PL-00975 Warszawa
POLAND

Dr S. Skompski
Institute of Geology, Warsaw Univ.
Al Zwirki i Wigury 93
PL-02089 Warszawa
POLAND
Fax: 0-048-22-220-248
Email:
skompski@sungeo.biogeo.uw.edu.pl

Dr Elzbieta Turnau
Institute of Geological Sciences PAS
Senacka 1
PL-31002 Krakow
POLAND
Email: ndturnau@cyf-kr.edu.pl

Dr H. Zakowa
Panstwowy Inst. Geol., Oddzial-Swietokrzyski, Slir Poczt. 59
PL-25953 Kielce
POLAND

PORTUGAL

Dr M.J. Lemos de Sousa
Min. Geol. Fac. Ciências
Universidade do Porto
Praça de Gomes Teixeira
4050 Porto
PORTUGAL
Fax: +351-2-316-456

Prof. J.T. Oliveira
Instituto Geológico e Mineiro
Estrada da Portela, Bairro Zambujal
Apartado 7586
2720 Alfragide
PORTUGAL

RUSSIA

Dr Alexander S. Alekseev
Dept of Palaeont., Geol. Faculty
Moscow State University
119899 Moscow GSP V-234
RUSSIA
Fax: 70953391266
Email: aaleks@geol.msu.ru

Dr K.A. Astafieva
Museum Zemlevedenya
Moskovsk. Gosud. Univ.
Leninskie Gory
117234 Moskva
RUSSIA

Dr I.S. Barskov
Moskovsk. Gosud. Univ.
Leninskie Gory
117234 Moskva
RUSSIA

Dr O.A. Betekhtina
Inst. Geol. & Geophys.
Siberian Branch, Russian Acad.of Sciences
630090 Novosibirsk
RUSSIA

Dr O.I. Bogush
Inst. Geol. & Geophys.
Siberian Branch, Russian Acad.of Sciences
630090 Novosibirsk
RUSSIA

Dr I.V. Budnikov
Siberian Inst. Geol., Geophys.& Min. Res.
Siberian Geological Survey
Krasny prospekt 67
630104 Novosibirsk
RUSSIA
Fax: 383-2-20-35-17, 22-57-40

Dr T.V. Byvsheva
ul. Bolshaia Academycheskaja
77 kor.1 kv. 154
125183 Moskva
RUSSIA

Dr V.A. Chermnykh
Inst.Geol.,Komi Scientific Centre
Uralian Branch, Academy of Science
ul. Pervomayskaya 54
167000 Syktyvkar
RUSSIA

Dr G.E. Chernyak
Sev. Mor. Geol.
nab. Mojki 120
190121 St Petersbourg
RUSSIA

Dr Boris Chuvashov
Inst. Geology/Geochemistry
Russian Academy of Sciences
Pochtoryi per. 7
620151 Ekaterinburg
RUSSIA

Dr V. I. Davydov
V.S.E.G.E.I.
Sredny pr. 74
199026 St Petersbourg
RUSSIA

Dr Marina V. Durante
Geological Institute
Russian Academy of Sciences
Pyzhevsky per. 7
109017 Moskva
RUSSIA
Fax: +7-95-231-0443
Email: durant@ginran.msk.su

Dr A.V. Durkina
Timan-Pechora Research Center
ul. Pushkina 2
169400 Ukhta
Komi Republic
RUSSIA
Fax: 6-13-04

Dr V.G. Ganelin
Geological Institute
Russian Academy of Sciences
Pyzhevsky per. 7
109017 Moskva
RUSSIA

Dr N. Goreva
Geological Institute
Russian Academy of Sciences
Pyzhevsky per. 7
109017 Moskva
RUSSIA
Fax: +7-095-231-04-43
Email: goreva@ginran.msk.su

Dr T.N. Isakova
Geological Institute
Russian Academy of Sciences
Pyzhevsky per. 7
109017 Moskva
RUSSIA
Fax: +7-095-231-04-43
Email: goreva@ginran.msk.su

Dr R.M. Ivanova
Institute of Geology & Geochemistry
Uralian Branch,Russian Academy of Sciences
Pochtovyi per. 7
620151 Ekaterinburg
RUSSIA
Fax: +7-3432-5152-52
Email: root@igg.e-burg.su

Dr A.H. Kagarmanov
Leningradsky Gorny Inst.
Vasilievsky ostr.
21 Linia, 2
199026 St Petersbourg
RUSSIA

Dr N.V. Kalashnikov
Inst.Geol.,Komi Scientific Cent.
Uralian Branch, Russian Academy of Science
ul. Pervomayskaya 57
167000 Syktyvkar
RUSSIA

Dr L.I. Kononova
Moskovsk. Gosud. Univ.
Leninskie Gory
117234 Moskva
RUSSIA

Dr M.V. Konovalova
Timan-Pechora Research Center
ul. Pushkina 2
169400 Ukhta
Komi Republic
RUSSIA
Fax: 6-13-04

Dr O. Kossovaya
Secretary, Russian Comm. Carb. Stratigraphy
V.S.E.G.E.I.
Sredni pr. 74
199026 St Petersbourg
RUSSIA
Fax: 7-212-213-57-38
Email: vsg@sovam.com

Dr S.S. Lazarev
Paleontological Institute
Russian Academy of Sciences
Profsoyuznaya ul. 123
117321 Moskva
RUSSIA

Dr M.K. Makhlina
T.T.P. "Centrgeologia"
Varshavskoje Shosse 39a
113105 Moskva
RUSSIA
Fax: 7-095-954-38-15

Dr E. V. Movshovich
P.O. Box 1204
344091 Rostov-na-Donu-91
RUSSIA

Dr Svetlana Nikolaeva
Paleontological Institute
Russian Academy of Sciences
Profsoyuznaya 123
117 321 Moskva
RUSSIA

Mrs M.V. Oshurkova
V.S.E.G.E.I.
Sredni pr. 74
199026 St Petersbourg
RUSSIA

Dr L.N. Peterson
Krasnoyarskgeolsyomka
ul. Beresina, 3
660020 Krasnoyarsk
RUSSIA

Dr A.V. Popov
Leningrad University
16 Linia, 29
199178 St Petersbourg
RUSSIA

Dr B.V. Poyarkov
Moskovsky prospekt 163 kv. 639
150057 Yaroslavl
RUSSIA

Dr E.A. Reitlinger
Geological Institute
Russian Academy of Sciences
Pyzhevsky per. 7
109017 Moskva
RUSSIA
Fax: +7-095-231-04-43

Dr S.T. Remizova
Inst.Geol., Komi Scientific Centre
ul. Pervomajskayja 54
167000 Syktyvkar
Komi Republic
RUSSIA
Fax: 821-2-42-53-46
Email: strat@geol.dereza.komi.su

Dr R.A. Schekoldin
Dept of Historical Geology
Mining Institute, 21st line V.O. 2
St Petersburg
RUSSIA
Fax: 812-213-26-13
Email: benin@sovam.com

Dr O.A. Shcherbakov
Polytechnical Institute
Komsomolskiy Avenue 29a
614600 Perm
RUSSIA

Dr M.V. Shcherbakova
Polytechnical Institute
Komsomolskiy Avenue 29a
614600 Perm
RUSSIA

Dr K.V. Simakov
N.E.Inter.Sci.Res.Inst.,Far East
Russian Academy of Sciences
Portovajy 16
685005 Madagan
RUSSIA

Dr V. Tchizhova
V.N.I.I.neft
I Dmitrovsky proezd 10
125422 Moskva
RUSSIA

Dr Vladimir T. Zorin
Research & Production Firm AZeNS@
Prospekt Marksa, 62
660049 Krasnoyarsk
RUSSIA

SLOVENIA

Dr A. Ramovs
Katedra za geologijo in paleontologijo
Askerceva 2
SLO-1000 Ljubljana
SLOVENIA
Fax: 386-61-1259-337

SOUTH AFRICA

Dr D. Cole
Geological Survey
P.O. Box 572
Bellville 7535
SOUTH AFRICA

Dr Colin MacRae
Palaeont.Sect.,Geological Survey
Private Mail Bag X112
Pretoria 0001
SOUTH AFRICA

Mr Barry Millsteed
Palaeont.Sect.,Geological Survey
Private Mail Bag X112
Pretoria 0001
SOUTH AFRICA
Fax: 012-841-1278
Email: bmillstd@geoscience.org.za

Dr J.N. Theron
Geological Survey
P.O. Box 572
Bellville 7535
SOUTH AFRICA

SPAIN

Dr A. García-Loygorri
Cátedra de Geología
Escuela Sup. Ing. Minas
Ríos Rosas 21
28003 Madrid
SPAIN

L.F. Granados
Avda Juan Andrés 10bis
28035 Madrid
SPAIN

Dr M.L. Martinez Chacón
Depto de Geología
Universidad de Oviedo
Arias de Velasco s/n
33005 Oviedo
SPAIN
Fax: 34-8-510-3103
Email:
mmchacon@asturias.geol.uniovi.es

Dr Sergio Rodríguez
Depto de Paleontología
Facultad de Ciencias Geológicas
Ciudad Universitaria
28040 Madrid
SPAIN
Fax: 1-394-4854
Email: sergrodr@eumax.sim.ucm.es

Dr L.C. Sánchez de Posada
Depto de GeologRa
Universidad de Oviedo
Arias de Velasco s/n
33005 Oviedo
SPAIN
Fax: 34-8-510-3103
Email:
lposada@asturias.geol.uniovi.es

Dr Elisa Villa
Depto de Geología
Universidad de Oviedo
Arias de Velasco s/n
33005 Oviedo
SPAIN
Fax: 34-8-510-3103
Email: evilla@asturias.geol.uniovi.es

Dr R.H. Wagner
Unidad de Paleobotánica
Jardín Botánico de Córdoba
Avenida de Linneo s/n
14004 Córdoba
SPAIN
Fax: 34-57-295-333
Email: jardinbotcord@servicom.es

TARTARSTAN

Dr V.S. Gubareva
ul. Kosmonavtov 7 kv. 7
420061 Kazan
TARTARSTAN

THE NETHERLANDS

Bibliotheek Palaeobotanie
Lab. Palaeobotany and Palynology
Rijksuniversit., Heidelberglaan 2
NL-3584 CS Utrecht
THE NETHERLANDS
Fax: 31-30-253-096
Email: Z.Smeenk@ beov.biol.ruu.nl

Dr M.J.M. Bless
Looierstraat 3
NL-6271 BA Gulpen
THE NETHERLANDS

Dr M. van den Boogaard
Nationaal Natuurhistorisch Museum
Postbus 9517
NL-2300 RA Leiden
THE NETHERLANDS

Dr A.C. van Ginkel
Nationaal Natuurhistorisch Museum
Postbus 9517
NL-2300 RA Leiden
THE NETHERLANDS

Dr W. Khrschner
Lab. Palaeobotany & Palynology
Budapestlaan 4
NL-3584 CD Utrecht
THE NETHERLANDS

Library
Lab. Palaeobotany & Palynology
Budapestlaan 4
NL-3584 CD Utrecht
THE NETHERLANDS

Rijks Geologische Dienst
Geologisch Bureau
Postbus 126
NL-6400 AC Heerlen
THE NETHERLANDS

Subcommissie Stratig. Nederland
Nationaal Natuurhistorisch Museum
Postbus 9517
NL-2300 RA Leiden
THE NETHERLANDS

Dr C.F. Winkler Prins
Nationaal Natuurhistorisch Museum
Postbus 9517
NL-2300 RA Leiden
THE NETHERLANDS
Fax: 31-71-133-344
Email: wp.pal@nnm.nl

UNITED KINGDOM

Acquisitions
Department of Library Service
The Natural History Museum
Cromwell Road
London SW7 5BD
UNITED KINGDOM

Dr R.L. Austin
21 Bellevue Road
West Cross, Swansea
South Wales SA3 5QB
UNITED KINGDOM

Dr Karen Braithwaite
Exploration & Geological Analysis
British Gas Research Centre
Ashby Road
Loughborough, LEICS, LE11 3QU
UNITED KINGDOM
Fax: 01509-283-137
Email: karen.braithwaite@bggrc.co.uk

Dr C.J. Cleal
Department of Botany
National Museum & Gallery of Wales
Cathays Park
Cardiff CF1 3NP
UNITED KINGDOM
Fax: 01222-239-829
Email: 100015.567@compuserve.com

Dr R.M.C. Eagar
23 High Bond End
Knaresborough
North Yorks HG5 9BT
UNITED KINGDOM
Fax: 01423-865-892
Email: 100305.1736@compuserve.com

Dr A.C. Higgins
9 Tresglos Court
Oatlands Drive
Weybridge, Surrey KT13 9JG
UNITED KINGDOM

Dr M.R. House
Department of Geology
University of Southampton
Harts SO9 5NH
UNITED KINGDOM

Dr G.A.L. Johnson
Department of Geology
University of Durham
Durham DH1 3LE
UNITED KINGDOM

Mr M. Mitchell
11 Ryder Gardens
Leeds, W. Yorks. LS8 1JS
UNITED KINGDOM

Dr B. Owens
British Geological Survey
Keyworth
Nottingham NG12 5GG
UNITED KINGDOM

Dr W.H.C. Ramsbottom
Brow Cottage
Kirkby Malzeard
Ripon, N.Yorks HG4 3RY
UNITED KINGDOM

Dr N.J. Riley
British Geological Survey
Keyworth
Nottingham NG12 5GG
UNITED KINGDOM
Fax: 44-115-9363200
Email: n.riley@bgs.ac.uk

Dr A.R.E. Strank
British Petroleum Res.Centre
Chertsey Rd, Sunbury-on-Thames
Middlesex TW16 7LN
UNITED KINGDOM

Dr N. Turner
British Geological Survey
Keyworth
Nottingham NG12 5GG
UNITED KINGDOM

Dr W.J. Varker
Department of Earth Sciences
The University of Leeds
Leeds LS2 9JT
UNITED KINGDOM

U.S.A.

Dr John Baesemann
Amoco Production Company
P.O. Box 3092
Houston, TX 77253
U.S.A.

Dr Paul Brenckle
1 Whistler Point Road,
Westport MA 02790
USA
Fax: 1-713-366-7416
Email:
saltwaterfarm@compuserve.com

Dr D.K. Brezinski
Maryland Geological Survey
2300 St Paul Street
Baltimore,MD 21218
U.S.A.

Dr Lewis M. Brown
Department of Geology
Lake Superior State University
Sault Sainte Marie,
Michigan, MI 49783-1699
U.S.A.
Fax: 906-635-2111
Email: lbrown@lakers.lssu.edu

Dr J.L. Carter
Carnegie Museum of Natural History
4400 Forbes Ave.
Pittsburgh, PA 15213
U.S.A.
Fax: 412-622-8837
Email: jcl4@vsm.cis.pitt.edu

Dr D.R. Chesnut
Kentucky Geological Survey
228 Min.Res.Bldg, Univ. Kentucky
Lexington, Kentucky 40506-0107
U.S.A.
Fax: 606-257-5500
Email: chesnut@ukcc.uky.edu

Dr H.H. Damberger
Illinois State Geological Survey
200 Nat.Res.Bldg, 615 E.Peabody Dr.
Champaign,IL 61820-6964
U.S.A.

Dr William C. Darrah
2235 Baltimore Pike
Gettysburg, PA 17325
U.S.A.

Dr Cortland Eble
Kentucky Geological Survey
228 Min.Res.Bldg, Univ. Kentucky
Lexington, KY 40506-0107
U.S.A.

Dr J.T. Dutro Jr
5173 Fulton St. NW
Washington DC 20016
U.S.A.
Fax: 1-202-343-8620

Dr Kenneth J. Englund
U.S. Geological Survey
956 National Center
Reston, VA 22001 U.S.A.

Dr F.R. Ettensohn
Department of Geological Sciences
University of Kentucky
Lexington, KY 40506-0053
U.S.A.
Fax: 606-323-1938
Email: geofre@ukcc.uky.edu

Dr Robert Gastaldo
Dept Geology, Auburn University
210 Petrie Hall
Auburn, AL, 36849-5305
U.S.A.

Geology Library
The University of Iowa
136 Trowbridge Hall
Iowa City, IA 53342-1379
U.S.A.

William H. Gillespie
US Geological Survey
916 Churchill Circle
Charleston, WV, 25314-1747
U.S.A.

Dr Brian F. Glenister
Department of Geology
University of Iowa
Iowa City, IA, 52242-1379
U.S.A.
Fax: 319-335-1821
Email: geology@uiowa.edu

Dr John Groves
Amoco Production Co.
P.O. Box 3092
Houston, TX, 77253
U.S.A.
Fax: 713-366-7416
Email: jrgroves@hou.amoco.com

Dr Philip H. Heckel
Department of Geology
University of Iowa
Iowa City, Iowa 52242 U.S.A.
Fax: 319-335-1821
Email: philip-henkel@uiowa.edu

Dr Thomas W. Henry
U.S. Geological Survey
Denver Federal Center, MS 919
Denver, CO, 80225
U.S.A.

Dr A.S. Horowitz
Department of Geological Sciences
Indiana University
1005 E 10th St.
Bloomington, IN, 47401
U.S.A.

Claren M Kidd
100 E Boyd R220
University of Oklahoma
Norman, OK 73019-0628
USA
Fax: 405 325-6451 or 405 325-3180
Email: ckidd@uoknor.edu

Ms Andrea Krumhardt
Dept of Geology & Geophysics
University of Alaska
P.O. Box 755780
Fairbanks, AK 99775
U.S.A.
Fax: 907-474-5163
Email: fnapk@aurura.alaska.edu

Dr Lance Lambert
Department of Physics
Southwest Texas State University
601 University Drive
San Marcos, TX 78666
U.S.A.
Email: CW12@swt.edu

Dr H. Richard Lane
Amoco Corporation
550 Westlake Park Blvd, Rm 1086W3
P.O. Box 3092
Houston, TX, 77253
U.S.A.
Fax: 1-713-3667416
Email: hrlane@netropolis.net

Dr Ralph L. Langenheim
Dept Geol.,Univ. of Illinois
254 N.B.H.,1301 W. Green St.
Urbana, IL, 61801
U.S.A.

Dr R.L. Leary
Illinois State Museum
Research & Collections Center
1011 East Ash Street
Springfield, IL 62703
U.S.A.
Fax: 217-785-2857
Email: Leary@museum.state.il.us

Dr Richard Lund
Department of Biology
Adelphi University
Garden City, NY, 11530
U.S.A.

Dr W.L. Manger
Department of Geology
Univ. of Arkansas
Fayetteville, AR, 72701
U.S.A.
Email: wmanger@comp.uark.edu

Dr Gene Mapes
Dept of Envir. & Plant Biology
Ohio University
Athens, OH, 45701
U.S.A.

Dr R.H. Mapes
Department of Geology
Ohio University
Athens, OH, 45701
U.S.A.

Dr C.G. Maples
4201 Wilson Blvd
Arlington, VA, 22230
U.S.A.
Email: cmaples@nsf.gov

Dr Hermann W. Pfefferkorn
Department of Geology
University of Pennsylvania
240 S 33rd St.
Philadelphia, PA, 19104-6316
U.S.A.
Fax: 215-898-0964
Email: hpfeffer@sas.upenn.edu

Dr Carl B. Rexroad
Indiana Geological Survey
611 N. Walnut Grove
Bloomington, IN, 47405
U.S.A.
Fax: 812-855-2862
Email:
Rexroad@gismo.geology.indiana.edu

Dr C.A. Ross
GeoBioStrat Consultants
600 Highland Drive
Bellingham, WA 98225-6410
U.S.A.
Fax: 360-650-3148
Email: rossjpr@henson.cc.wwu.edu

Dr June R.P Ross
600 Highland Drive
Bellingham, WA 98225-6410
U.S.A.
Fax: 360-650-3148
Email: rossjpr@henson.cc.wwu.edu

Dr C.A. Sandberg
U.S. Geological Survey
Box 25046, MS 940,Federal Center
Denver, CO, 80225
U.S.A.

A. Sartwell, Chief Info. Services
Geological Survey of Alabama
P.O.Drawer 0, University Station
Tuscaloosa, AL, 35486-9780
U.S.A.

Dr W. Bruce Saunders
Geology Department
Bryn Mawr College
Bryn Mawr, PA, 19010
U.S.A.

Serials Department
Univ. of Illinois Library
1408 West Gregory Drive
Urbana,IL 61801
U.S.A.

Dr B. Skipp
U.S. Geol. Survey, Box 25046
M.S. 913, Denver Fed.Center
Denver, CO, 80225-0046
U.S.A.

Dr Gerilyn S. Soreghan
Geology & Geophysics
University of Oklahoma
100 E. Boyd St.
Norman, OK, 73019
U.S.A.
Email: lsoreg@uoknor.edu

Dr C.H. Stevens
Dept Geology, School of Science
San Jose State University
San Jose, CA, 95192-0102
U.S.A.
Fax: 408-924-5053
Email: stevens@geosun1.sjsu.edu

Ms Mathilda Stucke
30 Oakland Avenue
West Hempstead
New York, 11552-1923
U.S.A.
Fax: 516-877-4711
Email: stucke@adlibv.adelphi.edu

Dr P.K. Sutherland
School of Geology & Geophysics
University of Oklahoma
Norman, OK, 73069
U.S.A.

Dr T.N. Taylor
Department of Botany, Haworth Hall
University of Kansas
Lawrence
Kansas 66045
U.S.A.
Email: ttaylor@falcon.cc.ukans.edu

Dr T.L. Thompson
Missouri Geological Survey
Box 250
Rolla, MO, 65401
U.S.A.

Dr Peter R. Vail
Dept Geol., Rice University
P.O. Box 1892
Houston, TX, 77251
U.S.A.

Dr G.P. Wahlman
Amoco Production Co. USA
501 Westlake Park Blvd
P.O. Box 3092
Houston, TX 77253
U.S.A.
Fax: 1-713-366-7416
Email: gpwahlman@hou.amoco.com

Dr Bruce Wardlaw
U.S. Geological Survey
970 National Center
Reston, VA, 22092
U.S.A.

Dr J.A. Waters
Department of Geology
West Georgia College
Carrollton, Georgia 30118
U.S.A.
Fax: 770-836-4373
Email: jwaters@westga.edu

Dr Keith Watts
P.O. Box
Wilson, Wyoming
U.S.A.

Dr Gary Webster
Department of Geology
Washington State University
Physical Science 1228
Pullman, WA, 99164
U.S.A.
Fax: 509-335-7816

Dr R.R. West
Dept Geol., Thompson Hall
Kansas State University
Manhattan, KS, 66506-3201
U.S.A.
Fax: 913-532-5159
Email: rrwest@ksuum.ksu.edu

Dr Garner L. Wilde
5 Auburn Court
Midland, Texas 79705
U.S.A.

UKRAINIA

Dr N.I. Bojarina
Institute of Geology
Ukrainian Academy of Science
ul. Chkalova 55b
252054 Kiev
UKRAINA

Dr O.P. Fissunenko
Pedagog. Inst.
Oboronnaja 2
348011 Voroshilovgrad
UKRAINA

Dr R.I. Kozitskaya
Institute of Geology
Ukrainian Academy of Science
ul. Chkalova 55b
252054 Kiev
UKRAINA

Dr T.I. Nemirovskaya
Institute of Geology
Ukrainian Academy of Science
ul. Chkalova 55b
252054 Kiev
UKRAINA

Dr V.I. Poletaev
Institute of Geology
Ukrainian Academy of Science
ul. Chkalova 55b
252054 Kiev
UKRAINA

Dr Z.S. Rumyantseva
ul. Vasilovskaja 42, Kv.33
252022 Kiev
UKRAINA

Dr A.K. Shchegolev
Institute of Geology
Ukrainian Academy of Science
ul. Chkalova 55b
252054 Kiev
UKRAINA

Dr N.P. Vassiljuk
Donetskij Politekhn. Inst.
ul. Artema 58
Donetsk
UKRAINA

Mrs M.V. Vdovenko
Institute of Geology
Ukrainian Academy of Science
ul. Chkalova 55b
252054 Kiev
UKRAINA

UZBEKISTAN

Dr F.R. Bensh
Inst. Geol. & Geophys.
ul. Sulejmanovoj 33
700017 Tashkent
UZBEKISTAN
Dr Iskander M. Nigmadjanov
ul. G. Lopatina 80, kv. 35
700003 Tashkent
UZBEKISTAN

SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY (SCCS)

OFFICERS AND VOTING MEMBERS 1996-2000

CHAIRMAN:

Professor J. Roberts
School of Applied Geology
The University of New South Wales
SYDNEY NSW 2052
AUSTRALIA.
PHONE: +61 2 9385 4279
FAX: +61 2 9385 5935
E-MAIL: J.Roberts@unsw.edu.au

VICE-CHAIRMAN:

Dr J.T. Dutro Jr
5173 Fulton St. NW
Washington DC 20016
U.S.A.
PHONE: +1-202-343-3222
FAX: +1-202-343-8620

SECRETARY/EDITOR:

Assoc. Prof. Ian Metcalfe
Division of Earth Sciences
School of Physical Sciences
& Engineering
University of New England
ARMIDALE NSW 2351
AUSTRALIA
PHONE: +61-67-732860
FAX: +61-67-733300
E-MAIL: sccs@une.edu.au

OTHER TITULAR MEMBERS:

Dr Alexander S. Alekseev
Dept of Palaeont., Geol. Faculty
Moscow State University
119899 Moscow GSP V-234
RUSSIA
FAX: 70953391266
E-MAIL: aaleks@geol.msu.ru

Dr Paul Brenckle
1 Whistler Point Road,
Westport MA 02790
USA
Fax: 1-713-366-7416
Email:
saltwaterfarm@compuserve.com

Dr Boris Chuvashov
Inst. Geology/Geochemistry
Russian Academy of Sciences
Pochtoryi per. 7
620219 Ekatezinburg
RUSSIA
FAX: 7 3432 515252
E-MAIL: root@igg.e-burg.su

Dr Geoff Clayton
Department of Geology
Trinity College
Dublin 2
IRELAND
FAX: +353 1 671 1199
E-MAIL: gclayton@tcd.ie

Dr Marina V. Durante
Geological Institute
Russian Academy of Sciences
Pyzhevsky per. 7
109017 Moskva
RUSSIA
FAX: +7 95 231 0443
E-MAIL: durante@ginran.msk.su

Dr B.A. Engel
Department of Geology
University of Newcastle
NEWCASTLE NSW 2308
AUSTRALIA
PHONE: +61-49-215402
FAX: +61-49-216925
E-MAIL:
bengel@geology.newcastle.edu.au

Dr Carlos R. González
Instituto de Paleontologia
Fundación Miguel Lillo
Miguel Lillo 251
4000 S.M. deTucumán
ARGENTINA
FAX: +54 81 330 868
E-MAIL: iesglo@tucunet.com.ar

Dr Philip H. Heckel
Department of Geology
University of Iowa
Iowa City, Iowa 52242
U.S.A.
FAX: +1 319 335 1821
E-MAIL: philip-heckel@uiowa.edu

Dr H. Richard Lane
Amoco Corporation
550 Westlake Park Blvd, Rm 1086W3
P.O. Box 3092
Houston, TX, 77253
U.S.A.
FAX: +1-713-3667416
E-MAIL: hrlane@netropolis.net

Dr J.P. Laveine
Lab.PalJobot.,UFR Sci.de la Terre
Univ. Sci. Techn. de Lille
F-59655 Villeneuve d'Ascq Cédex
FRANCE
FAX: +33 2043 6900
E-MAIL: Jean-Pierre.Laveine@univ-lille1.fr

Dr Bernard L. Mamet
Department of Geology
University of Montreal
Montreal P.Q., H3C 3J7
CANADA
FAX: +1-514-343-5782
E-MAIL: geologie@ere.umontreal.ca

Dr W.L. Manger
Department of Geology
Univ. of Arkansas
Fayetteville, AR, 72701
U.S.A.
FAX: +1- 501-575-3846
E-MAIL: wmanger@comp.uark.edu

Dr Ouyang Shu
Nanjing Inst. of Geol. & Palaeont.
Academia Sinica, Chi-Ming-Ssu
Nanjing 210008
PEOPLES REPUBLIC OF CHINA
FAX: +86 25 335 7026
E-MAIL: lixx@njnet.nj.ac.cn

Dr N.J. Riley
British Geological Survey
Keyworth
Nottingham NG12 5GG
UNITED KINGDOM
FAX:
E-MAIL: N.Riley@gbs.ac.uk

Dr A.C. Rocha-Campos
Instituto de Geociências
Universidade de São Paulo
CP 11348 CEP 05422-970
São Paulo
BRAZIL
FAX: +55 11 818 4129
E-MAIL: acrcampo@usp.br

Prof. G.D. Sevastopulo
Department of Geology
Trinity College
Dublin 2
IRELAND
FAX: +353-1-671 2821 (until mid-July, 1997)
E-MAIL: gsvstpul@tcd.ie

Dr Elisa Villa
Depto de Geología
Universidad de Oviedo
Arias de Velasco s/n
33005 Oviedo
SPAIN
FAX: +34 8 510 3103
E-MAIL:
evilla@asturias.geol.uniovi.es

Dr R.H. Wagner
Unidad de Paleobotánica
Jardín Botánico de Córdoba
Avenida de Linneo s/n
14004 Córdoba
SPAIN
FAX: +34 57 295 333

Dr C.F. Winkler Prins
Nationaal Natuurhistorisch Museum
Postbus 9517
NL-2300 RA Leiden
THE NETHERLANDS
FAX: +31 715 133 344
E-MAIL: wp.pal@nnm.nl