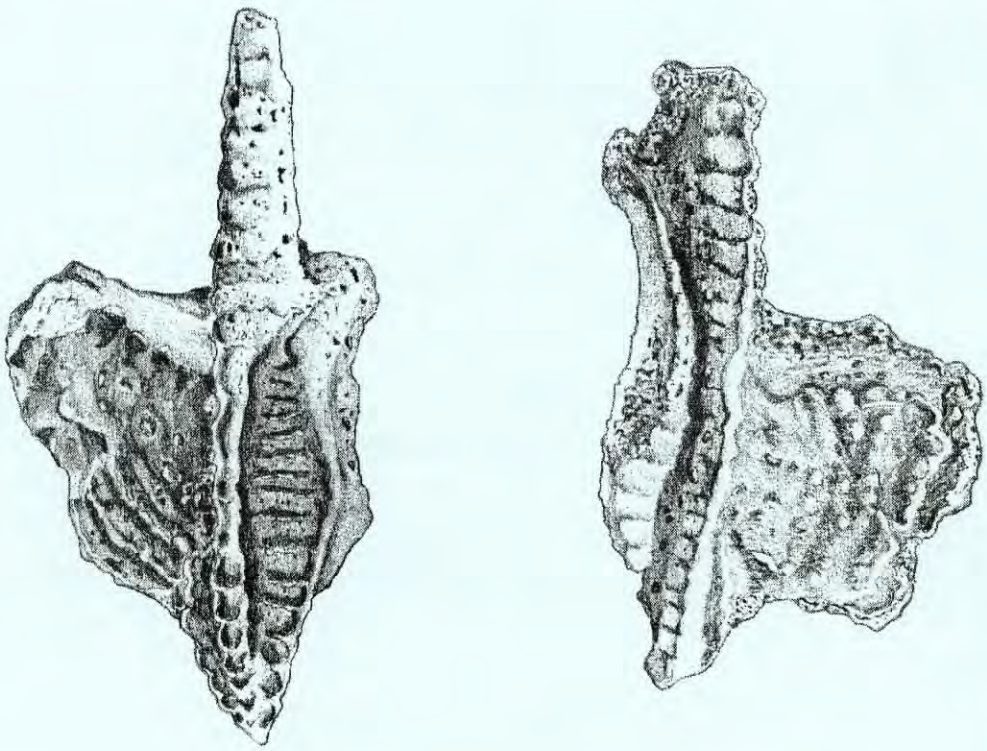
NEWSLETTER ON CARBONIFEROUS STRATIGRAPHY

Volume 13 July 1995



SCCS

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

Table of Contents

CHAIRMAN'S COLUMN . . . 1

SCCS ANNUAL REPORT 1994 . . . 2
- Statement of Income and Expenditure 1993-94 . . . 2
- Member donations in 1994/95 . . . 2

WORKING GROUP REPORTS . . . 3
- Mid-Carboniferous Boundary Working Group (Lane) . . . 3
- Ballot results for Mid-Carboniferous Working Group and the Subcommission . . . 3
- Working Group on the Middle Pennsylvanian of North America (Manger) . . . 4

ICS VOTING STATUTES . . . 5

PROJECT GROUP REPORTS . . . 6
- Project Group 1 (Brenckle) . . . 6
- Project Group 4 (Kullmann) . . . 6
- Project Group 5 (Villa) . . . 6

VALE SCCS MEMBERS . . . 8
- Jeanne DOUBINGER (1921 - 1994) . . . 8
- Maria Nikolaevna SOLOVIEVA (1920-1994) . . . 8
- Susanna Georgievna GORELOVA (1920-1994) . . . 9

NEWS ITEMS FROM MEMBERS . . . 10
- Bill Sando . . . 10
- Sue Turner . . . 10
- Ichthyolith Issues and Special Publication No. 1 (Turner) . . . 11
- Committee for Quantitative Stratigraphy Newsletter No. 6, January 1995 (Agterberg) 11
- Discovery of Levipustula fauna in Antarctica (Dickins) . . . 11
- Centenary of Dagmara Maximilianovna RAUZER-CHERNOUSOVA . . . 12
- Jirí Kalvoda . . . 12

CONTRIBUTIONS BY MEMBERS . . . 13
- Carboniferous Palynostratigraphy of Northern Tarim Basin, Xinjiang, China (Gao Lianda, He Zhoushen & Dongkailin) . . . 13
- Carboniferous Sediments in Sinai and Adjacent Eastern Desert, Egypt (Kholief) . . . 14
- CZECH - US Workshop on Carboniferous Paleobotany (Leary) . . . 14
- Devonian olistoliths in Lower Carboniferous flysch of central south Karavanke (Ramovs) 15
- Devonian-Carboniferous boundary position in continental successions of Angaraland (Peterson & Zorin) . . . 16
- Carboniferous stratigraphy: Quo vadis? (Wagner & Winkler Prins) . . . 20
- The Australian late Carboniferous magnetostratigraphic timescale (Roberts) . . . 21
- Carboniferous of Brazil (Anelli & Rocha-Campos) . . . 21
- ABSTRACTS OF PAPERS RECEIVED . . . 23
- Biostratigraphy and Sequence Stratigraphy at the Devonian-Carboniferous transition in southern China (Hunan Province) (Hance *et al.*) . . . 23
- An outline of the Moliniacian (Upper Tournaisian-Lower Viséan) in southern Belgium (Hance *et al.*) . . . 23
- Non-marine bivalve assemblage in the Asker Group, Oslo Graben and its correlation with a late Pennsylvanian assemblage from North America (Eagar) . . . 23
- General overview of Carboniferous Stratigraphy (Wagner & Winkler Prins) . . . 23
- Carboniferous Stratigraphy and Palynology of China (Gao Lianda *et al.*) . . . 24
- The Namurian and its Biota in the Eastern Sector of North Qilian Mts, NW China (Li Xingxue *et al.*) . . . 24
- Australian Carboniferous Trilobites (Engel & Morris) . . . 25

CONFERENCES AND NOTICES . . . 26
- Sixth North American Paleontological Convention - Symposia (Lane *et al.*) . . . 26
- SEPM Quantitative Research Group (Lane *et al.*) . . . 26
- Peri-Tethys Programme Working Group on the Moscovian and Artinskian Maps (Vai) 28

CONTRIBUTIONS TO THE NEWSLETTER . . . 5

APPENDIX 1: SCCS Membership mailing list . . . *Appendix 1-1 to 1-5*

APPENDIX 2: SCCS Voting Members list 1992-96 . . . *Appendix 1-5*

Newsletter on Carboniferous Stratigraphy

IUGS SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY / VOL. 13 - 1995

CHAIRMAN'S COLUMN

The Carboniferous System is now very close to being formally subdivided into two parts: the Subcommission has accepted the recommendation of its Working Group and all that now remains is for this decision to be ratified by ICS/IUGS. These last official steps have still to be completed but there is little doubt that the Mid-Carboniferous Boundary will have been formalised by the time of the next International Congress in China in August 1996.

The Mid-Carboniferous Boundary is the first boundary defined by this Subcommission in modern times (the base of the Carboniferous was put in place by an independent Working Group). This definition might be the apparition of *Eos*, the dawn, indicating the approaching full light of day, that sets in motion the further subdivision of the Carboniferous into a suite of clearly defined stages.

The nearest contender seems to be the boundary between the Tournaisian and Viséan stages (SCCS Project 2). Also not too far away may be the definition of the base of a unit near the level of the paralic/non-marine Westphalian (SCCS Project 4), and the base of a unit in the younger part of the Carboniferous (SCCS Project 5).

May I be permitted to mention once more that type sections (GSSP) of internationally accepted units have to be represented in fully marine facies, and named as such; and that in general, it is easier and surer to select for international (stage) boundaries, a level that has already stood the test of long term and widespread usage, although, of course, the new definition of a GSSP in certain sections may differ somewhat from historical usage.

The Carboniferous System is now very close to being formally subdivided into two parts

The forthcoming meeting in Kraków, Poland will reunite Carboniferous and Permian specialists near the long established, well known, Upper Silesia coal basin of Namurian age. The visit will be most instructive to all of us - about 3000 m of sequence represent a time interval that is documented elsewhere, not very far away (e.g. NW Europe), by less than 10% of that thickness. In both areas, non-sequences are scarce or non-existent; it may, or may not, be surprising that local reworking and gaps are more common in the thick rather than the thin sequences. Certainly, more than one explanation may be contemplated for this disparity. For the time being, we must accept the fact that no sedimentary sequence can be a perfect representation of time, however thick or thin it may be. We ought to accept, too, that our stratigraphical approach to time measurement is of necessity a compromise. Let us try to find reasonable compromises!

I do hope to see many of you at the Carboniferous-Permian Congress in Kraków, and on the field trips. Our Polish friends and colleagues will do their utmost to present the best features of Carboniferous and Permian geology and stratigraphy in this part of central Europe. It is our task to acknowledge this effort by our attendance, lively discussion and the development of many interesting results.

Eva Paproth

THE COVER ILLUSTRATION

Diagrams based on photographs of the conodont *Gnathodus bilineatus bilineatus* (Roundy) collected from Milivojevici, northwest Serbia (Zone *bilineatus*).

Drawing by **R. MIRKOVIC**, Adelaide (Year 12 High School student), supplied by SCCS Corresponding Member **DR SMILJANA STOJANOVIC**, Adelaide, South Australia.

SCCS ANNUAL REPORT 1994

Membership:

The Subcommission has 22 Voting Members including the Executive Officers. Correponding Membership as of 1 October 1994 was 245 plus 7 Libraries which receive this *Newsletter*. At the date of publication, Corresponding Membership has increased to 250.

Bureau Officers:

Chairman:
Dr Eva PAPROTH, Schwanenburgstr. 14, D–47804 Krefeld Germany.

Secretary/Vice Chairman:
Dr B.A. ENGEL, Department of Geology, University of Newcastle, NSW 2308 Australia

Activities in 1994:

Details of 1994 activities of the Subcommission are incorporated in the reports of the Working Groups and Project Groups which are presented on the next pages.

The major milestone achieved during 1994 was the completion of the deliberations of the Mid-Carboniferous Boundary Working Group resulting in the nomination of the Arrow Canyon Section in Nevada USA as the location for the GSSP marking the base of the upper Carboniferous.

SCCS Work Plans for 1995

During 1995, it is anticipated that the Subcommission will deliberate on the 1994 recommendation of the MCBWG, undertake a postal vote and, if approved, forward the recommendation to ICS for formal ratification of the Arrow Canyon section as the site for the GSSP.

Other plans concerned with the possible selection, based on biostratigraphic data, of a section defining the base of the Viséan (mid-lower Carboniferous - Project Group 2). Progress by other Project Groups will also be monitored by the Subcommission.

STATEMENT OF INCOME AND EXPENDITURE 1993-94

INCOME	AUS$ Definitive	US$ Estimated
IUGS Grant for 1994	669.07	485.00
Donations from members	398.42	294.83
Bank interest	22.18	16.41
TOTAL INCOME	1,089.67	796.24
EXPENDITURE		
Newsletter 12 publication	542.03	401.10
Newsletter 12 postage	487.00	360.38
Bureau postage & stationery	274.19	202.90
Bank charges	29.55	21.87
TOTAL EXPENDITURE	1,332.77	986.25

Explanatory Note: Definitive income and expenditure are quoted in Australian Dollars. All income and expenditure have been converted at an exchange rate of AUS$1.00=US$0.74

BALANCE SHEET (1994)	AUS$ Definitive	US$ Estimated
Funds carried forward from 1993	268.15	174.29
Exchange rate gain (0.65 to 0.74 US)		34.24
PLUS Income 1993	1,089.67	796.24
LESS Expenditure 1993	(1,332.77)	(986.25)
CREDIT balance forward to 1994	25.05	18.52

BUDGET REQUEST FOR 1994	US$
Newsletter 13 (prep./publ./post)	600.00
Bureau expenses	300.00
XIII Carb. Congress expenses (Kraków)	300.00
XIII Carb. Congress Delegate Support	300.00
PROJECTED EXPENDITURE	1,500.00

The Subcommission has been advised by ICS that it has been allocated US$880.00 in IUGS funding for 1995.

Donations in 1994/95

Publication of this *Newsletter* is made possible with generous donations received from the following members during 1994-95, combined with an IUGS subsidy of US$880.00 in 1995, and additional support from a small group of members who provide internal postal charges for the *Newsletter* within their respective geographic regions.

Dr N.W. Archbold, Australia
Dr J. Carter, USA
Dr W.H. Gillespie, USA
Dr K. Ishizaki, Japan
Dr P. Jones, Australia
Dr J. Kullmann, Germany
Dr M. Legrand-Blain, France
Dr B. Mamet, Canada
Dr G. Playford, Australia
Dr N. Sabattini, Argentina
Dr W.J. Sando, USA
Dr K. Watanabe, Japan
Dr J.A. Waters, USA
Dr G.L. Wilde, USA
Anonymous - Australia (x1)
Anonymous - Japan (x1)
Anonymous - USA (x2)

Mid-Carboniferous Boundary Working Group

H. RICHARD LANE, Amoco Production Co. USA, 550 Westlake Park Blvd, PO Box 3092, Houston Texas 77253 USA.

The Mid-Carboniferous Boundary Working Group was formed in 1984 at the time of the Carboniferous Congress held in Madrid. It was a direct outgrowth of the Biennial Carboniferous Subcommission Meeting held in Leeds in 1981, where a symposium entitled *Biostratigraphic Data for a Mid-Carboniferous Boundary*, organised by W. H. C. Ramsbottom, W. B. Saunders and B. Owens, was held.

That symposium established a group to recommend a paleontologically-based boundary level for the middle of the Carboniferous. H.R. Lane was asked to chair the Committee and the group recommended that the boundary correspond to the appearance of the conodont *Declinognathodus noduliferus*, approximating the *Eumorphoceras/Homoceras* transition. This recommendation was accepted by the Subcommission at the Madrid Congress. H.R. Lane was then asked by the Subcommission to Chair a Working Group on selection of a stratotype at that level. That Working Group (MCBWG) subsequently visited sections in England, USA, China, Ukraine, Uzbekistan and France before coming to a final decision on the Arrow Canyon Section late in 1994. Details of the two previous votes have been published in *Newsletter* 12. Results of the third and final Working Group vote confirming the selection of the Arrow Canyon Section are presented on this page.

Membership of the Working Group included: Dr P. Brenckle, Dr J. Dvorak, Dr B. Engel, Dr R.A. Gastaldo, Dr N. Gibshman, Dr A.C. Higgins, Dr H. Igo, Dr H Richard Lane (Chairman), Dr W. Manger, Dr T. Nemirovskaya, Dr B. Owens, Dr E. Paproth, Dr Marie-France Perret, Dr W.H.C. Ramsbottom, Dr A. Rocha-Campos, Dr Ruan Yi-Ping, Dr B. Skipp, Dr Wang Zhi-Hao, and Dr Yang Jing-Zhi.

I wish to acknowledge the contributions of the Working Group members and all those people who assisted with field inspections and other deliberations of the Working Group.

H. Richard Lane
Chairman MCBWG

BALLOT RESULT

Mid-Carboniferous Boundary Working Group - Third and Final Vote

As a consequence of the need to relocate the exact position of the boundary in the Arrow Canyon Section a short distance to the level of Sample 61B, a third ballot of Working Group members, confirming the earlier decision taken in ballots 1 and 2, was considered to be necessary following the decision of the first two ballots as detailed in the last *Newsletter* (12: 3). This vote (declared on 4 November 1994) confirmed the original decision which was then passed to the Subcommission for its further deliberation and possible ratification.

Alan Higgins
Secretary MCBWG

BALLOT RESULT

Subcommission Vote on the Mid-Carboniferous Boundary

The proposition with supporting documentation that the Arrow Canyon Section should be recognised as the site for the Mid-Carboniferous Boundary was presented to the Voting Membership of the Subcommission in a ballot which closed on 15 February 1995. The result presented below was a strong confirmation of the choice of the Working Group and documentation is now in preparation for the formal ratification of this decision by ICS-IUGS.

Brian Engel
Secretary SCCS

MCB WORKING GROUP MEMBERS			SCCS VOTING MEMBERS		
	YES	NO		YES	NO
Dr Paul L. Brenckle	X		Dr Paul L. Brenckle	X	
Dr J. Dvorak	X		Dr Boris Chuvashov	X	
Dr Brian A. Engel	X		Dr Marina Durante	X	
Dr Robert A. Gastaldo	X		Dr J. Thomas Dutro Jr	X	
Dr N. Gibshman	X		Dr Brian A. Engel		X
Dr Alan C. Higgins		X	Dr Carlos R. Gonzalez	X	
Dr Hisayoshi Igo	-		Dr Guo Hongjun	X	
Dr H. Richard Lane	X		Dr Hisayoshi Igo	X	
Dr Walter L. Manger		X	Dr Robert M. Kosanke	X	
Dr Tamara Nemirovskaya	X		Dr H. Richard Lane	X	
Dr Bernard Owens		X	Dr Jean Pierre Laveine	X	
Dr Eva Paproth		X	Dr Li Xingxue	X	
Dr Marie-France Perret	X		Dr Bernard L. Mamet		X
Dr W.H.C. Ramsbottom		X	Dr Walter L. Manger	X	
Dr A. C. Rocha-Campos	X		Dr Eva Paproth		X
Dr Ruan Yi-Ping	X		Dr W.H.C. Ramsbottom		X
Dr Betty Skipp	X		Dr John Roberts	X	
Dr Wang Zhi-Hao	X		Dr A.C. Rocha-Campos	X	
Dr Yang Jing-Zhi	X		Dr George D. Sevastopulo	X	
			Dr Robert H. Wagner	X	
			Dr Cor F. Winkler Prins	X	
			Dr Yang Shipu	X	
VOTE TOTALS	13	5	VOTE TOTALS	18	4

Working Group on the Middle Pennsylvanian of North America

WALTER L. MANGER, Department of Geology, University of Arkansas, Fayetteville, AR 72701, USA (received 8 July 1994).

The Working Group on the Middle Pennsylvanian of North America continues to be active in its analysis of potential horizons for subdivision and correlation of series and stages both locally and intercontinentally. Current members of the Working Group are: Darwin Boardman (Oklahoma State Univ.), Robert Grayson (Baylor Univ.), John Groves (Amoco Prod. Co.), Philip Heckel (Univ. of Iowa), Thomas W. Henry (US Geol. Survey), Ralph Langenheim (Univ. of Illinois), Walter Manger (Chairman - Univ. of Arkansas), Walter Nassichuk (Geol. Survey of Canada), Russell Peppers (Illinois Geol. Survey), Patrick Sutherland (Univ. of Oklahoma), and Gary Webster (Washington State Univ.).

Progress has been made on two projects involving members of the working group. In July 1990, seven members of the working group - Grayson, Groves, Langenheim, Manger, Nassichuk, Sutherland and Webster) - visited northern Ellesmere Island, Canadian Northwest Territories. There they spent nine days collecting samples for calcareous foraminifers and conodonts from two sections in the Nansen Formation, and a section through the Otto Fiord and lower Hare Fiord. Faunal occurrences were studied to compare that portion of the Arctic succession with coeval assemblages from the North American midcontinent, Russia and the Commonwealth of Independent States, and elsewhere. Analysis of those occurrences has been published as Geological Survey of Canada Bulletin 469 "Middle Carboniferous Fusulinacean Biostratigraphy, Northern Ellesmere Island (Sverdrup Basin, Canadian Arctic Archipelago)" by GROVES, J.R., NASSICHUK, W.W., LIN, R., and PINARD, S. (1994). They report primitive fusulinaceans from the lower few metres of the Nansen Formation suggesting an early Bashkirian (Morrowan) age, succeeded by assemblages representing the later Bashkirian through the early Late Moscovian (early Desmoinesian) Series. The foraminifer assemblages exhibit close affinities to those from elsewhere in the Eurasian-Arctic realm. They provide evidence for the origin of the Fusulininae through splitting of the plectostaffelloid stock in the early Bashkirian. The authors also discuss foraminifer occurrences in the late early Bashkirian (Atokan) Otto Fiord and lower Hare Fiord Formations, although abundance and diversity are limited in those units. The report comprises 55 pages, including five plates, and is available from the Geological Survey of Canada, 601 Booth Street, Ottawa,K1A 0E8 Canada. Conodonts from these Middle Pennsylvanian sections are under study by Bob Grayson and Gary Webster.

In October 1991, five members of the working group - Grayson, Henry, Langenheim, Manger and Sutherland - spent two days sampling three key horizons of value in subdividing and correlating the Middle Pennsylvanian. These are the lowest occurrences of the fusulinaceans *Pseudostaffella, Profusulinella* and *Fusulina*. Of particular interest is the evaluation of *Pseudostaffella* and *Profusulinella* as horizons for placement of the base of the Atokan Series. North American biostratigraphers have used either of those taxa and there is a need to standardise placement of the Morrowan-Atokan boundary, and correlate the foraminifer data with conodont occurrences. The appearance of *Fusulina* has traditionally marked the beginning of the Desmoinesian Series, but there has been little examination of conodont assemblages marking that horizon. Bob Grayson has been studying the conodonts from the Arrow Canyon succession with some of his students at Baylor University. He reported at the Pander Society meeting held in April 1994 that there are marked discrepancies in horizons correlated by conodonts when compared to fusulinacean correlations. For example, the appearance of *Pseudostaffella*, the most commonly used index for the Morrowan-Atokan boundary in North America corresponds to the appearance of conodonts typical of the Upper Morrowan (Brentwood Member, Bloyd Shale), and well below the Morrowan-Atokan boundary in the type region. Unequivocal Atokan conodonts occur as much as 60 cm below the appearance of *Profusulinella* in Arrow Canyon, rendering a definition based on that taxon unsatisfactory in terms of the conodont succession. The appearance of *Fusulina* is consistent with the conodont occurrences, but conodont assemblages through the Middle Pennsylvanian in Arrow Canyon exhibit discontinuous occurrences of index taxa, are frequently impoverished, and facies control is a significant factor in their composition. Analysis of the succession is continuing under Grayson's supervision.

The working group has since held a meeting in conjunction with the annual meeting of the Geological Society of America in Seattle, Washington on 24 October 1994.

ICS VOTING STATUTES

Elections

As we move into the last year of the term of office of the current executive, it is pertinent to remind Subcommission members that ICS has approved a revised edition of the *Statutes of the International Commission on Stratigraphy* and that the following extracts are relevant to the election of the Executive and Voting Members of the Subcommission.

8.1 Terms of Office

The term of office for the Voting Members of the Full Commission, of Subcommissions and their constituent bodies, and of Committees shall be the period between two IGCs, normally four (4) years. The Chairperson, including his/her selected Secretary, and the First Vice Chairperson of ICS and Chairpersons of Subcommissions, including Intersystem Boundary Working Groups, and of Committees shall be reelectable only for one more four-year term after their election for the initial term of office.

Voting Members of Subcommissions, including Intersystem Boundary Working Groups, and of Committees shall be reelectable for two more four-year terms after their election for the initial term of office. At the end of each term one-third (1/3) of the Voting Members shall be replaced by new Voting Members. In case of extraordinary organisational or scientific circumstances, Voting Membership may be extended after approval has been obtained from the ICS Chairperson.

8.4 Nomination of Chairpersons of Subcommissions

Each Subcommission of ICS shall propose to the ICS Chairperson one or two qualified candidates who are willing to serve as Chairperson.

8.5 Election Procedure

In the case of a single candidate, the officers of the ICS Bureau and the Chairpersons of ICS Subcommissions are elected by a sixty per cent (60%) majority and non-responses to ballots shall be counted as approval votes. In the case of more than one candidate, a relative majority will suffice for election.

8.5.2 Chairpersons of ICS Subcommission

Chairpersons of Subcommissions of ICS shall be elected by the Voting Members of the Commission by ballot to be mailed by the ICS Secretary not later than twelve (12) months prior to the next IGC.

8.5.3 Others

Voting Members of Subcommissions and bodies reporting to Subcommissions, including Intersystem Boundary Working Groups and their Chairpersons, and Chairpersons and Voting Members of Committees shall be elected by the Voting Members of the respective bodies at the time of election of Chairpersons of Subcommissions. Voting Members of an Intersystem Boundary Working Group are confirmed by the Chairperson of the Subcommission to which it reports. The election of Voting Members of Subcommissions, including Chairpersons of Intersystem Boundary Working Groups, and of Chairpersons and Voting Members of Committees is subject to the approval of the ICS Chairperson.

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 WordPerfect but contributions on most other word processing systems can be accommodated. Material should be forwarded on either 5.25 inch IBM compatible or 3.5 inch IBM or Macintosh disks. 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 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 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 far greater than the original value of the disk.

AIR MAIL your contribution to the Editor:
Dr B.A. Engel, Department of Geology, University of Newcastle, Newcastle NSW 2308 Australia.

Files can be sent attached to, or included in, an E-mail message on the Internet. 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. The Editor's E-mail address is:

bengel@geology.newcastle.edu.au

PROJECT GROUP REPORTS

PROJECT GROUP 1

PAUL BRENCKLE, Amoco Production Co., PO Box 3092, Houston TX 77253 USA.

Chairman Paul Brenckle advises that there has been no new progress to report. The Group is searching for a section that contains both conodont and foram occurrences, as well as megafossil data, and as yet no mid-Tournaisian section has been found to be suitable for detailed study. In the sections looked at so far, foraminifer and conodont occurrences are generally mutually exclusive. Furthermore, from the standpoint of the Chairman's speciality, no section has been found that shows a clear evolutionary succession for the taxa as suggested for a boundary definition.

A search for possible sections in the Former Soviet Union and/or China has been instituted but to date no suggestions have been forthcoming from specialists working in these regions.

PROJECT GROUP 4: Ammonoid zonation in Upper Namurian and Lower Westphalian successions.

JÜRGEN KULLMANN, Institut für Geologie und Paläontologie, Universität Tübingen, Germany.

Ammonoid zonation of Upper Carboniferous successions allow in practice reliable international correlations between European, American and Uralian sections, although ammonoids are often regarded as "usually too rare and isolated to provide a sound basis for intercontinental subdivisions" (WINKLER PRINS 1990). In a number of the publications listed below, the stratigraphical range and the boundaries of the corresponding zones and their fossil content have been recently reviewed (KULLMANN, NIKOLAEVA, 1993, 1994, 1995, in press). The boundary between the Upper Namurian G1 Zone (Yeadonian, *Bilinguites-Cancelloceras* Genozone) and the beginning of the Westphalian (G2, *Branneroceras-Gastrioceras* Genozone) is defined by the entry of *Gastrioceras subcrenatum*, the oldest species of the genus *Gastrioceras*, occurring in England, Belgium, Netherlands and Germany. In Arkansas (USA), this boundary seems to correspond to the upper boundary of the *Verneuilites pygmaeus* Zone and correlates approximately with the Halian-Bloydian boundary marked by the entry of *Branneroceras branneri*, the oldest species of the family Schistoceratidae. In Central Asia (Uzbekistan) and the Southern Urals, *Branneroceras* and *Gastrioceras* are recorded from a few localities, but the precise position of the ammonoids are not specified. In the Donets Basin, the presence of ammonoids from both upper Namurian and lower Westphalian strata are known, but there is no continuous section spanning the transition from the lower to the upper Bashkirian. The only continuous European section which contains *Bilinguites, Cancelloceras* and possibly *Gastrioceras* is located in Southwest Portugal. A detailed study by D. KORN (Tübingen) of the ammonoid succession is presently being undertaken.

Recent publications:

KORN, D. & KULLMANN, J. 1994. GONIAT Database System, version 2.50; Tübingen.

KULLMANN, J. 1993. A boundary at the base of the *Branneroceras branneri* zone (base of G2: basal Westphalian, basal Bloydian). *Newsletter on Carboniferous Stratigraphy* **11**: 8-9, Newcastle, NSW Australia.

KULLMANN, J. & NIKOLAEVA, S. 1994. Ammonoid biostratigraphy at the base of the Westphalian and the Bloydian. *Newsletter on Carboniferous Stratigraphy* **12**: 4-6, Newcastle, NSW Australia.

KULLMANN, J. & NIKOLAEVA, S. (in press). A review of the Upper Namurian ammonoid biostratigraphy. *Newsletters on Stratigraphy*, Berlin, Stuttgart.

NIKOLAEVA, S. V. 1994. Serpukhovskie i bashkirskie ammonoidei Srednei Azii. *Trudy Paleontol. Inst. Ross. Akad. Nauk*, **259**: 1-143, Moskva. [In Russian: Serpukhovian and Bashkirian ammonoids of Central Asia].

NIKOLAEVA, S. V. 1994. Ammonoid biostratigraphy for the proposed Mid-Carboniferous boundary stratotype, Aksu-River, South Tian-Shan, Central Asia. *Bull. Soc. geol. Belg.* **177**: 265-273, Bruxelles.

NIKOLAEVA, S. V. 1995. Ammonoids from the late Lower and early Upper Carboniferous of Central Asia. *Courier Forschungsinstitut Senckenberg* **179**: 1-106, 75 figs., 9 pls., Frankfurt a.M.

NIKOLAEVA, S. & KULLMANN, J. (in press). The Late Namurian Genus *Cancelloceras* (Carboniferous Ammonoidea) and its distribution. *Paläont. Z.* **69**, Stuttgart.

WINKLER PRINS, C.F. 1990. SCCS Working Group on the subdivision of the Upper Carboniferous s. l. ("Pennsylvanian"): A summary report. *Courier Forsch.-Inst. Senckenberg* **130**: 297-306, Frankfurt.

PROJECT GROUP 5:

ELISA VILLA, Departamento de Geología, Universidad de Oviedo, 33005 Oviedo, Spain.

For the past twelve months, specialists engaged on this project have continued to gather information on the palaeontological characterisation of a stratigraphic boundary in the upper part of the Carboniferous System. Efforts are now concentrated on the study of the conodont and fusulinid content of four sections representing relevant Carboniferous areas of the world: Moscow Basin, Donetz Basin, American Midcontinent and Cantabrian Mountains. Depending on the types of facies present in the respective sections, the study has also focused on other fossil groups such as ammonoids, brachiopods, corals, ostracods, algae, spores, etc.

a) **Domodedovo section (Moscow Basin)**. A large team of Russian specialists headed by DR ALEKSANDR S. ALEKSEEV (Department of Palaeontology, Moscow State University) are currently investigating the palaeontological and sedimentological characteristics of the Domodedovo section. The palaeontological investigation includes studies on conodonts, fusulinids, brachiopods, ammonoids and fish. A preliminary report has been presented to the Project Group, including data related to the most significant events registered in the section.

b) **Kalinovo section (Donets Basin)**. Detailed data about the fusulinid content of this section has already been submitted to the Project Group by DR VLADIMIR I.

DAVYDOV (VSEGEI, St Petersburg) and presented at the Subcommission Meeting held in Liège in 1993 (VILLA *et al.*, 1994). Intense interest shown in the Donets succession promoted an investigation of its conodont content. These studies were undertaken by DR TAMARA NEMIROVSKAYA and are currently in progress.

c) **American Midcontinent.** The American group, coordinated by DR JAMES E. BARRICK (Texas Tech University), DR DARWIN R. BOARDMAN (Oklahoma State University) and DR PHILLIP H. HECKEL (University of Iowa), has submitted to the Project Group a comprehensive report dealing with the biostratigraphy of the Desmoinesian-Missourian transition in the North American Midcontinent. This report includes numerous data about the distribution of conodont, ammonoid and fusulinid species, a discussion concerning the stratigraphic implications derived from these data, and an analysis of the major eustatic cyclothems that can be distinguished in the region.

d) **Las Llacerias section (Cantabrian Mountains).** Preliminary information on the fossil content of this section (conodonts, fusulinids, brachiopods, corals and spores) was presented at the Carboniferous Congress in Buenos Aires (VILLA *et al.*, 1991). Subsequently, studies that have been made include an analysis of the fossil algae and further investigation of the fusulinids and conodonts. The Las Llacerias section can probably provide one of the most complete records of fusulinid lineages within the interval of interest for this Project Group.

Apart from these four areas, the Project Group has also received information from Northern Timan, submitted by DR SVETLANA T. REMIZOVA (Institute of Geology, Komi Scientific Centre, Syktyvkar) and from Spitsbergen, Arctic Norway, submitted by DR VLADIMIR DAVYDOV (VSEGEI, St Petersburg) and DR INGER NILSSON (Saga Petroleum, Harstad, Norway). In her report, DR. REMIZOVA analyses the biostratigraphy of the Carboniferous rocks in Northern Timan and establishes several fusulinid zones which broadly correlate with fusulinid zones established in the Moscow Basin, Samara Bend, NW Spain, southwest Japan and North America. The correlation is established on the basis of previous data published by several authors. With respect to the Spitsbergen (Kolosseum section), the data received from DR DAVYDOV and DR NILSSON deal mainly with the characteristics of the fusulinids located in the boundary beds. They note that the Moscovian/Kasimovian interval is represented by a thick limestone succession which contains many fusulinid-bearing horizons and that it is possible to observe evolutionary changes occurring at this interval in several fusulinid lineages. They also make some interesting comments about wall microstructure, which is of great importance for understanding the characteristics of the fusulinid assemblages at the Moscovian/ Kasimovian transition.

The activities of the Project Group also included several visits and meetings among members of the Group, thus allowing fruitful discussions and a direct exchange of information. In September 1994, DR S. LAZAREV (Palaeontological Institute, RAS, Moscow) visited Oviedo to discuss with DR M. LUISA MARTÍNEZ CHACÓN (University of Oviedo) the characteristics of the brachiopod fauna occurring within the interval embracing the Moscovian/Kasimovian transition. In March 1995, DR TAMARA NEMIROVSKAYA (Institute of Geological Sciences, Ukrainian Academy of Sciences, Kiev) also visited Oviedo, and had the opportunity to examine with DR CARLOS MÉNDEZ (University of Oviedo) the conodont assemblages from the Moscovian/Kasimovian transition in the Cantabrian Mountains. Several meetings have also been arranged in Moscow and St Petersburg with Russian specialists working in different areas. At the same time, the American and Moscow teams have started an active exchange of samples and information that will support a broad consensus of agreement.

Finally, several members of the Group, including myself, will meet in Moscow in June, with the aim of visiting several outcrops exposing the uppermost Moscovian/lowermost Kasimovian rocks in the Moscow Basin and discussing a proposed correlation between the Moscow Basin and the Cantabrian Mountains. The results of this attempt at correlation will be presented at the coming XIII International Congress on the Carboniferous-Permian in Kraków (Poland) in August-September 1995.

References

VILLA, E., GINKEL, A. C. VAN, LEYVA, F., MARTÍNEZ-CHACÓN, M. L., MÉNDEZ, C., RODRÍGUEZ-GONZÁLEZ, R. M., RODRÍGUEZ, S. AND SÁNCHEZ DE POSADA, L. C. 1993. Fossil content of the Moscovian-Kasimovian boundary in a section of the Picos de Europa area (Carboniferous, NW Spain). *XIIe Congrès International de Stratigraphie et de Géologie du Carbonifère et Permien, Buenos Aires 1991, Comptes Rendus*, **2**, 385-406.

VILLA, E., DAVYDOV, V. I., KONOVALOVA, M. V. AND REMIZOVA, S. 1994. Studies on the base of the *Protriticites* Zone: A report on SCCS Project Group 5. *Annales de la Société géologique de Belgique*, **116** (2), 323-331; Liège.

VALE SCCS MEMBERS

Jeanne DOUBINGER (1921 - 1994)

With much sadness we advise the SCCS membership that **Dr Jeanne Doubinger**, a retired Voting Member of the Subcommission, passed away in Strasbourg on 16 July 1994, at the age of 73.

Dr Doubinger was the "Directeur de Recherche" at the "Centre National de la Recherche Scientifique (C.N.R.S.)" and from 1960 to 1986 she was the head of the palynological laboratory at the "Centre de Sédimentologie et Géochimie de la Surface" of the Geological Institute of Strasbourg.

All those who were fortunate enough to know her, either by working at her side or during scientific collaborations and meetings, could appreciate her scientific expertise, her great kindness to others including researchers, students and technicians, and above all her great modesty and discretion.

Originally trained as a palaeobotanist of the Permo-Carboniferous, and then as a palynologist at the school of R. Potonié in Krefeld, she established herself as one of the pioneers in Permo-Carboniferous palynology in France. The many works carried out or guided by her in this field, the knowledge she acquired during her numerous field trips in France and abroad, and the prominent part she played in several scientific organisations (including SCCS), gave her an international audience, not only in palaeobotany and palynology, but also in Permo-Carboniferous stratigraphy.

Convinced that palynological studies provided great potential, Dr. Doubinger extended this field of research into other geological periods, particularly the Triassic in which she became an internationally recognised authority. Microfossils other than spores and pollen grains, such as acritarchs, chitinozoans and dinocysts, were another area of research activity.

It is not possible to list here all Dr Doubinger's works and the resultant expansion of our knowledge of continental and marine microfloras, stratigraphy, palaeoecology, palaeogeography and geology in general. After 50 years devoted to research, her published record is impressive: more than 300 publications, plus many theses which she supervised or in which she participated, and her contributions to many national and international scientific programs. In addition, her dedication has resulted in the training of numerous students who are determined to continue the work of their esteemed patron.

Without doubt, palaeobotany and palynology have lost an eminent researcher who, in spite of her great modesty, contributed through her many works to higher standards and wider participation in her chosen scientific disciplines.

The palynological and palaeobotanical team, Geological Institute of Strasbourg.

Maria Nikolaevna SOLOVIEVA (1920-1994)

Dr. M. N. **Solovieva**, well known Carboniferous stratigrapher and palaeontologist, a wise scientist, a talented poet and high spirited person passed away on 4 December 1994. She was born on 3 July 1920 in the town of Chanchun (China) into a Russian emigrant family. At the end of the 1920s the family returned to Russia.

In 1944, Maria Solovieva graduated from the Geological Faculty of the Middle Asia University (Tashkent, Uzbekistan) and then extended her geological education there as a post-graduate student. Outstanding Central Asia researchers - A.N.Krishtofovich, V.I.Popov, K.N.Wendland- were her teachers.

Until the end of the 1950s she worked as a field geologist for the Geological Survey in different regions all over Central Asia. Her main scientific interests (Upper Palaeozoic stratigraphy, micropalaeontology, palaeogeography) were formed during these years.

In 1959, Maria Nikolaevna Solovieva came to the Micropalaeontological Laboratory of the USSR Academy of Science Geological Institution. There she joined with an extensive working group of stratigraphers, under the leadership of Dr. Rauzer-Chernousova, working out the zonal schemes of the Russian platform and adjacent Upper Palaeozoic areas. The main field of **Dr** Solovieva's investigations within this group was the biostratigraphy of the Middle Carboniferous.

In 1963, she had already proposed foraminiferal zonation of the equatorial belt inside the former USSR. The importance of this research is impossible to overestimate. This zonal sheme has been used for the correlation of Middle Carboniferous deposits all over Eurasia.

In recent decades, Dr Solovieva was especially interested in the problem of the Moscovian stage as an international unit. She found some errors in interpretation of the sections of this stage and founded the new (Tsninsky) horizon inside the Moscovian. As well, the thickness of the Kashirsky and Vereisky horizons has been defined more precisely.

Dr Solovieva was not only a palaeontologist and stratigrapher - the problems of phylogenesis and evolution, the formalisation of geological knowledge, and the history of geology were all of interest to her. She was a very good scientific organiser. As a chief of the former USSR Micropalaeontological Commission, she constantly stimulated professional meetings with wide discussions of current problems. She was a very active member of the Moscow Naturalists Society. Her work in the national and international com-

missions on Carboniferous stratigraphy is well known too.

A high level of professionalism and wide scientific interests attracted many people (especially the young) to Maria Nikolaevna. In her last years she became the informal leader in the field of Carboniferous stratigraphy in the former USSR and she was highly respected for her work internationally.

Dr Solovieva was not only a talented scientist, but a gifted artist as well. She was educated as a professional pianist and singer. All her life she wrote very interesting and original poems. Some of them have now been published and show how talented she was in this respect.

As a deeply religious person she carried out her duties faithfully all through her life. She left active research work five years ago because of her mother's illness. This last duty took all her strength and forty days after her mother's death she suddenly passed away following a cardiac arrest.

Everyone who knew Maria Nikolaevna will remember her with love and admiration. May she rest in peace!

V.Durante, V.S.Gubareva, N.V.Goreva, T.N.Isacova.

Susanna Georgievna GORELOVA (1920-1994)

On 25 May 1994, a tragic accident ended the life of **Susanna Georgievna Gorelova**, a well known phytostratigrapher, palaeobotanist, and investigator of the Upper Palaeozoic coal measures of Siberia.

Susanna Gorelova was born in December 1920 and received her geological education at the University in the city of Tomsk, the oldest cultural and scientific centre of Siberia. The most famous Siberian researchers, Drs A. V. Ananiev, V. A. Khakhlov, and L. L. Khalfin were her teachers in palaeobotany and stratigraphy. The greater part of her life was devoted to palaeobotanical and phytostratigraphical investigation of Kuzbass, the major Upper Palaeozoic coal basin of Siberia. The result of Dr Gorelova's eighteen years of investigations was the creation of a detailed stratigraphical scheme for the Upper Palaeozoic of the Kuznetsk Basin. It is difficult to overestimate the importance of this scheme for geological investigations of the basin.

Dr Gorelova was an organiser of the palaeontological department of the USSR Geological Survey West-Siberian Branch. Marine and non-marine fauna, land plants, and miospores of the Kuznetsk Basin and adjacent areas have been studied there. It was one of the first regional palaeontological departments of the USSR Geological Survey and it played a major role in the geological study of Middle Siberia. Dr Gorelova was the chief of this department from 1948 till 1966. Later, coming to the Geological Survey Siberian Institute of Geology, Geophysics and Mineral Resources, Dr Gorelova began to study the Upper Palaeozoic plant-bearing deposits of Gorlovka, Tunguska, and Minusinsk Coal Basins and spread the Kuznetsk Basin phytostratigraphical scheme all over Middle Siberia.

In her last years, she began to study fossil plants from marine and coastal Upper Palaeozoic deposits of the Verkhoyanie Ridge (northeast of Russia) and has produced very interesting results dealing with the correlation of Boreal marine faunas and Angara plant assemblages. This data enabled an age determination of some Kuznetsk Basin plant-bearing units. Unfortunately, the description of the Upper Palaeozoic Verkhoyanie flora is incomplete because of Dr Gorelova's tragic death. Her colleagues feel an obligation to honour her by finishing this very important study.

During the whole of her life Susanna Georgievna was full of energy. In spite of the large volume of research and administrative work, she maintained her home in immaculate order and she educated two fine daughters.

Dr Gorelova's death is a great loss not only for her family but for the modern generation of palaeobotanists in the former USSR. Her memory will be kept in our hearts forever.

M. V. Durante, A. V. Gomankov, M. A. Akhemtiev, S. K. Batyaeva, O. A. Betekhtina, I. A. Budnikov, I. A. Ignatiev.

NEWS ITEMS FROM MEMBERS

Bill Sando

BILL SANDO has advised that he retired as of 1 October 1993 after 40 years service to USGS. He will be continuing his work on Carboniferous biostratigraphy as Geologist Emeritus, USGS and Research Associate of the National Museum of Natural History (Smithsonian). Bill retains an office in USGS (address unchanged) and is currently working part-time compiling databases on Late Palaeozoic coral genera and statistics on coral research.

Sue Turner

Dr SUE TURNER reports that the joint meeting and workshop in July 1994 of the *Subcommission on Devonian Stratigraphy* and *ICCP 328 (Palaeozoic Microvertebrates)* held in Moscow was most successful. Some of the contributions were relevant to the Carboniferous, especially the Early Carboniferous and the Devonian/Carboniferous boundary. Work is also under way on fish material from the Moscovian/basal Kasimovian of the Moscow region - participants were able to collect material on the associated field excursion. (Papers from this workshop will be available soon as *Special Publication no.1 of Ichthyolith Issues* - see contents below). Drs OLEG LEBEDEV and SASHA IVANOV are undertaking this research in Russia and attended the *EDE-94 Dinantian meeting* in Dublin (both have papers in press with the symposium volume).

Series	Stage	Regional Stages or Substages	Formation
UPPER	KASIMOVIAN	Yauzian	Troshkovo Fm
			Izmaylovo Fm
		Dorogomilovian	Meshcherino Fm
			Perkhurovo Fm
		Khamovnikian	Neverovo Fm
			Ratmirovo Fm
		Krevyakian	Voskresensk Fm
			Suvorovo Fm
MIDDLE	MOSCOVIAN	Myachkovian	Peski Fm
			Novlinskoye Fm
		Podolskian	Shchurovo Fm
			Ulitino Fm
			Vaskino Fm
		Kashirian	Lopasnya Fm
			Nara Fm
		Tsnian	Polustova Gora Fm
		Vereian	Ordynka Fm
			Alyutovo Fm

TABLE 1: Stratigraphic Nomenclature of the Moscow Region Carboniferous (Moscovian and Kasimovian Stages)

(Source: A.S. Alekseyev 1994. Moscovian and basal Kasimovian (Middle and Upper Carboniferous) of the Moscow Basin - Field Excursion Guidebook. Published in the Palaeontological Institute of RAS, 9 pp., 1 pl.)

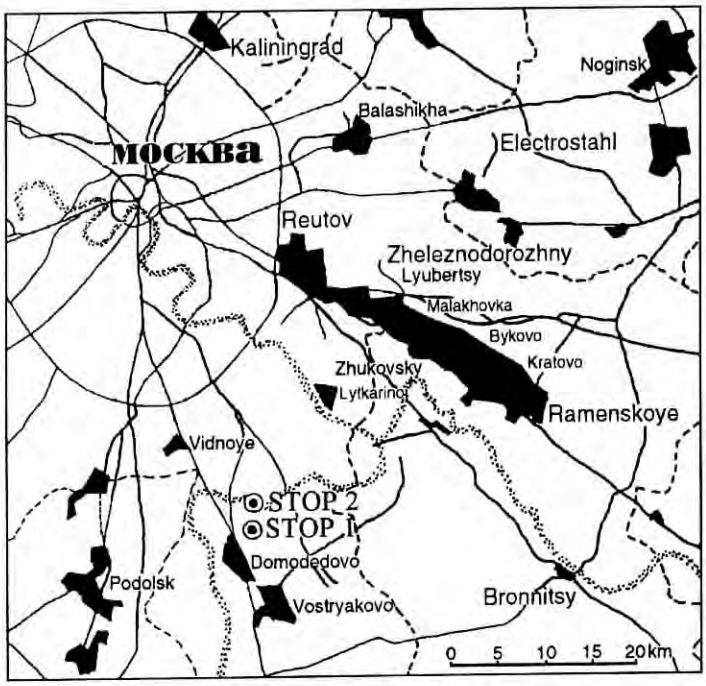


Figure 1: The Moscow Basin Field Excursion Map

(Source: A.S. Alekseyev 1994. Moscovian and basal Kasimovian (Middle and Upper Carboniferous) of the Moscow Basin - Field Excursion Guidebook.

ROMA MERTINIENE of Lithuania is also researching the Early Carboniferous fishes, as is Dr D. ESIN of Moscow State University.

As of August 1994, OLEG LEBEDEV had the Abstracts Volume for the 1994 Moscow Symposium, *Devonian Eustatic Changes of the World Ocean Level, Moscow and Ukhta*, (DECWOL) and *Field Guide for the Moscovian and Basal Kasimovian (Middle and Upper Carboniferous)* of the Moscow Basin for sale at US$10; Oleg can be contacted at the Palaeontological Institute in Moscow (R.A.S.), Profsoyuznaya 123, 177868 Moscow, Russia if you wish to check if copies are still available. A stratigraphic nomenclature table and locality map from the Field Guide are reproduced on this page. (Ed: By courtesy of Sue Turner, the Editor has a photocopy of the contents of the above abstract volume. Interested SCCS members can contact either of us for a copy of the list).

While in Goettingen, Sue caught up with JOERG SCHNEIDER (Freiberg U.) and OLIVER HAMPE (Mainz U.), both of whom are investigating the stratigraphical uses of xenacanth teeth in Late Carboniferous - Permian. Oliver has new "Namurian" articulated xenacanth remains from Germany and both workers are interested in

the Australian xenacanth - one of the youngest from the Mid Triassic, but are finding isolated teeth now in the Carboniferous as well. It is hoped that this work may result in a good xenacanth zonation in the future.

Ichthyolith Issues

DR SUE TURNER, C/- Queensland Museum, PO Box 3300, South Brisbane, Qld 4101, Australia.

ICHTHYOLITH ISSUES (December 1994, No.14, 65 pp.; May 1995, No. 15, 50pp.) These recent issues of the IGCP 328 Newsletter details the more recent activities of the members of this very active group. Rather than try to extract material relevant to the Carboniferous, it would be appropritate for SCCS members to subscribe to this very useful publication. The annual subscription (usually for two issues) is AUS$20 and back issues are AUS$5 each. Send your contribution to Dr Susan Turner, C/- Queensland Museum, PO Box 3300, South Brisbane, Qld 4101, Australia. Make your bank draft or cheque payable to "Queensland Museum (Microvertebrate Account)" or send credit card details (VISA, MASTERCARD, BANKCARD only). Please note the Final meeting of IGCP 328 will be held in Paris at the Museum National d'Histoire Naturelle on September 4-8 with a field meeting looking at the Devonian and D/C of North France and Belgium from 9-15 September. Sue can be contacted by **Fax** (+61 73840 1918); **E-mail** <s.turner@mailbox.uq.oz.au> for any further details.

Ichthyolith Issues IGCP 328 Special Publication No. 1

Edited by S. Turner : Published by J. Zidek Serv, Socorro, New Mexico.

CONTENTS

TURNER, S. & BLIECK, A. Introduction - IGCP 328 State of Play; Cambrian; Ordovician; Silurian; Devonian; Carboniferous; Permian.

BLIECK, A. *et al.* The state of IGCP 328 Devonian research.

GINTER, M. & IVANOV, A.O. New Late Devonian species of *Phoebodus*.

GINTER, M. Ichthyoliths and Late Devonian events in Poland and Germany.

IVANOV, A.O. Ichthyofauna of the South Timan sections.

KRUPINA, N.I. Comparison of the larval dentition developmental patterns in Devonian and recent dipnoans.

TALIMAA, V.N. Vertebrate complexes in the heterofacial Lower Devonian deposits of Timan-Pechora province.

TURNER, S. Defining microvertebrate faunal assemblages or zones for eastern Gondwana.

VALIUKEVICIUS, J., TALIMAA, V. & KRUCHEK, S. Complexes of microremains of vertebrates and correlation of terrigenous Devonian deposits of Belarus' and adjacent territories.

VOROBYEVA, E. & PANTELEYEV, N. Histological and SEM studies of *Laccognathus* scales.

YOUNG, V.T. Micro-remains of some Early and Middle Devonian acanthodian fishes and their stratigraphic possibilities.

IGCP 328 DECWOL abstracts by:

BULANOV & ESIN

ESIN, PETUKHOVA & LEBEDEV

IVANOV

KOLESNIK & IVANOV

LUKSEVICS

MERTENIENE

TURNER & YOUNG

WANG J-Q ET AL.

For your copy of *Ichthyolith Issues Special Publication no. 1* (ISSN 1032-1314), place your order (US$20 + p.p.) with Dr S. Turner, c/- Queensland Museum, P.O. Box. 3300, S. Brisbane, Qld 4101, Australia.
Fax: +61 7 3840 1918; **E-mail:** <s.turner@mailbox.uq.oz.au>.

Committee for Quantitative Stratigraphy Newsletter No. 6, January 1995

The Committee for Quantitative Stratigraphy (CQS) was founded in 1985. The current executive (DR FRITS AGTERBERG, Chairman; DR WALTHER SCHWARZACHER, Vice-Chairman; DR ZHOU DI, Secretary) was elected in 1994. CQS is a Committee of ICS and maintains close ties with the International Association of Mathematical Geologists (IAMG).

The functions of QCS are: (a) to co-ordinate international co-operation in research and development of quantitative methods for the construction of stratigraphic scales and their use in correlation between geological sections; and (b) to provide advice on the application of these methods to members of ICS Subcommissions. Quantitative Stratigraphy will be a topic on the program of the 30th International Geological Congress in Beijing (August 1996).

Newsletter No. 6 contains the following articles on:

- GRADSTEIN. What is a biostratigraphic workstation?
- SCHWARZACHER. Cyclostratigraphy and Chaos.
- ZHOU DI. Quantitative Stratigraphic Studies in China.
- TIPPER. Quantitative Sequence Stratigraphy.
- Mesozoic Time Scale.
- HARFF. What is IAMG?
- BONHAM-CARTER Update on *Computers & Geosciences*.
- Reports on The Quantitative Stratigraphy Issue of the *Journal of Mathematical Geology*, 23rd Geochautauqua on Basin Analysis and the SEPM Research Conference on Graphic Correlation.

SCCS members with an interest in Quantitative Stratigraphy may wish to apply for Corresponding Membership to DR F.P. AGTERBERG, Geological Survey of Canada, 601 Booth Street, Ottawa K1A 0E8, Canada.
Phone +1-613-9962374;
Fax +1-613-9963726; **E-mail:** <agterberg@gsc.emr.ca>

Discovery of Levipustula fauna in Antarctica

J.M. DICKINS, Australian Geological Survey Organisation, PO Box 378, Canberra ACT 2601 AUSTRALIA.

The fauna is from three localities in the Mount King area of Alexander Island, collected with the aid of a helicopter by the British Antarctic Survey during the 1992-1993 season. The rocks are mainly mudstone and were previously considered to be of Jurassic age because of the associated shelly fauna. Carboniferous to Permian spores had been previously recognised from the area but not confirmed by later work. SIMON KELLY who took part in the helicopter collecting exercise suspected a Palaeozoic age and referred them to relevant specialists for identification.

A paper is being prepared for publication in the Journal of the Geological Society of London - S.R.A. KELLY & P.A. DOUBLEDAY (geology); C.H. BRUNTON (brachiopods); J.M. DICKINS (bivalves, gastropods), G.D. SEVASTOPULO

(crinoids); and P. TAYLOR (bryozoans). The fauna shows fairly clear relationships with the Namurian to ?Westphalian faunas known so far only from eastern Australia (New South Wales & Queensland) and South America (western Argentina).

Centenary of Dagmara Maximilianovna Rauzer-Chernousova

Congratulations to the outstanding micropalaeontologist Professor Dr DAGMARA MAXIMILIANOVNA RAUZER-CHERNOUSOVA on the occasion of her centenary on 19 March 1995. In 1918, she commenced her palaeontological career by graduating from a "Higher Courses for Women" (Sanct-Peterbourg) with the specialisation of "Geology".

At the beginning of the 1930s, D.M.RAUZER-CHERNOUSOVA moved to Moscow, began the study of Palaeozoic foraminifera, and soon established for herself a world-wide reputation in this field. At that time, few scientists believed in the stratigraphic importance of this group but shortly before the Second World War she produced a zonal scheme for the Carboniferous-Permian sequence exposed in the Volga-Ural region. She is a great theorist of palaeobiology and systematics of Upper Palaeozoic foraminifera and was an editor and one of the authors of the volume *Protozoa* of the *Principles of Palaeontology*. Moreover, she extended her interests to the study of calcareous algae and presented new data on algae facial distribution and their significance for detailed sequence subdivisions and large-scale correlations.

PROF. RAUZER-CHERNOUSOVA was the primary founder of the Laboratory of Micropalaeontology in the Geological Institute of the Russian Academy of Sciences and held the position as its head for a long time. For many years she was a leader of the Micropalaeontology Committee and the primary editor of the first thirty volumes of *Questions of Micropalaeontology*.

She is gifted not only with scientific intuition but also with enthusiasm and organising talent and is very responsive to the needs of others by being very generous with her time.

D.M.RAUZER-CHERNOUSOVA continues on with her scientific activity. In 1993, the first volume of *Reference of Palaeozoic Foraminifera* was published for which she was both editor and co-author. This year, the second volume will be published. We congratulate our dear teacher and colleague on the achievement of this grand age and wish her good health and fortune.

E.A.Reitlinger, K.I.Kuznetsova, N.G.Muzylov, T.N.Isakova, Laboratory of Micropalaeontology of the Geological Institute of the Russian Academy of Sciences.

Jiří Kalvoda

Dr Jiří Kalvoda, Dept. Geol. Paleont., Kotlárská 2, 61137 Brno, CZECH REPUBLIC.

Jiří reports that he is concentrating on the study of Lower Carboniferous biostratigraphy (conodonts, foraminifers, events) especially with respect to the horizons of possible new Lower Carboniferous subdivisions. Further research includes the biostratigraphic dating of the Culm facies in the Czech Republic both directly (limestone and calcareous sandstone intercalations) and indirectly (limestone pebbles in conglomerates).

Carboniferous Palynostratigraphy of Northern Tarim Basin, Xinjiang, China

GAO LIANDA, Institute of Geology, Chinese Academy of Geological Sciences, Beijing, HE ZHOUSHEN & DONGKAILIN, Northwest Petroleum Bureau, Ministry of Geology and Mineral Resources, P. R CHINA.

Diverse and well preserved palynofloras occur in cores of the Tarim Basin, Xinjiang, China. Acritarchs and scolecodonts occur infrequently but miospores are abundant, being represented by 74 genera with 231 species and varieties, including one new genus and nine new species.

The Carboniferous deposits in the Northern Tarim Basin rest with either angular unconformity or disconformity on a variety of Ordovician rock units. They are made up of greyish, dark shale and sandstone, intercalated with limestones with a total thickness of 800-1300 m. These Carboniferous deposits are generally unconformably overlain by Triassic deposits and are very rich in oil and gas accumulation.

As a result of extensive research on spore assemblages from the cores of the Tarim Basin, the sequence has been subdivided into nine spore assemblage zones, with eight zones in the Lower Carboniferous and one in the Upper Carboniferous, as listed below in order from oldest to youngest.

1. Vallatisporites verrucosus - Retusotriletes incohatus (VI) zone

This zone is confined to horizons corresponding to the lower part of the Lower Carboniferous in the Tarim Basin. The miospore zones assigned to the V1 zone are characterised by representatives of the following association: *Cymbosporites magnificus* (McGregor) McGregor & Camfield, *Diaphanospora depressa* (Balme & Hassel) Evans, *Punctatisporites irrasus* Hacq, *Hymenozonotriletes explanatus* (Lub.) Kedo, *Rugospora polyptycha* Neves & Ioannides, *Verrucosisporites nitidus* (Naumova) Play., *Grandispora notonsis* Play., *G. echinata* Hacq., *Tumulispora varireticulata* (Lub.) Potonié, *Auroraspora macra* Sullivan, and *Knoxisporites literatus* (Walta) Play. This zone is equivalent to the VI zone of Ireland (HIGGS ET AL. 1988).

2. Kraeselisporites hibernicus - Umbonatisporites distinctus (HD) zone

The base of the HD zone is marked by the first appearance of *Kraeselisporites hibernicus* Higgs, and *Umbonatisporites distinctus* Clayton, the more consistent appearance of *Rugospora polyptycha*, *Auroraspora macra*, *A. trilobata* Gao, *Grandispora echinata*, *Discernisporites micromanifestus* (Hacq.) Sabry & Neves, *Corbulispora cancellata* (Waltz) Bharad. & Venk., *C. similis* (Kedo) Gao, and *Fastispora proelegans* (Kedo) Gao. This zone may be generally correlated with the HD zone proposed by HIGGS ET AL. (1988).

3. Spelaeotriletes balteatus - Rugospora polyptycha (BP) zone

The base of this zone is marked by the appearance of *Spelaeotriletes balteatus* Higgs, *S. obtusus* Higgs, *S. resolatus* Higgs, *Baculatisporites fasticulus* Neves & Ioannides, *Colatisporites denticulatus* Neves & Ioannides, which permits an assignment to the BP zone of HIGGS ET AL. (1988).

4. Spelaeotriletes pretiosus - Raistrickia clavita (PC) zone

Assemblages from the PC zone contain several species which persist from the preceding HD and BP zones, but are distinguished by the presence of *Spelaeotriletes pretiosus* (Play.) Neves & Belt, *Raistrickia clavita* (Hacq.) Play., *R. corynages* Sullivan, *Dictyotriletes trivilis* Naumova in Kedo, *Exallospora cornata* Play., *Colatisporites decorus* (Bharad. & Venk.) Williams, *Velamisporites rugosus* Bharad. & Venk., and *Granulatisporites frustulentus* Play., indicating that this zone should be assigned to the PC zone of HIGGS ET AL. (1988).

5. Schopfites claviger - Auroraspora macra (CM) zone

The lower limit of the CM zone is marked by the appearance of the species *Schopfites claviger* Sullivan. Other taxa which typically occur in assemblages from this zone include: *Crassispora trychera* Neves & Ioannides, *Vallatisporites ciliaris* (Lub.) Sullivan, *Velamisporites rugosus* and *Fastispora minuta* Gao.

miospore zones can be correlated with those of China, Western Europe and North America

This zone contains rich and low diversity acritarchs, sphaeromorph acritarchs; in particular laevigate, thin walled, *Leiosphaeridia* are abundant and *Micrhystridium* and *Gorgonisphaeridium* are common. Other genera are rare, and not represented in great numbers. This zone is assigned to the CM zone of CLAYTON ET AL. (1977).

6. Lycospora pusilla (PU) zone

The assemblage represents a new stage of development consisting of spores of many genera and species. The lower limit of this zone is marked by the biozone of *Lycospora pusilla* (Ibrahim) Somers which also coincides with the base of the biozone of the genus *Lycospora*. Other species which appear at the base of the zone include *Lycospora noctuina* Butt. & Williams, *L. rotunda* (Bharad.) Somers, *L. subtriquata* (Lub.) Pot. & Kr., *Densosporites anulatus* (Loose) Smith & Butt., *Crassis-*

pora maculosa Sullivan, *Convolutispora venusta* H.S.& M., *Murospora intortus* (Waltz) Play., suggesting an early Viséan age.

7. Raistrickia nigra - Schulzospora campyloptera (NC) zone

In general characteristics, it is similar to the PU zone, but richer in genera and species than the latter. The assemblages assigned to the NC zone are characteristically dominated by *Lycospora* which often constitutes up to 15-20% or more of the assemblage. Other taxa which typically occur in assemblages from this zone include: *Remysporites magnificus* (Horst) Butt. & Williams, *R. stigmacus* Gao, *Anapiculatisporites minor* Butt. & Williams, *Waltzispora planingulata* Sullivan, *Ahrensisporites guerickei* (Horst) Pot. & Kr., *A. duplicata* Neville, *Orbispores convoluta*, *Tricidarisporites* sp., *Knoxisporites seniradiatus* H.S. & M., *K. stephanophus Love*, *Triquitrites trifurgidus* Neves, *Alatisporites* sp., *?Rotaspora* sp., *Densosporites lobatus* Kos., and *Gansusispora mammilla* Gao. The base of this zone coincides with the appearance of the first monosaccate *Florinites* and *Potonieisporites*. It is therefore considered to be of middle to late Viséan age.

8. Bellispores nitidus - Grandispora spinosa (NS) zone

Assemblages from the NS zone are characterised by containing many of the taxa (forms) present in the underlying NC zone i.e. *Anapiculatisporites minor*, *Ahrensisporites guerickei*, *Knoxisporites stephanophus*, and *Gansusispora mammilla*. The chief species of this zone include *Pustulatisporites pustatus* (Knox) Pot.& Kr., *Pilosisporites venustus* Sullivan & Marshall, *Ibrahimisporites brevispinosus* Neves, *I. magnificus* Neves, *Raistrickia fibrata* (Loose) S.W.& B., *Convolutispora baricosa* H.S.& M., *Dictyotriletes densoreticulatus* Peppers, *Foveosporites incertus* (Andr.) Gao, *Didicites micrornatus* (Kedo) Van Veen, *Knoxisporites probelos* Utting, and *Cirratriradites rarus* (Ibrahim) S.W. & B.. This zone is therefore considered to be of early Namurian (Namurian A) age.

9. Proprisporites lavigatus - Grumosisporites varireticulatus (LV) zone

This zone is the youngest of the Carboniferous in the Northern Tarim Basin. This formation is generally unconformably overlain by Triassic deposits. Accessory species in this assemblage include *Punctatisporites sinutus* (Artuz) Neves, *Raistrickia crinita* Peppers, *R. irregularis* Kos., *Microreticulatisporites nobilis* (Wicher) Knox, *M. lunotus* Knox, *Reticulatisporites pseudomuricatus* Peppers, *R. reticulatus* (Ibrahim) Ibrahim, *Grumosisporites reticulatus* Gao, *Secarisporites remotus* Neves, *Tantillus triquetrus* Felix & Burbrigade, *Densosporites glandulosus* Kos., *Schopfites dimorphus* Kos., *Trinidulus diamphidies* Felix & Paden, *Schopfipollenites ellipsoides* (Ibrahim) Pot. & Kr., *Potonieisporites novicus* Bharad., and *Florinites antiauus* S.W. & B. It is considered to be Namurian B-C age. The above miospore zones can be correlated with those of China (Jingyuan, Gansu), Western Europe and North America.

Carboniferous Sediments in Sinai and Adjacent Eastern Desert, Egypt

M. M. KHOLIEF, Egyptian Petroleum Research Institute, Nasr City, 7th Region, Cairo, Egypt.

There has been an expansion of investigations into Carboniferous sediments in Egypt. Intensive recent studies have been undertaken by research groups from the universities and other Egyptian geological organisations including:

1. The group from El_Mansoura University, headed by Dr M. Kora, is interested mainly in the stratigraphic zonation of the Carboniferous sequence.

2. A recently organised group from the Suez Canal University, headed by Dr F. El-Fawal, is carrying out sedimentological and facies analysis of selected Carboniferous outcrops.

3. Tanta University and Dr Kholief have commenced a joint research project on the sedimentology of the late Palaeozoic sequence from west-central Sinai.

4. A group from the Nuclear Material Authority, headed by Dr N. El-Hazek, is looking at the mineralisation and geochemistry of enriched Cu-U mineral deposits.

Besides all this activity the Egyptian Geological Survey, headed by geologist G. Naim, has proposed a detailed field study project within the present research program of the Survey.

CZECH - US Workshop on Carboniferous Paleobotany

RICHARD LEARY, Illinois State Museum, Research & Collections Center, 1920 South 101/2 Street,Springfield, Illinois 62703, US.

A CZECH - US Paleobotany Workshop was held at the Illinois State Museum's Research and Collections Center, 4-11 October 1994. Funded by the National Science Foundation and organized by DR RICHARD LEARY (Curator of Paleobotany), the workshop was arranged in cooperation with the Czech Geological Survey.

The workshop was attended by ZBYNEK SIMUNEK (Co-PI) and JANA DRABKOVA (both of the Czech Geological Survey), EVA PURKYNOVA (Silesian Museum, Ostrava, C.R.), ROBERT GASTALDO (Auburn University), HERMANN PFEFFERKORN (University of Pennsylvania), TOM PHILLIPS (University of Illinois), ANNE RAYMOND (Texas A&M University), MARY LOUIS TRIVETT (Ohio University), JULIE CARLTON (student, University of Pennsylvania), and ERWIN ZODROW (University

College of Cape Breton, Nova Scotia, Canada).

The Czech visitors presented papers on fossil assemblages from Czech coal basins and detailed work on specific fossil plant taxa. US paleobotanists dealt with modern environments of deposition, paleoclimates, paleoecology, and fossil plant distribution. In each case, the workshop participants gained a knowledge of current research conducted by colleagues and the potential for future joint studies.

Taking advantage of the presence of Czech paleobotanists who were familiar with the thinking of the late Czech paleobotanist VACLAV HAVLENA, relating to the terms *Floznah* and *Flozfern*, the group was able to probe the original interpretation of these terms. Other participants, notably PFEFFERKORN and GASTALDO, familiar with current Carboniferous stratigraphy, older, traditional interpretations, and modern environments of deposition, were able to combine this knowledge, enabling the fitting of these terms into contemporary ideas of biostratigraphy.

Czech - USA Paleobotanical collaboration

While in Illinois, the Czech scientists conducted field studies with LEARY in Rock Island County and visited the Field Museum of Natural History in Chicago where PETER CRANE and PATRICK HERENDEEN were their hosts.

One goal of the meeting was to develop future cooperative research projects. The State Museum anticipates continued cooperation with paleobotanists in the Czech Republic, including exchanges of specimens.

The workshop was very successful, with participants examining the extensive collections of Upper Carboniferous plant fossils at the Museum's Research and Collections Center. Many plant fossils in the coal basins of the Czech Republic are similar to those of Illinois and detailed examination of the collections allowed participants to note significant, though often subtle, differences between fossil plants from the Illinois and Czech coal basins. Variation in the stratigraphic range of some species from the two regions was also noted. Such differences and similarities provide clues to the evolution and migration of ancient plants and environments.

Devonian olistoliths in Lower Carboniferous flysch of central south Karavanke

A new concept of the geological structure in the Jezersko area of south Karavanke (Seeberg-Aufbruch), Slovenian part

A. RAMOVŠ, Katedra za geologijo in paleontologijo, Aškerčeva 2, SLO-61000 Ljubljana, Slovenija.

On the geological map sheet Eisenkappel and Kanker (TELLER 1898), the Silurian and Devonian northeasterly striking belts are distinctly delineated as: (1) banded limestone with the *Cardiola interrupta* horizon, (2) a zone of banded limestone and reef limestone, and (3) a coral reef limestone. These belts have served as the basis for reconstruction of the depositional environment in the "Seeberg-Aufbruch" area of the central Karavanke. According to HERITSCH-KUHN (1951, p.290), the "Seeberg-Aufbruch" represents a large anticline with repeatedly occurring belts of Silurian and Devonian limestone and Hochwipfel Carboniferous. This is the overthrust structure.

TESSENSOHN (1974, p.121-122) established in the Jezerski vrh /Seeberg/ area, an overthrust structure consisting of two tectonic units: the upper Storžič nappe (Storzic-Decke) and the lower nappe of banded limestone (Banderkalk-Decke).

ROLSEN & TESSENSOHN (1974) considered three tectonic units: the reef-limestone unit, banded-limestone unit and basal unit (Riffkalk-, Banderkalk-, and Basis-Einheit). The nappes form a large anticlinal structure that passes northwards into a steep overthrust structure (p. 32, fig. 2).

According to BUSER (1980, p. 38), the Devonian, Lower Carboniferous and Upper Carboniferous beds between Jezersko, Stegovnik and Pečovnik form a large anticline that represents the continuation of the Jezerski vrh anticline.

New stratigraphic investigations

During detailed stratigraphic investigations on the southern side of the Karavanke (Slovenian part), the following Devonian stratigraphic units were distinguished: (1) Black, platy and bedded *Orthoceras* limestone with numerous conodonts and echinoderm remains. Lochkovian. (2) Flesh-red and reddish limestones. Pragian. (3) Bedded and poorly-bedded grey limestones, in places of banded structure. Poorly-bedded grey limestones with brown and pink marl coatings of silky lustre. They contain styliolines and frequent conodonts which establish a Lower Emsian age. The most extended allochthonous Devonian unit is represented by reef limestones of Virnikov Grintavec, Klešne peči and Stegovnik, and smaller cliffs lie dispersed among the Lower Carboniferous flysch beds. The reef organisms are principally tabulate and rugose corals and Stromatoporoidea. Of frequent occurrence are crinoid remains and typical fore-reef crinoid breccia. The author attributes these beds to Upper Emsian, but accepts the possibility of the continuation of reef sedimentation in the upper part into the Middle Devonian. To the Upper Devonian belong small isolated blocks of dark grey, fine grained, massive and poorly-bedded limestone with conodonts of the genus *Palmatolepsis* which demonstrate that the lower part is of Upper Devonian age.

All mentioned Devonian members do not occur in continuous belts but in haphazardly distributed large isolated blocks, in Virnikov Grintavec almost of mountain size, lying on the Lower Carboniferous shale and greywacke-flysch succession.

The occurrence of conformable Lower Carboniferous limestones with conodonts *Gnathodus* and *Lochriea* is important, as well as "porphyroides" in the Lower Carboniferous flysch, with predominating shales and greywackes. Observed were Lower Carboniferous olistostromes with olistoliths of Middle and Upper Devonian and Lower Carboniferous limestones.

A new concept of geological structure in the Jezerko area of southern Karavanke (Slovenian part)

After having solved the chronostratigraphic problems and establishing the position of individual Lower, Middle and Upper Devonian extensive units and smaller blocks among the Lower Carboniferous flysch beds, the author elaborated a new concept of the "Seeberg-Aufbruch" structure in its South Karavanke (Slovenian) part.

The mostly smaller, variously aged limestone blocks of several deeper marine Devonian sedimentary rocks and large block units of coral-stromatoporoid reef limestone and accompanying rocks (mountains of Virnikov Grintavec, Stegovnik, etc.) lie in the intensely dislocated flysch Lower Carboniferous beds. All Devonian remains are olistoliths.

At the northern margin of the (probably) flysch sedimentation basin in the Lower Carboniferous tectonic disintegration of the mighty Devonian sequence took place. Large block units and smaller blocks of various limestones slid into the Lower Carboniferous basin. Olistoliths lie in disorderly fashion on tectonically dislocated Lower Carboniferous flysch deposits, and they do not form regular belts of beds of distinct ages, as drawn by TELLER (1898) and adopted after him by other researchers. The age of these events was Namurian, (*nodosa* Zone), Lower Carboniferous.

References

BUSER, S. 1980. Tolmač lista Celovec (Klagenfurt). *Osnovna geološka karta SFRJ 1:100,000, Zvezni geološki zavod Beograd*, 62 p.; Beograd.

RAMOVS, A. 1994. Die Devon-Vorkommen des "Seeberg-Aufbruchs" in den Sudkarawanken, slowenischer Teil, sind Olistolithe. *Rudar. Metal. Zbornik*, **41**: 153-160.

ROLSEN, J. & TESSENSOHN, E. 1974. Alpidische Tektonik im Varistikum der Karawanken und ihre Beziehung zum Periadriatischen Lineament. *Geol. Jb. A.* **25**: 23-53; Hannover.

TELLER, F. 1898. Geologische Spezialkarte der Österr.-Ungar. Monarchie 1:75,000, Blatt Eisenkappel und Kanker. *Geol. Reichsanst*; Wien.

TESSENSOHN, F. 1974. Zur Fazies paläozoischer Kalke in den Karawanken (Karawankenkalke II). *Verh. Geol. Bundesanst. Jg. 1974*, 89-124; Wien.

Devonian-Carboniferous boundary position in continental successions of Angaraland

LIDIA N. PETERSON Krasnoyarsk geolsyomka, ul. Beresina 3, Krasnoyarsk, 660020 Russia and **VLADIMIR T. ZORIN**, Research & Production firm "ZeNS", Prospect Marksa 62, Krasnoyarsk, 660049 Russia.

The position of the Devonian-Carboniferous boundary within continental successions of Angaraland is conjectural. The most complete, representative section of nonmarine Upper Devonian and Lower Carboniferous of Angaraland is situated in the south of Middle Siberia in the Minussinsk Trough where Upper Devonian deposits are exposed as a thick series of red beds of Frasnian-Famennian age, overlain by a sedimentary-pyroclastic complex, the lower part of which is defined as the Bystryanskaya suite (Series). The most notable feature of the latter is its mixed Devonian-Carboniferous assemblage of flora and fauna. The age of the series is uncertain with the Devonian-Carboniferous boundary being placed at the base, top, or within the series by different researchers.

New data obtained by the authors in recent years, on the stratigraphy and flora of the Bystryanskaya Series and the overlying deposits, permit a reconsideration of this problem. The series has been studied in greatest detail in the northern part of the Minussinsk Trough where up to six subdivisions (fig. 1) are recognised. Rich deposits of flora and fish remains are found within the series. On lithological grounds, the Bystryanskaya Series is very closely related to the overlying Tournaisian deposits, with which it forms a united complex and is strongly differentiated from the underlying Upper Devonian red beds on which it rests unconformably.

The fauna of the Bystryanskaya Series consists of fish remains and bivalves. The latter occur in the second to fourth members, are poorly preserved and have been referred to two species known from Upper Devonian deposits of North America: *Avicula (Leptodesma) arciforme* (HALLE) and *Amnigenia catskillensis* (VEN.).

Fish remains are found throughout the whole Bystryanskaya Series. They are referred mostly to endemic genera of acanthods, palaeoniscids, rhizodonthids and sharks such as *Carycinacanthus*, *Ganolepis*, *Oxypteriscus*, *Palaeobergia*, *Gyrolepidothus*, *Platysomus?*, *Rhizodopsis*, *Pycnoctenion*, *Greiserolepis*, *Cladodus* and *Ctenacanthus*. Taxa of the bystryanskan fish assemblage are rare in the underlying Devonian red beds but are more common in the overlying Tournaisian deposits. Comparison of the bystryanskan and older fish assemblages of the Minussinsk Trough and other regions of the world enabled D.V.OBRUTCHEV (1954) to reach the conclusion that the bystryanskan fish assemblage belongs to an Early Carboniferous age.

The base of the megafossil flora of the Bystryanskaya Series consists of European lepidophytes accompanied by the remains of Euramerican articulates, rare ferns, and the rhizophore (*Stigmaria* sp.). One of the main features of this assemblage is the domination of forms typical of the Strunian ("Etroeungt") strata of Western Europe. Plant fossil distribution in the Bystryanskaya Series and the overlying Tournaisian strata is shown in Fig. 1. Data presented in this figure are based on material from more than 40 localities of megaflora and 40 spore spectra.

Megafloras of the Bystryanskaya Series and those of the underlying Upper Devonian red bed sequence

differ as strongly as did the corresponding fish assemblages. The general content of the bystryanskan megaflora consists of the lepidophytes *Cyclostigma kiltorkense* HAUGHT. and *Pseudolepidodendropsis carneggianum* (HEER). These taxa are typical for assemblage-zone VII *(Rhacophyton)* and are characteristic of Upper Famennian and Strunian strata (BANKS 1980; FAIRON-DEMARET 1986). It should be noted that reliable records for these lepidophytes, outside their type localities (Kiltorkan, Ireland and Bear Island in the Barents Sea), are known only in Rudnyi Altai (Kazakhstan) and in the Minussinsk Trough. In the first two localities, their age is probably delimited by the Strunian (FAIRON-DEMARET 1986). In Rudnyi Altai they are found in the mid subsuite of the Tarchanskaya suite which contains spores of the palynozone *Tumulispora malevkensis* (=spore subzone VI Western Europe) and which according to T.S.GRISHINA (in BUBLICHENKO & GRISHINA 1988) can be correlated with the earliest Carboniferous.

The third and rather typical representative of the bystryanskan megaflora is the articulate *Sphenophyllum* cf. *subtenerrimum* NATH. According to H.P. BANKS (1980) it is also typical for his assemblage-zone VII. But remains of this plant are practically indistinguishable in appearance from those which are also found in the overlying Tournaisian strata (fig. 1).

The most archaic elements of the bystryanskan megaflora are the ferns, *Archaeopteris* sp. and *S.* cf. *belgicum* which are found only in some localities and in general are not typical for this megaflora. These plants are characteristic of late Devonian floral assemblage-zones VI and VII by H.P. BANKS (1980). The upper limits of the stratigraphic range of these plants and the first occurrence of *Archaeopteris* have not been sufficiently investigated. As for the genus *Rhacophyton,* modern data affords definite evidence for its persistence into the lowermost Carboniferous (FAIRON-DEMARET 1986). The other representatives of the bystryanskan megaflora such as the ferns *Aneimites acadica* DAWSON, *Adiantites* and *Rhacopteris?* sp. and the articulate *Archaeocalamites* sp. are typical forms of Euramerican Carboniferous floral communities.

Thus, although the bystryanskan megaflora is represented mainly by Strunian forms, when estimating its age it should be kept in mind that the greater part of the mentioned taxa could persist into the lowermost Carboniferous. In view of this, caution must be exercised in using the megaflora to date the Bystryanskaya Series.

The next floral assemblage (L-2 by S.V.MEYEN 1982) is known in the Glyadenskaya and the Zagorskaya suites with a mixed composition of megaflora (fig. 1) being typical for the former. The flora of the Zagorskaya suite has a clearly established Tournaisian age

Base of the Bystryanskaya Series is preferred as the Devonian-Carboniferous boundary in continental successions of Angaraland

For spore assemblages of the Bystryanskaya Series, as studied from the second to sixth members, the following features are typical:

The palynocomplex of the second member is represented by two spectra. It is typically dominated by small spores *Hymenozonotriletes rugosiusculus* KEDO (14.8-18%) and *Spelaeotriletes microgranulatus* BYVSCH. (1-22.5%). Characteristic forms are *Trachytriletes solidus* NAUM. (8.5%), *Lophotriletes rotundus* NAUM., *L. atratus* NAUM., *Lophozonotriletes proscurrus* NAUM., *L. macrogrumosus* KEDO, *Tumulispora rarituberculata* (LUB.), *Retusotriletes simplex* NAUM. and *R. setosus* KEDO. An archaic genus *Stenozonotriletes* is present with *S. laevigatus* N. and *S. angularis* KEDO, and the genus *Archaeozonotriletes* with *A. basilaris* NAUM. and *A. famenensis* NAUM. The typical Famennian spore *Retispora lepidophyta* (KEDO) PL. makes up 5.5%. Also present are various spores of the genus *Hymenozonotriletes*: *H. submirabilis* (LUB.) KEDO, *H. flavus* KEDO, *H. granulatus* (N.) JUSH., *H. explanatus* (LUB.) K.

The palynocomplex of the third member is studied in 10 spectra. Principal spores are *Cyrtospora cristifera* (LUB.) ZWAN. (2.3 to 50.6%; average 17.8%) and *Hymenozonotriletes rugosiusculus* K. (6-22.5%). Some spectra of this complex are dominated by *Verrucosisporites mesogrumosus* (K) BYVSH. (up to 17.6%), *Hymenozonotriletes flavus* K. (up to 22%), and *Grandispora famenensis* N. (up to 26.2%). The spores *Tumulispora malevkensis* (NAUM.) TURNAU (7%), *Spelaeotriletes microgranulatus* (12%) and the acritarch *Hystricosporites hamulus* N. (up to 15%) are present. The characteristic Lower Carboniferous spore *Knoxisporites literatus* (W.) PL. is present in almost all spectra of the complex (1.5-24.2%). The diagnostic spores *Lophotriletes rotundus* N., *L. atratus* N., *Lophozonotriletes proscurrus* K., *Tumulispora rarituberculata* (LUB.) POT., *T. malevkensis* are present as are considerable quantities of the archaic spores of the genera *Retusotriletes* (*R. simplex* N., *R. setosus* K., *R. granulatus* PASHK., *R. septalis* (JUSHK.); *Stenozonotriletes* (*S. laevigatus* N., *S. angularis* K., *S. pumilis* (W.) ISCH.) and *Archaeozonotriletes* (*A. basilaris* N., *A. decorus* N., *A. famenensis* N., *A. amplectus* K., *A. kurungurachus* PASHK.). The species *Grandispora upensis* (KEDO) BYVSH., *Auroraspora hyalina* (NAUM.) STR. var. *tournensis* K., *Hymenozonotriletes submirabilis* (L.) K. occur in spectra of this complex and are typical for the Lower Tournaisian palynocomplexes in Siberia and Russian platform. In isolated spectra, spores of Viséan habit occur rarely: *Euzonotriletes macrodiscus* (W.) ISCH., *E. auritus* (W.) BYVSH. and *Simozonotriletes intortus* (W.) POT.& KR.

The palynocomplex of the fourth member is studied in 8 spectra. Spores of the species *Knoxisporites literatus* (W.) PL. (1-35%), *Cyrtospora cristifera* (1-30%) and *Verrucosisporites mesogrumosus* (1-11%) are predominant. Spores

of the genus *Retusotriletes* (*R. simplex* N., *R. septalis* JUSH., *R. granulatus* PASHK., *R. setosus* K.) play a notable role. There are small quantities of the spores *Dictyotriletes cancellatus* (W.) N. and *D. grandiformis* (N.) K. in some spectra of this complex. Constantly present are archaic spores of the genera *Stenozonotriletes* and *Archaeozonotriletes*: (*S. laevigatus* N., *S. angularis* K., *S. pumilus* (W.) ISCH. and *A. decorus* N., *A. basilaris* N., *A. famenensis* N., *A. amplectus* K). Some spectra contain typically Tournaisian species - *Tumulispora rarituberculata* (L.), *T. malevkensis* (N.), *Lophozonotriletes macrogrumosus* K., *Auroraspora hyalina* var. *tournensis* K., *Grandispora upensis* (K.), *Hymenozonotriletes submirabilis* N. and *H. rugosiusculus* (JUSH.) K.

The palynocomplex of the fifth member is studied in six spectra. A great many spores of *Cyrtospora cristifera* (up to 55%), and *Knoxisporites literatus* (up to 35%) are typical for the complex. A notable occurrence (up to 13%) is the spore *Trachytriletes solidus* NAUM. (1-15.8%). In one of the spectra, *R. lepidophyta* reaches 37.5%. Constantly present are the Lower Carboniferous spores *Verrucosisporites mesogrumosus* (K.) (3-10%), *V. nitides* (N.) PL. (2.4%), *Lophozonotriletes macrogrumosus* K.(1.8-4%), *L. curvatus* N. (3.0-3.6%), and *L. proscurrus* K. - 3.7%. Archaic spores of the genera *Retusotriletes*, *Stenozonotriletes* and *Archaeozonotriletes*: (*R. simplex* N., *R. setosus* K., *S. laevigatus* N., *S. angularis* K., *S. basilaris* N., *A. decorus* N., *A. famenensis* N.) continue to play a significant role. Typical Tournaisian species present in small quantities include *Umbonatisporites regidesetosus* (JUSH.) BYVSH., *Dictiotriletes tschernischensis* K., *D. cancellatus* (W.) N., *Grandispora upensis* (K.), *Auroraspora hyalina* var. *tournensis* K., *Hymenozonotriletes rugosiusculus* K., *H. flavus* K., *H. granulatus* (N.) JUSCH., and *Tumulispora malevkensis*. In some spectra of this complex, isolated spores of Viséan habit *Euryzonotriletes macrodiscus* (W.) ISCH., *E. auritus* (W.) B., *E. intortus* (W.) B., *Simozonotriletes intortus* (W.) POT. & KR. are known.

The palynocomplex of the sixth member is studied in one spectrum. The spores *Cyrtospora cristifera* (44%) and *Knoxisporites literatus* (14.5%) dominate the complex. Typical Tournaisian spores are present with the species *Verrucosisporites mesogrumosus* (K.), *Dictyotriletes alveolatus* (W.) N., *Auroraspora hyalina* var. *tournensis*, *Hymenozonotriletes flavus* K., *Lophozonotriletes macrogrumosus* K. and the younger (Viséan) species *Simozonotriletes intortus* (W.) POT. & KR (0.5-9.5%). Archaic spores are present with *Archaeozonotriletes basilaris* N. and *A. decorus*.

The palynocomplex of the Glyadenskaya suite is studied in two spectra from the lower member and eight from the upper one.

In spectra from the lower member, the spores *C. cristifera* (26.1-30.8%), *K. literatus* (8-16%) and *R. lepidophyta* (1.5-17.6%) are dominant. Huge knobby spores in the complex are present with *Verrucosisporites mesogrumosus* (K.), *Lophotriletes atratus* N., *L. rotundus* N., *Lophozonotriletes macrogrumosus* K., and *Tumulispora rarituberculata* (L.) - typical for Tournaisian complexes of the Russian Platform. Archaic spores *Retusotriletes setosus* K. and *R. simplex* N., spores with narrow edging *Stenozonotriletes laevigatus* N., and compound forms *Geminospora micromanifesta* (N.) OWENS, *A. basilaris* N., *A. decorus* N., *A. famenensis* N. occur in small quantities. The Tournaisian species *Auroraspora hyalina* var. *tournensis* K., *H. submirabilis* (L.), *H. rugosiusculus* K., *H. explanatus* (L.) and *H. facilis* K. are typical for this complex. Spores of Viséan habit *Euryzonotriletes macrodiscus* (W.) ISCH., *E. auritus* (W.) and *E. appendices* (HACQ. & BARSS.) BYVSH. are of isolated occurrence.

For spectra of the upper member of the Glyadenskaya suite, the presence of a great quantity (up to 19.4%) of spores of the genus *Dictiotriletes*: *D. alveolatus* (W.) N., *D. grandiformis* (N.) K., *D. tschernyschensis* KEDO and *Convolutispora usitata* PL. is typical for the top of the Malevsky horizon of the Russian Platform. Other notable spores include *Lophotriletes rotundus* N., *Verrucosisporites mesogrumosus* (K.), *V. nitidus* (N.), *Lophozonotriletes macrogrumosus* K., *L. proscurrus* K., *Tumulispora rarituberculata* (L.) and *T. malevkensis*. The species *Knoxisporites literatus* occurs in great quantity (7-21%) and the spores of the genus *Hymenozonotriletes*: *H. rugosiusculus* (JUSH.)(5.4-31.6%), *H. flavus* K. (5.4-19%), *H. submirabilis* (L.) play a notable role. Some spectra contain up to 20% of *Grandispora upensis* (K.). and occasionally an isolated *R. lepidophyta*. Spores of archaic genera *Retusotriletes* and *Stenozonotriletes* (*R. granulatus* PASHK., *R. simplex* N., *R. setosus* K., *S. laevigatus*, *S. angularis* K.) are present constantly in this complex. In two spectra, *Cyrtospora cristifera* (5-18.5%) is recorded. The archaic spores *Archaeozonotriletes decorus* N., *A. basilaris* N., *A. famenensis* N., *A. amplectus* K. may occur in some spectra in small quantities. Isolated spores typical for Viséan complexes include *Euryzonotriletes macrodiscus* (W.), *E. auritus* (W.), *E. appendices* (H. & B.), *Murospora modica* (ISCH.) PL., and *M. sublobata* (W.) PL.

The Zagorsky palynocomplex is studied in three spectra. It is characterised by a great amount of spores of the species *Lophotriletes rotundus* N. (1.4-41.7%), *Verrucosisporites mesogrumosus* (K.) (23.2%), *Lophotriletes atratus* N. (4.8%), *Lophozonotriletes curvatus* N. (8.3%), and *Hymenozonotriletes facilis* KEDO (1.6-32%). The species *H. rugosiusculus* (JUSCH.) (2.1%), *H. dilectus* N. (1.6%) and the archaic spores of the genera *Retusotriletes* (1.6-20.5%) and *Archaeozonotriletes* (0.7-8.3%) are constantly present in this complex. The species *Dictyotriletes tschernischensis* K., typical for the Upinsky and Kizelovsky horizons of the Russian Platform, is present (16%). The species *Convolutispora usitata* PL., characteristic for the upper part of the Malevsky horizon, is of rare occurrence. The spores *Auroraspora hyalina* var. *tournensis* (17.6%), *Knoxisporites*

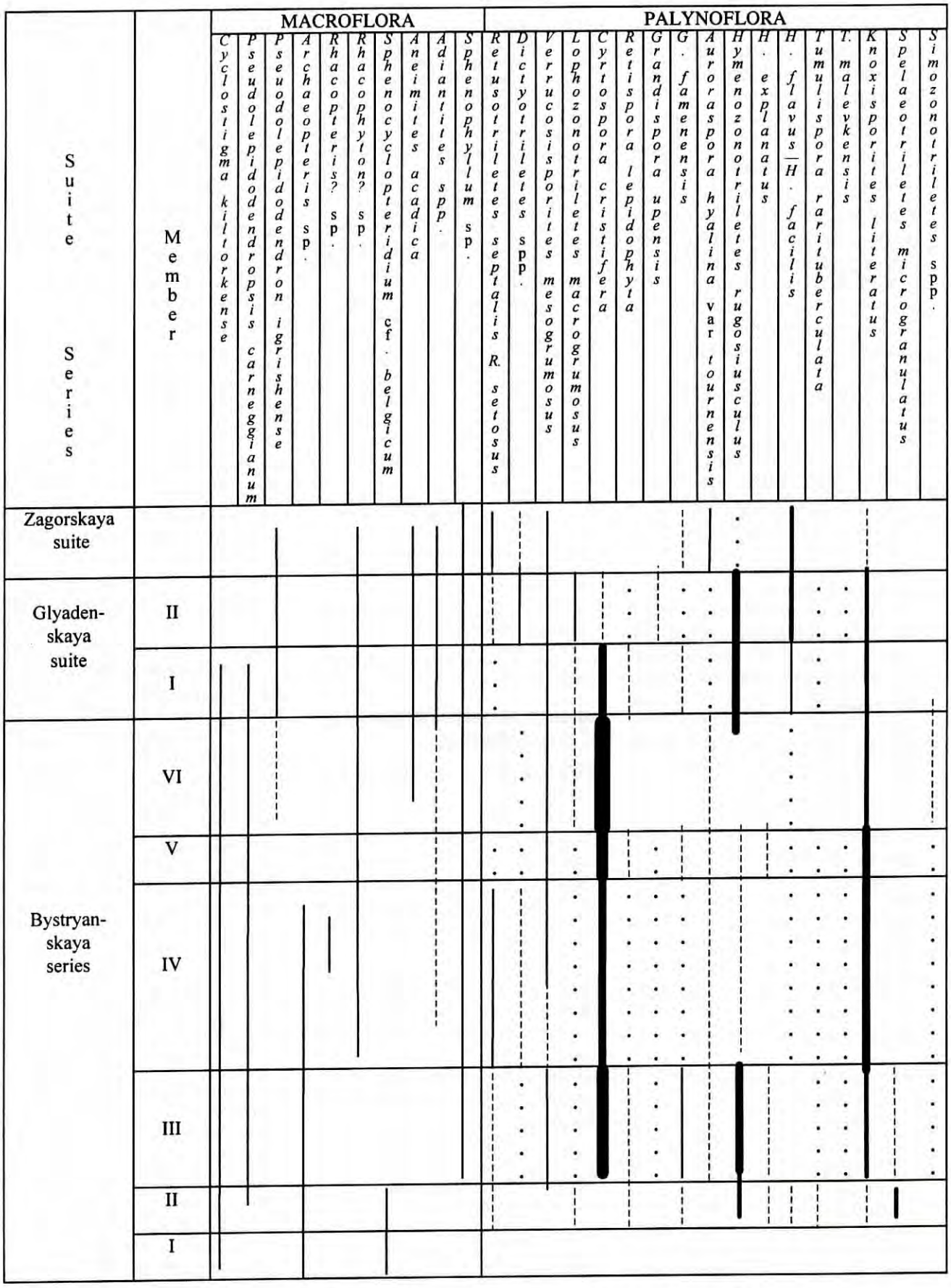


Figure 2: Plant fossils distribution at the Devonian-Carboniferous boundary in the Minussinsk sequence.
A median quantitative composition of spores spectra (%): ... - less 2; --- 2-5; —— 5-9; ▬ 10-19; ▬ 20-29; ▬ - 30-39; ▬ - 40-49.

literatus (3.6-6%), *Spinozonotriletes uncatus* HACQ. (12%) plus the spores of Viséan form *Euryzonotriletes intortus* (2.5%) are representative for the complex.

Summary

The above palynocomplexes have greatest similarity with those of the Pripyat Depression of Byelorussia (AVCHIMOVICH, V.J. 1992; AVCHIMOVICH, V.J. et al. 1992), differing only by the singularity of some species and the percentage distributions. The complexes of the Bystryanskaya Series and the Glyadenskaya suite can be conditionally compared with those of the Malevsky horizon. The complex of the Zagorskaya suite shows most affinity with that of the Upinsky horizon of the Russian Platform (BYVSCHEVA, T.V., 1978).

In the described sequence, two levels can be identified where rather noticeable changes take place. The first level correlates with the base of the Bystryanskaya Series and is accompanied by very strong faunal, floral and lithological changes. The second level correlates approximately with the top of the Glyadenskaya suite where a much weaker change is recorded. On this level Euramerican lepidophytes *C. kiltorkense* and *P. carneggianum* disappear. In spore spectra, the disappearance of *R. lepidophyta*, *V. nitides*, *T. malevkensis*, *T. rarituberculata* and a reduction of the species *K. literatus* and the archaic genera *Retusotriletes*, *Stenozonotriletes* and *Archaeozonotriletes* is observed.

Based on the degree and character of the changes, the base of the Bystryanskaya Series may be preferable as the Devonian-Carboniferous boundary in the continental successions of Angaraland. It marks a major shift of the palaeoecosystem which may be compared with global events at the Devonian-Carboniferous boundary in different regions of the world.

R. lepidophyta apparently can not be used as a marker for the Devonian-Carboniferous boundary in Angaraland.

References

AVCHIMOVITCH, V.J. 1992. Zonation and spore complexes of the Devonian and Carboniferous boundary deposits of the Pripyat Depression (Byelorussia). *Ann. Soc. géol. Belgique*, **115**, 425-451.

AVCHIMOVITCH, V.J., TURNAU, E. & CLAYTON, G. 1992. Correlation of Uppermost Devonian and Lower Carboniferous miospore zonations in Byelorussia, Poland and Western Europe. *Ann. Soc. géol. Belgique*, **115**, 453-458.

BANKS, H.P. 1980. Floral assemblages in Siluro-Devonian. **In**: *Biostratigraphy of Fossil Plants*, Dilcher, D.L. & Taylor, T.N. (eds), Dowden, Hutchinson & Ross Inc., 1-24.

BUBLITCHENKO, N.L. & GRISHINA, T.S. 1988. The Devonian/Carboniferous boundary in Eastern Kazakhstan. - The Devonian/ Carboniferous boundary in the territory of the USSR. *Minsk, Nauka i tecknica*, 194-199 (in Russian).

BYVSCHEVA, T.V. 1978. Main stages of microflora development in the transitional time Devonian/Carboniferous in the Eastern part of the Russian Plate. **In**: *General problems of Carboniferous stratigraphy*. Moskow: Nauka, p. 230.

FAIRON-DEMARET, M. 1986. Some Uppermost Devonian megafloras: a stratigraphical review. *Ann. Soc. géol. Belgique*, **109**, 43-48.

MEYEN, S.V. 1982. The Carboniferous and Permian floras of Angaraland: (A synthesis). *Biol. Mem.* 7(1), 1-109.

OBRUTCHEV, D.V. 1954. The Devonian-Carboniferous boundary position in Minussinsk depressions. **In**: *Problems of Asian geology*. V.1. Moscow, Press. Akad. Nauk USSR, 325-331 (in Russian).

Carboniferous stratigraphy: Quo vadis?

R.H. WAGNER, Jardín Botánico de Córdoba, Avenida de Linneo s/n, 14004 Córdoba, Spain and **C.F. WINKLER PRINS**, Nationaal Natuurhistorisch Museum, Postbus 9517, 2300 RA Leiden, The Netherlands.

In two successive papers (WAGNER & WINKLER PRINS 1991, 1994), the present writers presented correlations between regional chronostratigraphic units within the palaeoequatorial belt of Carboniferous times. The first one was a keynote address for the XI Carboniferous Congress (Beijing 1987) and the second a specially commissioned report (at Buenos Aires 1991) to correct the numerous errors found in the "Global Chart" issued by the IUGS Commission on Stratigraphy (COWIE & BASSETT 1989). It is regretted that this report, read at the SCCS Meeting in Liège 1993, met with opposition from the editors of the volume in which the contributions to this meeting were published and was forced to appear separately in a different volume of *Annales de la Société Géologique de Belgique*.

A third paper, read as a keynote address at the XII Carboniferous/Permian Congress (Buenos Aires 1991), emphasised the climatic changes occurring during the Carboniferous and suggested how these could be used for a globally valid chronostratigraphic classification (WAGNER 1993).

At the XIII Carboniferous Congress, to be held in Kraków 1995, the authors propose to read the paper summarised as follows:

A brief history of Carboniferous chronostratigraphy commences with the dual classification into marine and terrestrial stages proposed by MUNIER CHALMAS & de LAPPARENT (1893): Dinantian, Moscovian, Uralian and Culm, Westphalian, Stephanian, respectively. It developed further into regional classifications for eastern Europe (Russia, Ukraine), western Europe and North America (USA), with increasing emphasis on regional stratigraphic conditions linked to different basins and palaeogeographies. International cooperation for establishing a more generally applicable chronostratigraphic classification commenced with the first Heerlen Congress in 1927, and this work was continued by the IUGS Subcommission on Carboniferous Stratigraphy (SCCS). A gradual increase in membership of SCCS permitted the first attempts at integration of various regional chronostratigraphic classifications (BOUROZ *et al.* 1977-1978) and agreement was reached on the recognition of three major subdivisions, lower, middle and upper (BOUROZ, WAGNER & WINKLER PRINS 1978). An SCCS symposium held in Leeds (RAMSBOTTOM *et al.*1982) focused on the lower/middle boundary and agreement was reached subsequently on the biostratigraphic expression of this so-called mid-Carboniferous boundary (LANE *et al.* 1985; WAGNER *et al.* 1985). There is general consensus to regard this as the most important boundary within the Carboniferous, and it has been

given subsystemic rank internationally (MANGER 1988). It is regarded as a systemic boundary in North America where it separates Mississippian from Pennsylvanian. The middle/upper Carboniferous boundary has been entrusted to an SCCS working group (VILLA 1992; VILLA ET AL. 1994) but the importance of this boundary has been deemphasised in the most recent program of investigations of SCCS. In fact, the current program no longer seeks the integration of existing, historically recognisable classifications, but aims at establishing a new classification based on marine faunal changes (ENGEL 1989). This purely biostratigraphic approach has been criticised as conceptually limited and inapplicable to the areas of higher palaeolatitude (Gondwana, Angará) where climatic differentiation created different biostratigraphic conditions. It is proposed here to adopt a more flexible approach whereby climatically induced worldwide changes in floral and faunal diversity and distribution are used in conjunction with physical events for an overall worldwide stratigraphic framework into which regional chronostratigraphies can be fitted.

References

BOUROZ, A., EINOR, O.L., GORDON, M., MEYEN, S.V. &WAGNER, R.H. 1977-1978. Proposal for an International Chronostratigraphic Classification of the Carboniferous. *C.R. VIIIe Congr. Int. Strat. Géol. Carbonifère, Moskva 1975*, **1** (1978) General Problems of the Carboniferous Stratigraphy: 36-69 (Russian translation in *Izv. Akad. Nauk SSSR, Ser. Geol., 1977*, **2**: 1-24; French translation in *Industrie minérale* 60, 10 (1978): 469-483).

BOUROZ, A., WAGNER, R.H. & WINKLER PRINS, C.F. 1978. Report and Proceedings of the IUGS Subcommission on Carboniferous Stratigraphy, Meeting in Moscow 8-12 September 1975. *C.R. VIIIe Congr. Int. Strat. Géol. Carbonifère, Moskva, 1975*, **1**: 27-35.

COWIE, J.W., BASSETT, M.G. 1989. International Union of Geological Sciences 1989 Global Stratigraphic Chart with geochronometric and magnetostratigraphic calibration. *Episodes*, **12**, 2.

ENGEL, B.A. 1989. SCCS Field and General Meeting, Utah-Nevada, September 1989. *Newsl. Carb. Strat.* 7: 13-16.

LANE, H.R., BOUCKAERT, J., BRENCKLE, P., EINOR, O.L., HAVLENA, V., HIGGINS, A.C., YANG JING-ZHI, MANGER, W.L., NASSICHUK, W., NEMIROVSKAYA, T., OWENS, B., RAMSBOTTOM, W.H.C., REITLINGER, E.A. & WEYANT, M. 1985. Proposal for an international mid-Carboniferous boundary. *C.R. Xe Congr. Int. Strat. Géol. Carbonifère, Madrid, 1983*, **4**: 323-339.

MANGER, W.L. 1988. Report on SCCS program of meetings, Beijing, 1987. — *Newsl. Carb. Strat.* **6**: 11-15.

MUNIER CHALMAS, E. & de LAPPARENT, A. 1893. Note sur la Nomenclature des Terrains sédimentaires. *Bull. Soc. géol. France*, **3**, **21**: 438-493.

RAMSBOTTOM, W.H.C., SAUNDERS, W.B. & OWENS, B. (eds) 1982. Biostratigraphic data for a mid-Carboniferous boundary. *SCCS, Leeds.* 1-156.

VILLA, E. 1992. Project Group 5: A boundary at the base of the *Protriticites* Zone (basal Kasimovian; basal Missourian; mid-Cantabrian). *Newsl. Carb. Strat.* **10**: 19.

VILLA, E., DAVYDOV, V.I., KONOVALOVA, M.V. & REMIZOVA, S. 1994. Studies on the base of the *Protriticites* Zone. A report on SCCS Project Group 5. *Ann. Soc. géol Belg.*, 116, 2 (1993): 323-331.

WAGNER, R.H., 1993. Climatic significance of the major chronostratigraphic units of the Upper Palaeozoic. *C.R. XIIe Congr. Int. Strat. Géol. Carbonifère-Permien, Buenos Aires*, 1991, **1**: 83-108.

WAGNER, R.H., SAUNDERS, W.B. & MANGER, W.L. 1985. Report of the IUGS Subcommission on Carboniferous Stratigraphy (General Assembly in Madrid, September 1983). *C.R. Xe Congr. Int. Strat. Géol. Carbonifère, Madrid, 1983*, **1**: LVII-LXI.

WAGNER, R.H. & WINKLER PRINS, C.F. 1991. Major subdivisions of the Carboniferous System. *C.R. XIe Congr. Int. Strat. Géol. Carbonifère, Beijing, 1987*, **1**: 213-244.

WAGNER, R.H. & WINKLER PRINS, C.F. 1994. General overview of Carboniferous stratigraphy. *Ann. Soc. géol Belg.*, **116** (1993), 1:163-174.

The Australian late Carboniferous magnetostratigraphic timescale

JOHN ROBERTS, School of Applied Geology, The University of New South Wales, Sydney NSW 2052 AUSTRALIA.
E-mail: <J.Roberts@unsw.edu.au>

A group consisting of NEIL OPDYKE, University of Florida, TED IRVING, recently retired from the Pacific Geoscience Centre at Sidney, British Columbia, Canada, JOHN ROBERTS and XIANG WANG (PhD student), University of New South Wales, Sydney NSW, and JON CLAOUÉ-LONG, Australian Geological Survey Organisation, Canberra, are attempting to better define and date the base of the Kiaman (Permian-Carboniferous Reversed Superchron) in its type area. In 1994, IRVING, OPDYKE, ROBERTS and CLAOUÉ-LONG collected approximately 500 samples from 103 sites in Viséan, Namurian and Westphalian sedimentary and igneous rocks in the Werrie and Rocky Creek Synclines. These samples have been processed in the paleomagnetic laboratory at the University of Florida. Conglomerate tests on samples of Carboniferous ignimbrites from diamictites within the Late Carboniferous succession yield a very clear, high-temperature component which passes the conglomerate test. It is obvious that the Carboniferous rocks were magnetised at or soon after deposition or cooling. Sites with reverse magnetisation with steep inclinations characterise the Clifden, Rocky Creek and Lark Hill Formations of the Rocky Creek region. Normal directions of magnetisations are present in the Ermelo Dacite and rocks lower in the stratigraphic section. In the Werrie Syncline, the Currabubula Formation is reversely magnetised with the underlying Merlewood Formation having sites of both polarities.

Future work in 1995-96 will involve more detailed sampling for palaeomagnetic work, U-Pb SHRIMP dating of zircons from ignimbrites located at critical stratigraphic levels (JC-L and XW), the geochemical characterisation of ignimbrites (XW), field mapping to clarify the extent and continuity of individual ignimbrites within and between fault blocks (JR and XW), and the examination of possible source directions for ignimbrites using AMS data.

Carboniferous of Brazil

L.E. ANELLI and A.C. ROCHA-CAMPOS, Instituto de Geociências, Universidade de São Paulo, CP 11348, CEP 05422-970, São Paulo, SP, Brazil.
E-mail: ANELLI <anelli@usp.br>
ROCHA-CAMPOS <acrcampo@fox.cce.usp.br>

Paleomagnetism of the Poti Formation (early Carboniferous), Parnaíba Basin, Northern Brazil

A re-evaluation of the paleomagnetic data available for the Poti Formation (early Carboniferous) in the Parnaíba Basin, northern Brazil, is being performed by ALENCAR *et al.* (submitted). Analysis revealed that dispersion shown by the direction of magnetisation of samples from the Poti Formation may be related

to post-depositional tectonism in the area during the Palaeozoic and Mesozoic.

Late Carboniferous invertebrates from the Piauí Formation (mid Pennsylvanian), Parnaíba Basin, northern Brazil

Marine invertebrates associated with the bivalve fauna of the Piauí Formation, Parnaíba Basin (Mid ennsylvanian) (ANELLI 1994) is being described by ANELLI (in preparation). Preliminary identification of taxa include mostly inarticulate and articulate brachiopods (spiriferids, chonetids, strophomenids), archaeogastropods, orthocerathid cephalopds, fenestellid bryozoans and trilobites. Areal variation in faunal composition may be correlated with facies change in the shallow marine/lagoonal carbonate beds.

A new species of *Oriocrassatella* in the Piauí Formation represents the oldest known record of the genus. A phylogenetic analysis of the genus *Oriocrassatella* is being performed by ANELLI (in preparation).

Carboniferous of Paraná Basin, southeastern Brazil

The stratigraphic and facies analysis of the Aquidauana Group, cropping out in the western margin of the Paraná Basin was initiated by GESICKY (in preparation). The unit, palynologically dated as late Carboniferous (DAEMON & QUADROS 1970), is made up predominantly of sandstone with subsidiary mudstones and silty-clay diamictite. The stratigraphic relationship of the Aquidauana Formation with the Itararé Subgroup (containing glacial diamictites) in the eastern margin of the Paraná Basin is also being investigated.

References

ALENCAR, B.V., BORGES, M.S. & GÓES, A.M. (submitted). Avaliação paleomagnética e tectono-sedimentar das Formações Poti e Bons Pastos, na região de Floriano-Nazaré do Piauí. *Congr, Intern. Geofísica, Rio de Janeiro.*

ANELLI, L.E. 1994. Pelecípodes da Formação Piauí (Pensilvaniano médio), Bacia do Parnaíba, Brasil. São Paulo. *Master Dissertation, Instituto de Geociências, USP*, unpublished, 148 pp.

ANELLI, L.E. (in preparation). Invertebrados marinhos da Formação Piauí (Pensilvaniano médio), Bacia do Parnaíba, Brasil: taxonomia, tafonomia, paleoecologia, paleobiogeografia e evolução.

DAEMON, R.F. & QUADROS, L.P.de 1970. Bioestratigrafia do Neopaleozóico da Bacia do Paraná. *An. XXIV Congr. Brasil. Geol., Soc. Bras. Geol., Brasilia*, 1970, p.309-412.

GESICKY, A.L.D. (in preparation). Geology of the Aquidauana Formation in the northern-central part of Mato Grosso do Sul, west-central Brazil.

ABSTRACTS OF PAPERS

Biostratigraphy and Sequence Stratigraphy at the Devonian- Carboniferous transition in southern China (Hunan Province)

HANCE, L.[1], MUCHEZ, PH.[4,5], COEN M.[2,7], FANG, X.-S.[3], GROESSENS, E.[1,2], HOU, H.[3], POTY, E.[6], STEEMANS, PH.[6,7], STREEL, M.[6], TAN, Z.[8], TOURNEUR, F.[2], VAN STEENWINKEL, M.[9], & XU, S.-C.[3]

1. Service Geol. de Belgique, rue Jenner 13, B-1040 Brussels, Belgium.

2. Palaeont., Univ. de Louvain-la-Neuve, Pl. Louis Pasteur 3, B-1348 Louvain-la-Neuve, Belgium.

3. Inst.Geol., C.A.G.S., Baiwanzhuang Road, Beijing 100037, P.R. China.

4. Fysico-chemische geol., Celestijnenlaan 200C, B-3001 Heverlee, Belgium.

5. Senior Research Assistant, N.F.W.O.

6. Services Associés de Paléont., place du Vingt-Août, B-4000 Liège, Belgium.

7. Research Associate F.N.R.S.

8. Regional Geol. Surv., Hunan Bureau of Geol. & Min. Res., Shaoshanxilu Road, Xiangtan City, Hunan, P.R. China.

9. P.D.O., PO Box 81, Muscat, Sultanate of Oman.

Abstract: In southern China, the Devonian-Carboniferous transitional strata are well exposed in several sections representative of different sedimentary environments. The siliciclastic-carbonate deposits have been investigated in the Oujiachong, Malanbian and Sujiaping sections situated in central Hunan. The Devonian-Carboniferous boundary coincides with the boundary between the Menggongao and the overlying Malanbian Formation. Study of different fossil groups (conodonts, foraminifera, ostracods, spores, brachiopods, rugose and tabulate corals) gives coherent biostratigraphical results which form the framework for reconstruction of the sedimentological evolution. Strong similarities are observed with southern Belgium allowing biostratigraphical and sequence stratigraphical correlations between the two distant sedimentary basins.

Ref: *Annales de la Société de Belgique,* **T. 116** - 1993 (fascicule 2), 359-378.

An outline of the Moliniacian (Upper Tournaisian - Lower Viséan) in southern Belgium.

HANCE, L.[1], LALOUX, M.[2], MUCHEZ, PH.[3,4], GROESSENS, E.1,2, PEETERS, C.[3], & POTY, E.[5]

1. Service Geol. de Belgique, rue Jenner 13, B-1040 Bruxelles, Belgium.

2. Univ. Catholique de Louvain, Bâtiment Mercator, Place L. Pasteur 3, B-1348 Louvain-La-Neuve, Belgium.

3. K. U. Leuven, Fysico-chemische geologie, Celestijnenlaan 200C, B-3001 Heverlee, Belgium.

4. Senior Research Assistant, N.F.W.O.

5. Univ. de Liège, Lab. de Paléontologie animale, Place du Vingt Août 7, B-4000 Liège, Belgum.

Abstract: This paper presents a review of the Moliniacian of southern Belgium. It is the introduction to the field excursion of 12 October 1991 in honour of Raphaël Conil. The stratigraphy of the Moliniacian is discussed and the sedimentological evolution summarised. The outcrops visited are documented in the appendix.

Ref: *Mémoires Institut Géologique de l'Université Catholique de Louvain*, t. XXXV, 1994, 27-50.

Non-marine bivalve assemblage in the Asker Group, Oslo Graben and its correlation with a late Pennsylvanian assemblage from North America.

EAGAR, R.M.C., 23 High Bond End, Knaresborough, North Yorkshire HG5 9BT, UK.

Abstract: A non-marine bivalve band in the Asker Group of Semsvik, Asker, usually regarded as being of Permian age, has been re-examined. The fauna, an assemblage of *Anthraconaia protracta* EAGAR, is widely and continuously variable. The Semsvik assemblage is identical in shell height and length to *A. protracta* above the Benwood Limestone, middle Monongahela Group, of Pennsylvania, and to *A. protracta* 2700 km further west in central Arizona, with which the Pennsylvania band has been correlated. The ranges of variation within the Oslo, Pennsylvania and Arizona assemblages are closely similar. When their horizons are broadly correlated, the Semsvik band is placed in the upper Virgilian Stage of the Upper Pennsylvanian and in the upper Stephanian C of Europe. This age, which is applicable to the thin succession of the Asker Group in general, predates formation of the Oslo Graben and is in conformity with the radiometric age of the overlying basal basalt lava. The age of the Knabberud Limestone in the Asker Group is at present under discussion. The extremely widespread, evidently rapid dispersal of faunas of small *Anthraconaia* in Stephanian time may have been aided by palaeoniscoid fish.

Ref: *Journal of the Geological Society, London,* **151**, 669-680, 5 figs., 1994.

General Overview of Carboniferous Stratigraphy

ROBERT H. WAGNER, Jardín Botánico de Córdoba, Avenida de Linneo, s/n, E 14004 Córdoba, Spain & COR F. WINKLER PRINS, Nationaal Natuurhistorisch Museum, Postbus 9517, 2300 RA Leiden, The Netherlands.

Abstract: A revised "global stratigraphic chart" for the Carboniferous is given as a reaction on the one issued by the IUGS Commission on Stratigraphy (COWIE & BASSETT 1989). The underlying principles of the chronostratigraphic classification of the Carboniferous, both in the palaeoequatorial belt and the temperate to cold Angará and Gondwana regions are briefly discussed.

Ref: *Annales de la Société Géologique de Belgique,* T. **116** - 1993 (fascicule 1), 163-174.

Carboniferous Stratigraphy and Palynology of China

GAO LIANDA, Institute of Geology, Chinese Academy of Geological Sciences, Beijing, P.R. China.

Abstracts of some recently published papers include:

Devonian-Carboniferous Boundary palynostratigraphy.

GAO LIANDA 1990, Miospore zones in the Devonian-Carboniferous Boundary beds in Hunan and their stratigraphical sigificance. *Geological Review* 36 (1): 58-68.

Five miospore zones, three in the Upper Devonian and two in the Lower Carboniferous; the boundary in Hunan is placed between the Menggong'ao and Shaodong Formations.

GAO LIANDA 1991, Late Devonian and Early Carboniferous miospore zones from Southeastern Guizhou and the boundary of the Devonian-Carboniferous. *Geology of Guizhou* 8 (1) (Tol.28): 57-71.

Six miospore zones, one in Upper Devonian and five in Lower Carboniferous. *Retispora lepidophyta* is absent from Upper Devonian strata in Guizhou; the boundary in Southeastern Guizhou is placed within the Gelaoho Formation.

GAO LIANDA 1992, Palynostratigraphy at the Devonian-Carboniferous boundary in West and Northwest Hunan Provinces. *Bulletin of the Institute of Geology, Chinese Academy of Geological Sciences* 16: 171-192.

Fifty genera, 95 species and varieties, three new species and five new combinations. Six miospore zones, two in Late Devonian and four in the Early Carboniferous. The boundary between the *Retispora lepidophyta - Verrucosisporites nitidus* (LN) zone and the *Vallatisporites verrucosus - Retusotriletes incohatus* (VI) zone approximates to the D/C boundary, thus the boundary between D/C of W. Hubei and Northwest Hunan is placed at the base of the Changyang Formation.

GAO LIANDA 1991, New advances of palynostratigraphy of the Devonian-Carboniferous in the Lower Yangtze Valley. *Chinese Geology* (1991) **8** (No.171): 28-29.

Six miospore zones, three in the Upper Devonian, and three in the Lower Carboniferous; the boundary between Devonian-Carboniferous is placed at the base of the Cishan Formation.

HE SHENGCE & QUYANG SHU 1993, Spore assemblages from Devonian-Carboniferous transitional beds of Hsihu Formation, Fuyang, W. Zhejiang. *Acta Palaeontologica Sinica* **32** (1): 31-48.

Two miospore zones; the boundary of D/C is discussed.

WEN ZICAI & LU LICHANG 1993, Devonian-Carboniferous miospore assemblages from Xiaomu Section of Quannan, Jiangxi, China. *Acta Palaeontologica Sinica* **32** (3): 303-331.

Three miospore zones, two zones are in the Upper Devonian and one in the Lower Carboniferous; the D/C boundary in Jiangxi is placed at the base of the Huangtang Formation.

Carboniferous palynostratigraphy

GAO LIANDA, HE ZHUSHEN, WANG HUI & ZHANG HANMING 1991, The discovery of Early Carboniferous spores in Tarim Basin and its geological significance. *Chinese Geology* (1991), 12 (No.175): 25-26.

Five miospore zones (Tournaisian-Viséan).

GAO LIANDA 1994, Upper Carboniferous spore and pollen assemblages of the Yanghukou Formation from Jingyuan, Gansu Province. *Professional papers of Stratigraphy and Palaeontology*, 24: 108-127.

Forty-eight genera, 91 species and varieties, nine new species; four miospore zones. 1. *Tripartites trilinguis - Cirratriradites saturnii* (TS) zone, 2. *Radiiaonates aligerens* (RA) zone, 3. *Dictyotriletes bireticulatus - Microreticulatisporites nobilis* (BN) zone, 4. *Florinites junior - Vestispora cancellata* (JC) zone. These zones may be correlated with the *Triquitrites sinani - Cirratriradites saturnii* (SS) zone, *Radiiaonates aligerens* (RA) zone, and *Microreticulatisporites nobilis - Florinites junior* (NJ) zone proposed by CLAYTON ET AL. (1978), belonging to the Westphalian.

GAO LIANDA 1995, Discovery of late Early Carboniferous spores from East Liaoning Province and their stratigraphic significance. *Regional Geology of China* 2: 150-151.

Carboniferous-Permian boundary Palynostratigraphy

GAO LIANDA 1994, Carboniferous and Early Permian spore zonation and the boundary of the Carboniferous-Permian in Ningxia, China. *Acta Geology of Gansu* 3 (1): 11-26.

Sixty genera, 180 species and varieties; ten spore zones, eight are in the Carboniferous (Late Viséan-Stephanian), two are in Early Permian. The palynological recognition of this boundary can be based on the disappearance of *Lycospora* spp. in China, thus the Carboniferous-Permian boundary is placed at the base of the Sakmarian stage.

The Namurian and its Biota in the Eastern Sector of North Qilian Mts, NW China

LI XINGXUE, WU XIUYUAN, SHEN GUANGLONG *et al.*

(Published by the Shandong Science & Technology Press (Jinan) in December 1993, 482 pages (in Chinese with English summary), 200 illustrations, 110 fossil plates).

The monograph is presented in four parts:

1. Stratigraphy: On the basis of full geological data, together with the results of comprehensive studies of rich fossil materials, this monograph presents a new, detailed scheme for Namurian stratigraphy in this area, with the definition of relevant stratigraphical units, and the establishment of a biostratigraphical column for the paralic (marine) and non-marine sediments of the Namurian Stage in China. This stratigraphy might be regarded as the standard for correlating coeval deposits both from within China and abroad.

2. Early Namurian flora: The eastern sector of the North Qilian Mts is an important area of well developed Namurian flora comparable with that of the Upper Silesia Basin of East Europe. The flora of this stage is located in the critical

interval between Early and Late Carboniferous when the existing global unitary flora was obviously subdivided into different phytogeoprovinces. The North Qilian flora contains elements typical of both Euramerican and Early Cathaysian floras and is therefore very important for understanding the origin, development and evolution of the relevant floras of the world.

Although China is generally recognized as the birth place of the Cathaysian flora, its early floristic facies are still not very clear. In this regard, the Namurian plants found in the area have provided precious material which might improve these shortcomings. Moreover, the discovery of some index plants of this stage, which first appear after the Namurian in the stratigraphy of other countries, has also provided evidence for exploring the origin, dispersal and migration of some Carboniferous and Permian plant groups. For example, the neuropterids most probably first originated in East Asia and then shifted gradually to western Europe.

3. Palynological assemblages (by ZHU HUAICHENG). The monograph also presents a detailed study of the Namurian sporo-pollen assemblages. With a rich content collected from successive horizons, these assemblages are rarely seen in other regions of China or abroad; in addition, the studies of the sporo-pollen assemblages and the megafossil floras of this area complement each other, and thus increase the accuracy of the subdivision and correlation of the Namurian terrestrial deposits.

4. Cephalopoda fauna (by LIANG XILAO). Internationally, fossil cephalopods, especially ammonites, are considered to be important biotic evidence for stage division and zonation of the Carboniferous. The present work also includes a systematic study of Early Namurian cephalopods found in this area, combined with the establishment of Namurian cephalopod zones for the stratigraphy, thus affording superior conditions for correlating the marine and non-marine Carboniferous strata both in China and with other countries of the World.

Australian Carboniferous Trilobites

BRIAN A. ENGEL and L. NOREEN MORRIS, Department of Geology, University of Newcastle, University Drive, Callaghan NSW 2308 AUSTRALIA.

Ten species/subspecies of trilobites belonging to the Subfamily Ditomopyginae from Tournaisian/ Viséan strata of eastern Australia have recently been described (ENGEL & MORRIS 1994, 1995). They have been placed in five new genera/subgenera and include *A. (Australokaskia) corrugata*, *A. (Australokaskia) coulteri* (MITCHELL 1918), *A. (Australokaskia) collina*, *A. (Longilobus) similis*, *A. (Longilobus) convexicaudata* (MITCHELL 1918), *A. (Longilobus)* sp. indet., *A. (Planilobus) noorooensis*, *A. (Planilobus) constricta*, *Planokaskia gibsoni*, and *Malchi magnificus*.

The first three of the listed species with *Planokaskia gibsoni* share short (exsag.), rounded pre-occipital lobes and less inflated glabellar/pygidial axes. The other six species, including *Malchi magnificus*, share the development of relatively long (exsag.) triangular pre-occipital lobes, strongly inflated glabellar/pygidial axes, and small antennal pores which interrupt the glabella profile.

The oldest record of *Australokaskia*-type pygidia (*A. (Longiloba)* sp. indet.) occurs within the *Spirifer sol* Zone (Tn2a-Tn2c) in association with a range of brachiopods, bryozoans and molluscs together with four additional trilobite species namely *Weania goldringi* CAMPBELL, *Australosutura campbelli* ENGEL & MORRIS, *Aprathia rockhamptonensis* (MITCHELL) and *Conophillipsia ?morganensis* (MITCHELL).

Trilobites of the Ditomopyginae with distinctive marginal terrace ridges and moderately to strongly inflated glabellas made their first appearance during the late Tournaisian (Tn3b). In Australia, *Malchi magnificus* and *Australokaskia (Longiloba) similis* are found in the *Schellwienella burlingtonensis* Zone. Throughout the latest Tournaisian and Viséan interval, trilobites of *Australokaskia*-type were very numerous and they adopted a wide diversity of lineages.

Although the Australian specimens have been placed in separate taxa, a close relationship exists, in particular, with *Kaskia*. This is reinforced by the common development of a distinctive hypostome, often preserved with parts of the dorsal shield, with very long and wide 'wrap-around' anterior wings, distinctive ornament and small spines at the posterolateral corners of the posterior margin.

Most genera assigned to the Ditomopyginae have a glabella which is wider anteriorly than posteriorly, a small number of Early Carboniferous species have glabellas with the greatest width at the posterior. *Rhenogriffides* HAHN, HAHN & BRAUCKMANN 1987 is considered by these authors to be the ancestral line from which trilobites close to *Paladin* WELLER 1936 and *Kaskia* WELLER 1936 have been derived, but with a glabella which is narrower anteriorly. They have described five species of *Rhenogriffides* which range in age from latest Tournaisian (CuII) through Viséan, a range which coincides with the radiation of *Australokaskia* species in Australia.

References

ENGEL, B.A. & MORRIS, L.N. (1994). Ditomopyginae (Trilobita) from the Lower Carboniferous of eastern Australia (i) *Australokaskia (Australokaskia)*, *Planokaskia* and *Malchi* n. gen. *Geologica et Palaeontologica* **28**: 79-101, Text-figs. 1-6, Tabs. 1-2, Pls 1-3: Marburg.

ENGEL, B.A. & MORRIS, L.N. (1995). Ditomopyginae (Trilobita) from the Lower Carboniferous of eastern Australia (ii) *Australokaskia (Longilobus)* and *Australokaskia (Planilobus)* n. subgen. *Geologica et Palaeontologica* **29**: 193-211, Text-figs. 1-8, Tabs. 1-2, Pls 1-2: Marburg.

HAHN, G., HAHN, R. & BRAUCKMANN, C. (1987). Die Trilobiten des belgischen Kohlenkalkes (Unter-Karbon). 9. *Piltonia* und Nachträge. *Geologica et Palaeontologica* **21**: 137-167, Text-Figs. 1-13, Tabs. 1-5, Pls. 1-3; Marburg.

MITCHELL, J. (1918). The Carboniferous trilobites of Australia. Proc. Linn. Soc. NSW 43 (3), 437-494, Pls 46-53; Sydney.

WELLER, J. M. (1936). Carboniferous trilobite genera. — Journal of Paleontology **10** (8): 704–714, Pl. 95; Menasha/ Wisconsin.

Sixth North American Paleontological Convention - Symposia

H. RICHARD LANE, Amoco Explor. & Prod. Technology, PO Box 3092, Houston, Texas 77253 and WILLIAM W. CLOPINE, Conoco, Inc., PO Box 2197, Houston, Texas 77252.

The Sixth North American Paleontological Convention (NAPC) will be held in the Smithsonian Museum in Washington DC on 9-12 June 1996. SCCS Members seeking further details of this conference should contact: NAPC-96, National Museum of Natural History, Dept of Paleobiology - MRC 121, Washington, DC 20560.

The Industry Paleontology Managers Group (IPMG) has proposed two applications-oriented symposia for the NAPC-96 Convention. A call was made in March 1995 for contributors to a symposium centred around the topic "Quantitative Stratigraphic Paleontology" for which about 10 suggested titles have been received. Please send more titles on this topic if they are out there! The Organizing Committee must have the preliminary agenda by the middle of June in order for the sessions to be carried forward to the second circular to be distributed early this Fall.

Contact: H. Richard Lane, Amoco Explor. & Prod. Technology, PO Box 3092, Houston, Texas 77253 (Ph: 713-366-4156; Fax: 713-366-7416; E-mail: <hrlane@amoco.com> or William W. Clopine, Conoco, Inc., PO Box 2197, Houston, Texas 77252 (Ph: 713-293-3189; Fax: 713-293-3833; E-mail: <William.W.Clopine@conoco.dupont.com>.

The IPMG has also been approved to arrange a second session, this one to be entitled "Biologic Signatures of Sequence Stratigraphic Units". This one is being organised by Steve Root and John Armentrout, both of Mobil Corporation. If you have a paper that you feel would be appropriate for this session, please send the title to Steve and John at the following address or telephone number. Do not forget the middle of June deadline, as it applies to this session also.

Contact: Steve A. Root or John Armentrout, Mobil Research and Development Corp., PO Box 650232, Dallas, Texas 75265-0232 (Ph. 214-951-2654; Fax: 214-951-2265 or 2267)

SEPM Quantitative Research Group

H. R. LANE and R. W. SCOTT (contribution dated 20 February 1995)

The conferences - *Applications of Sedimentary Geology and Paleontology into the 21st Century* (Snowbird), and *Graphic Correlation: The Method and its Application* (Houston) - clearly outlined the need for a more quantitative approach in all of Sedimentary Geology and Paleontology if we expect to survive and thrive in the next Century. For example, the following recommendations, observations and issues (among others) were outcomes of these conferences.

1. Inability to communicate the potential for contributions by sedimentary geologists with other disciplines, particularly engineers, creates a significant obstacle to the application of sedimentary geology in the environmental and energy industries (Snowbird).

2. Future sedimentary geologists in both the environmental and petroleum industries will need quantitative skills and a high level of computer skills (Snowbird).

3. Establish an SEPM Quantitative Research Group (Houston).

4. Follow up on more than twenty issues and action items relating to quantitative stratigraphy (Houston).

In following up these recommendations, we have proposed to SEPM the formation of a Research Group on Quantitative Stratigraphy. That proposal, reproduced below, was presented to the SEPM Research Committee at the annual meeting in Houston.

On March 5, 1995, the SEPM Research Committee approved the formation of this Research Group. With the approval of the new Research Group, the Committee requested that:

1) leadership be expanded beyond biostratigraphy to include other geoscience disciplines,
2) efforts should be closely coordinated with other SEPM research groups, such as those for Cyclostratigraphy and Sequence Stratigraphy and,
3) that since there was an international working group (IUGS) on Quantitative Stratigraphy, perhaps a modification of the SEPM's research group name might be good to keep the two efforts distinct in title, while maintaining and enhancing the cooperative relations that already exist.

With this charge, the first meeting of the SEPM Quantitative Stratigraphy Research Group was held from 3-5 PM on March 5, 1995, in Doubletree Hotel, Houston, Texas with an attendance of 17 geoscientists. Of these, 7 were biostratigraphers, 8 sedimentologists/ lithostratigraphers, and 2 mathematical geologists. Organizationally, there were 8 attendees from industry, 1 from government, 6 from academia, and 2 consultants. The group was pleased with the mix of specialties and organisations present at the first meeting. These included:

Dr. Janok P. Bhattacharya, Bureau of Economic Geology, Box X, University Station, Austin, TX 78756 (Ph.512-471-1534).

Dr Martin B. Farley, Exxon Production Research, PO Box 189, Houston, TX 77252 (Ph.713-965-4033; Fx.713-965-7279).

Dr Bruce Fouke, De Boelelaan 10851081 HV Amsterdam, The Netherlands (Ph.31-20-548-5315; Fx.31-20-646-2457; E-mail. <foub@geo.vu.nl>).

Dr Howard Harper ARCO (AEPT)2300 W. Plano ParkwayDallas, TX 75075 (Ph. 214-509-4233; Fx.214-509-6813; E-mail. <hharper1@is.arco.com>).

Dr Mark Harris, Department of Geoscience, UWM, PO Box 413, Milwaukee, WI 53201, (Ph.414-229-5777; Fx.414-229-5452; E-mail. <mfharris@csd.uwm.edu>).

Dr Christopher G. St. C. Kendall, University of South Carolina, Dept of Geology, Columbia, SC 29208 (Ph.803-777-2410; Fx.803-777-6610; E-mail. <Kendall@scardina.edu>).

Dr Dennis Kerr, University of Tulsa, Department of Geosciences, Tulsa, OK 74104 (Ph.918 631-3020; Fx.918-631-3091).

Dr Elaine Kirova, P O Box 441292,Houston, TX 77244 (Ph.713-531-9849).

Dr John Kocurko, Midwestern State University Wichita, KS 76308 (Ph.817-689-4181; E-mail. <jkocurko@nexus.mwsu.edu>).

Dr H. R. Lane, Amoco Corporation, P. O. Box 3092, Houston, TX 77253-3092 (Ph.713-366-4156; Fx.713-366-7416; E-mail. <hrlane@amoco.com>).

Dr Robert K. Matthews, Brown University, Department of Geological Sciences, Providence, RI 02912.

Dr Peter P. McLaughlin, Jr., Exxon Exploration Company, PO Box 4778, Houston, TX 77210 (Ph.713-423-5988).

Dr Robert W. Pierce, 23119 Winding Knoll Drive, Katy, TX 77494-2102 (Ph.713-366-2590: Fx.713-366-2949; E-mail. <rwpierce@amoco.com>).

Dr David T. Pocknall, Amoco Corporation, P. O. Box 3092, Houston, TX 77293-3092.

Dr Charles Ross, GeoBioStrat, 600 Highland Drive, Bellingham, WA 98225 (Ph.360-734-3040).

Dr Robert W. Scott, Precision Stratigraphic Associates, 3734 S. Darlington, Tulsa, OK 74135, (Ph. 918-663-7730; E-mail. <rscott@aip.org>).

Dr Mike Simmons, BP Exploration, Stockley Park, Oxbridge, OB11 1BP, U.K. (Ph.44-0181-750-0934; Fx.44-0181-750-0530; E-mail< simmonmd@txpcap.hou. exu.bp.com>

Dr Thomas Yancy, Texas A&M University, Department of Geology & Geophysics, College Station, TX 77843-3115 (Ph. 409-845-0643; E-mail. <tyancy@ tamu.edu>)

Spirited discussion of the assembled group revolved around several topics. These included:

- The need to focus on techniques and tools.
- The need to develop a short course on quantitative techniques .
- The need to develop a laboratory manual.
- The need to assemble case studies.
- The need to develop globally accessible databases.

Interest focused mainly on developing a course on quantitative stratigraphy, a lab manual, and organising a symposium at a future SEPM meeting. It was decided that exercises for a course/lab manual could be developed around, Graphic Correlation, Composite Standard, RASCing, No-Space Graphing, Spectral Analysis, Fischer Plots of Parasequence Stacking Patterns, Markov Chains, Binary Matching Coefficients, Variograms/Geostatistics, Multivariate Methods, and Geohistory Analysis.

The following list of tasks and responsibilities was agreed to by the attendees.

- Establish a membership (Lane, Scott, Fouke, Harris):
  a) Announcement in the SEPM Newsletter.
  b) announcement in International Q. S. Newsletter.
- Propose two half day technical sessions for the 1997 Dallas AAPG/SEPM Annual Meeting as follows; proposal has been submitted to the technical committee:
  a) Quantitative Stratigraphic Techniques applied to Reservoir Characterization (Lane, Hohn).
  b) Quantitative Stratigraphic Techniques applied to Sequence Stratigraphy (Scott, Bhattacharya).
- Within one year:
  a) A plan for a teaching manual (PM, MH, PS).
  b) Presentation of the Manual as a short course at 1997 Dallas AAPG/SEPM Meeting.
- Long-range Planning.

The leadership of the Working Group was expanded to include Mark Harris, University of Wisconsin, Milwaukee and Bruce Fouke,Vrije Universiteit, Amsterdam. The group decided to delay a change in the name of the group until the next meeting.

For the Research Group,

H. R. Lane R. W. Scott
M. F. Harris B. W. Fouke

APPENDIX: Proposal for an SEPM Research Group: Quantitative Stratigraphy

(Dated 21 December 1994).

This proposal comes from a consensus of those at the SEPM Research Conference on Graphic Correlation and the Composite Standard: The Method and their Applications held in Houston in November-December 1994. The proposal also implements a recommendation from the SEPM Conference on Future Applications of Sedimentary Geology/Paleontology held in Snowbird, Utah in October 1994.

Objectives of this proposal:

- To facilitate communication among sedimentary geologists and paleontologists on concepts and applications of quantitative stratigraphic techniques;
- To promote the development of publicly accessible stratigraphic databases that include paleontologic, sedimentologic, geochemical, and magnetostratigraphic data, among other types of data;
- To promote the development of innovative techniques in the acquisition, analysis and interpretation of stratigraphic data;
- To facilitate the integration of stratigraphic data with other disciplines in order to provide more accurate interpretations and problem solving.

Recognised Needs

The types and amounts of stratigraphic data have diversified and expanded greatly during the past twenty years so that correlations and age dating are accomplished in many different ways. The data are generated and acquired by very different techniques and archived in diverse methods. Much of this data is not readily accessible to the geoscience community. In addition, the robustness of quantitative interpretative techniques has increased so that the analysis of these data can be performed quickly and efficiently at sites remote from the data archives. The need is to archive these diverse data sets in one database that can be reached by the global community at any time.

An SEPM Research Group on Quantitative Stratigraphy would have the scope and expertise to communicate with other groups who are considering these problems, and to address complex issues such as data organization, quality, accountability, and costs of archiving and retrieving. This group which would be in a position to engage SEPM members who have critical skills for these objectives would inform the SEPM membership at large about the potential value added to stratigraphic data by such a globally accessible

database. It would also place SEPM in the forefront of stratigraphic research.

We seek the approval and recognition of this Research Group under the authority of the SEPM Council.

Peri-Tethys Programme Working Group on the Moscovian and Artinskian Maps

Prof. GIAN BATTISTA VAI, Dipart. Scienze Geologiche, Univ. Bologna, V. Zamboni 67, I-40127 Bologna, ITALY.

Report on the Kraków meeting and a call for submissions of stratigraphic data (4 January 1995)

The first meeting of the Working Group was held on 31 August 1994 in conjunction with the IGCP 343 Annual Meeting in Kraków, 29 August-3 September 1994. Following a scientific overview of problems and perspectives related to the late Palaeozoic palaeogeography and palaeogeodynamics of the area the convener (Prof. VAI) introduced the general aim of the two maps. This is to extend in time, downwards to the Carboniferous, the maps already published in the Atlas by DERCOURT *et al.* (1993) and to expand in space, to the peri-Tethyan region, similar palaeogeographic reconstructions attempted for the Palaeozoic by ZIEGLER (1988 etc.).

It was agreed that the two maps should also include part of the areas which have been involved in the Tethyan deformational processes proper, because no map for these two time slices has been attempted so far within the different Tethys projects. General contents and procedures for the preparation of the maps were discussed in detail and the convener was asked to distribute a set of Guidelines and Instruction Sheets for contributors setting out all the items agreed upon at the meeting. A review of potential contributors by countries and groups of countries was made. The usefulness of a call for individual contributions through the information systems of the Peri-Tethys Programme (PTP), the related IGCP 343, 359 and 369, and the pertinent ICS Subcommissions on the Carboniferous and Permian was also stressed.

Finally, it was agreed to speed the gathering of a pertinent database by calling for submission of contributions at a special one day session on the "Late Carboniferous and Early Permian maps", which was organised in conjunction with the PTP meeting in Milan, Italy on 15-16 June 1995. All potential contributors were asked to contact the convener of the session (Prof. VAI, Bologna). The session was held on 17 June 1995 at the same place.

Submissions are to conform to the enclosed guidelines and instructions. The submissions will be presented verbally by their authors and discussed at the session. They will be collected and printed in a special issue to be published, probably by IFP, following the usual referee procedure. The volume is expected to provide an updated close up, concentrated in a shorter time interval, of the issue on "Stratigraphic correlation forms - Pre-Variscan and Variscan events in the Alpine-Mediterranean belts" by IGCP 5 (which appeared in *Rendiconti Soc. Geol. Ital.*, **12** (1989), 2, 437 pp., 1990).

The next informal session of the Working Group will be held during the 13th Int. Congr. Carboniferous-Permian, Kraków, Poland, 28 Aug.-2 Sept., 1995.

Working Group on the Moscovian & Artinskian Maps

****

Guidelines and instructions to contributors

1. The submissions should provide original and/or updated stratigraphic rough data on the Moscovian and/or/to Artinskian time slices in the different areas within the scope of the Programme, mainly as spot columnar sections, with the aim of acting as validation data points for the following map reconstruction:

A. The Moscovian Map, limited to the age interval (~310-330 Ma) and including additional information up to the top of the Carboniferous (~295 Ma).

B. The Artinskian Map, limited to the age interval (~275-265 Ma) and including additional information down to the base of the Permian (~295 Ma).

2. It is preferred that submissions be coordinated in a set of sections by country or group of countries (e.g. France, Belgium, UK, Germany, Poland, Hungary, Austria + Tchekia, Bulgaria + Romania, former Yugoslavia, Turkey, Greece, Italy, Spain, NW Africa, Libya, Central W Africa, Middle East + Arabia, Iran, Russia + Ukraine, Kazakhstan, etc.). However, submissions provided by individuals or research groups are also welcome.

3. The submissions should consist mainly of a set of *spot* columnar sections (stratigraphic columns), possibly correlated on a stratigraphic chart (see ZIEGLER 1988), accompanied by location and/or simplified geological maps and by a concise explanatory text. The text shall not exceed 10 double-spaced, typed pages (or 5 printed pages). Columnar sections, correlation charts (one or more if needed) and location/geological maps must be drawn on A4 sized sheets allowing final print reduction up to 50%. Each individual map drawing must contain a graphic scale.

4. Drawings must be submitted in both colour and black and white (BW) versions, one for the sake of the future map compilation, the other for the immediate purpose of printing the volume. To speed work, it is suggested that the different units in the BW version be labelled with numbers (see legend) and coloured by hand for the colour version.

5. Columnar sections are to be drawn and correlated in time/space (chronostratigraphic) diagrams. The thickness of the different lithostratigraphic units will appear in labelling in a side-column and separate from the text. The vertical axis of the columnar sections (time) will adopt the geo-

logical time scale version by ODIN (1994), following the stage/substage divisions used in DERCOURT et al. (1993) and HARLAND et al. (1990) (see Appendix A).

6. Each individual columnar section (representing a true spot-like section exposed in the field or drilled by a well, or a composite section whose elements are included within the resolution power of a point on a 1:10,000,000 scale map - which is a circle of about 1 km radius) should consist of a main column and a few side columns. The main column should include the lithology, lithostratigraphic units, and depositional environments. The side-columns should contain data on thickness, unconformities, tectonics, magmatic and metamorphic events, tectofacies and other additional information (see legend). The location of each section within a resolution power of 1 km of radius should be identified by means of its latitude and longitude figures.

6. If graphically possible, the columns should include the data on both the Moscovian and Artinskian (plus possibly the intervening interval) on the same sheet (also by using the long side of the A4 sheet).

7. The structure of the legend should mainly conform to the previous one used in DERCOURT *et al.* (1993) with some integrations derived from ZIEGLER (1988), SASSI & ZANFERRARI (1990) and VAI (1991). It seems particularly useful to include whenever possible in the maps the isopach contours or the margins of the main basins of the late Carboniferous (and Moscovian if available separately) and of the early Permian (plus Artinskian if available separately).

In the present stage, the basic legend type, for both the stratigraphic columnar sections and the related geological maps (if available), is reported in Appendix B and C respectively.

When additional subdivisions and symbols are needed, they must be added by the contributors in their own legend sheets, preferably conforming to those used by the above authors.

References

DERCOURT, J., RICOU, L.E. & VRIELYNCK, B. (eds) 1993. Atlas Tethys Palaeoenvironmental Maps. Gauthier-Villars, Paris, 307 p., 14 maps, 1 pl.

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 Univ. Press, 263 p.

ODIN, G.S. 1994. Geologic Time scale (1994). *C. R. Acad. Sci. Paris*, (2), **318**, 59-71.

SASSI, F.P. & ZANFERRARI, A. 1990. Stratigraphic correlation forms. Pre-Variscan and Variscan events in the Alpine-Mediterranean Belts. *Rendiconti Soc. Geol. Ital.*, **12** (1989), 2, 95-433.

VAI, G.B. 1991. Palaeozoic strike-slip rift pulses and palaeogeography in the circum-Mediterranean Tethyan realm. *Paleogeogr., Paleoclim., Paleoecol.*, **87**, 223-252.

ZIEGLER, P.A. 1988. Evolution of the Arctic-North Atlantic and the Western Tethys. *AAPG Mem.*, **43**, 198 p.

Appendices

Appendix A: Geological Time Scale suggested (after ODIN 1994 & HARLAND *et al.* 1990).

Appendix B: Columnar section legend.

Appendix C: Map legend.

Individuals interested in contributing may ask for copies of these appendices from the following contacts:

Prof. G.B. VAI, (address above) **Phone:** +39-51-354552; **Fax:** +39-51-354522; **E-mail:** <Vai@geomin.unibo.it>).

Dr D. VASLET, BRGM,
Av. de Concyr, B.P. 6009,
F-45060 Orléans Cedex, France
Phone: +33-38-643034;
Fax: +33-38-643685).

SCCS VOTING AND CORRESPONDING MEMBERSHIP LIST, 1995

Please check your entry and report any changes to the Secretary

ARGENTINA

Dr S. Archangelsky
URQUIZA 1132
Vicente Lopez (1638)
Buenos Aires,
R. ARGENTINA

Dr Carlos Azcuy
Depto. de Ciencias Geológicas
Pabellón 2, Ciudad Universitaria
C.P.1428 Núñez, Buenos Aires
R. ARGENTINA

Dr Carlos R. Gonzalez
Instituto de Paleontologia
Fundacion Miguel Lillo
Miguel Lillo 251
4000 S.M. deTucumán,
R. ARGENTINA

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

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

AUSTRALIA

Dr N. Archbold
Faculty of Applied Science
Deakin University, Rusden Campus
Clayton VIC 3168
AUSTRALIA

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

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

Dr B.A. Engel
Department of Geology
University of Newcastle
Newcastle,NSW 2308
AUSTRALIA

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
Dept. Geology & Geophysics
University of New England
Armidale, NSW 2351
AUSTRALIA

Dr G. Playford
Department of Earth Sciences
The University of Queensland
Queensland 4072
AUSTRALIA

Dr J. Roberts
School of Applied Geology
The University of New South Wales
Sydney 2052 AUSTRALIA

Dr S. Stojanovic
71 Barracks Road
Hope Valley
Adelaide, SA 5090
AUSTRALIA

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

AUSTRIA

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

Dr Franz Kahler
Walther v.d. Vogelweide-Str. 29
A-9300 St Veit, AUSTRIA

Dr K. Krainer
Inst.für Geol. und Paläontologie
Universität Innsbruck
Innrain 52
A-6020 Innsbruck, AUSTRIA

Dr H.P. Schönlaub
Geol. Bundesanstalt Wien
Rasumofskygasse 23
A-1031 Wien, Postfach 154
AUSTRIA

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

Dr E. Poty
Lab. Paléont., Univ. Liège
Place du XX Août 7
B-4000 Liège
BELGIUM

Dr M. Streel
Lab. Paléont., Univ.de Liège
Place du XX Août 7
B-4000 Liège
BELGIUM

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

BRAZIL

Mr L.E. Anelli
Instituto de Geociências
Univer. de São Paulo, CP 20899
01498-970 São Paulo
BRAZIL

Dr U.G. Cordani
Instituto de Geosciências
Univers. de São Paulo, CP 20899
01498-970 São Paulo
BRAZIL

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

Dr A.C. Rocha-Campos
Instituto de Geociências
Univers. de São Paulo, CP 20899
01498-970 São Paulo
BRAZIL

BULGARIA

Dr Y.G. Tenchov
Geol.Inst. ul. Acad.
Bonchev bloc. 24
Sofia 1113
BULGARIA

CANADA

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

Mr. Sedley Barss
506-6095 Coburg Road
Halifax
Nova Scotia, B3H 4K1
CANADA

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.Geol.Sci., 6339 Stores Rd.
Vancouver B.C., V6T 1Z4
CANADA

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

Dr Bernard L. Mamet
Department of Geology
University of Montreal
Montreal P.Q., H3C 3J7
CANADA

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

Dr S. Pinard
Pinard Consulting
143 Hillgrove Cr. S.W.
Calgary AB, T2V 3K9
CANADA

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

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

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

CZECH REPUBLIC

Dr J. Dvořák
Cesky geologicky Ustav
Leitnerova 22
65869 Brno
CZECH REPUBLIC

Dr Jiří Kalvoda
Dept. Geol. Paleont.
Kotlářská 2
61137 Brno
CZECH REPUBLIC

Dr Jiří Král
Department of Geology
Karlovy University
Viničná 7
128 44 Praha 2, CZECH REPUBLIC

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

Dr Jiří Pesek
Dept.Geol.Min.Depos.,Fac.Science
Charles University
128 43 Praha 2, Albertov 6
CZECH REPUBLIC

EGYPT

Dr Mahmoud M. Kholief
Egyptian Petroleum Research Inst
Nasr City, 7th Region
Cairo, EGYPT

FRANCE

Dr J-F. Becq-Giraudon
BRGM-BP 6009
F-45060 Orleans, Cedex
FRANCE

Dr A. Bouroz
110 Avenue Felix Faure
F-75015 Paris
FRANCE

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 Cédex 05
FRANCE

Dr J.P. Laveine
Lab.Paléobot.,UFR Sci.de la Terre
Univ. Sci. Techn. de Lille
F-59655 Villeneuve d'Ascq Cédex
FRANCE

Dr Marie Legrand-Blain
Université Bordeaux 3
Institut de Géodynamique
Bât."Géologie", Av.des Facultés
F-33405 Talance, FRANCE

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

Dr M.F. Perret
Lab.Géol.Struct., Univ.Paul-Sabatier, 38 rue des 36 Ponts
F-31400 Toulouse
FRANCE

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

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

Dr Z. Belka
Inst.und Mus.für Geol.und Paläont.
Universität Tübingen
Sigwartstr. 10
D-72076 Tübingen, GERMANY

Dr C.G. Brauckmann
Fuhlrott Museum
Auer Schulstrasse 20
D-42103 Wuppertal
GERMANY

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

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

Dr Chr. Hartkopf-Fröder
Geol.Landesamt Nordrh.-Westfalen
De Greiff Str.195
D-47803 Krefeld
GERMANY

Dr Hans-Georg Herbig
Lehrstuhl. für Paläont. u. Hist. Geol.
Geol. Inst., Universität zu Köln
Zülpicher Str. 49a
D-50674 Köln, GERMANY

Dr Hans Kerp
Westfälische Wilhelms-Universität
Abt.Paläobot.am Geol-Pal.Inst.
Hindenburgplatz 57-59
D-48143 Münster, GERMANY

Dr J. Kullmann
Panoramastrasse 27
D-72076 Mössingen 5
GERMANY

Dr Manfred Menning
GeoForschungsZentrum
Telegrafenberg A26
D-14473 Potsdam
GERMANY

Dr E. Paproth
Schwanenburgstr. 14
D-47804 Krefeld, GERMANY

Dr M. von Sperber
DMT-Gesellschaft f. Forsch. u. Prüf.
Inst.für Lagerstätte u.Vermessung
Hernerstr. 40
D-44787 Bochum, GERMANY

Dr D. Stoppel
Bund.fur Geowissen. und Rohstoffe
Stilleweg 2
D-30655 Hannover, GERMANY

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

Dr Matthias Zeller
Geol.Landesamt Nordrh.-Westfalen
De Greiff Str.195
D-47803 Krefeld
GERMANY

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

HUNGARY

Dr.sc. Heinz Kozur
Rézeü u. 83
H-1029 Budapest
HUNGARY

IRELAND

Dr Geoff Clayton
Department of Geology
Trinity College
Dublin 2, IRELAND

Dr Ken Higgins
Department of Geology
University College
Cork, IRELAND

Dr G.D. Sevastopulo
Department of Geology
Trinity College
Dublin 2, IRELAND

ITALY

Prof. Mario Pasini
Universitarià 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 Paleont.
Tohoku University
Kawauchi, Aoba-ku
Sendai, JAPAN 980-77

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
Institute of Geoscience
University of Tsukuba
Tsukuba, Ibaraki, JAPAN 305

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
Inst. of Geology & Mineralogy
Faculty of Science
Hokkaido University, Kita-ku
Sapporo, Hokkaido, JAPAN 060

Dr T. Kawamura
Dept. Earth Sci., Fac.Education
Miyagi Univ. Education, Aoba-ku
Sendai, JAPAN 980

Dr T. Kimura
Inst. Natural History
3-14-24 Takada, Toshima-ku
Tokyo, JAPAN 171

Dr T. Koike
Dept. Geology, Fac. Education
Yokohama National University
Hodogaya-ku
Yokohama, JAPAN 240

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

Dr Yasuhiro Ota
Mine City Museum
Mine City,
Yamaguchi, 759-22 JAPAN

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
Dept. Earth Sci., Fac.Science
Chiba University
Chiba, JAPAN 263

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

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

Dr Tetsuo Sugiyama
Dept. Geology, Faculty Science
Fukuoka University, Jonan-ku
Fukuoka, JAPAN 814-01

Dr J. Tazawa
Dept. Earth Sci., Fac. Science
Niigata University
Niigata, JAPAN 950-21

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

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

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

Dr Juichi Yanagida
Dept. Earth & Planetary Sci.
Fac.Science, Kyushu University
Higashi-ku
Fukuoka, JAPAN 812

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

KAZAKHSTAN

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

Mrs. 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

KOMI REPUBLIC

Dr A.V. Durkina
V.N.I.G.R.I T.P.O.
ul. Pushkina 2
169400 Ukhta
KOMI REPUBLIC

Dr M.V. Konovalova
Geological Expedition (U.G.R.E.)
ul. Geologov 2
169400 Ukhta-2
KOMI REPUBLIC

Dr S.T. Remisova
Inst.Geol.Komi Scientific Centre
ul. Pervomayaskaya 57
167000 Syktyvkar
KOMI REPUBLIC

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

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

Dr Jerzy Fedorowski
Institute of Geology
Adam Mickiewicz University
Maków Polnych 16
61-601 Poznan, POLAND

Dr Tadeusz Peryt
Dept of Chemical Resources
Państwowy Instytut Geologiczny
Rakowiecka 4
00-975 Warszawa, POLAND

Dr S. Skompski
Institute of Geology, Warsaw Univ.
Al Zwirki i Wigury 93
PL-02089 Warszawa
POLAND

Dr H. Zakowa
Państwowy 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
4000 Porto, PORTUGAL

Dr J.T. Oliveira
Instituto Geologico e Mineiro
rua Academia Ciências 19,2
Lisboa 1200, PORTUGAL

RUSSIA

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 T.N. Belskaya
Paleontological Institute
Russian Academy of Sciences
Profsoyuznaya ul. 123
117321 Moskva, RUSSIA

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

Mrs. O.I. Bogush
Inst. Geol. & Geophys. Sib. Otdel.
Siberian Branch, Acad.of Sciences
630090 Novosibirsk, RUSSIA

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

Dr V.A. Chermnykh
Geol.& Chem.Inst., Ural Branch
Russian Academy of Sciences
Pochtovyi per. 7
620219 Sverdlovsk, 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
620219 Ekatezinburg, RUSSIA

Dr Marina V. Durante
Geological Institute
Russian Academy of Sciences
Pyzhevsky per. 7
109017 Moskva, RUSSIA

Dr V.G. Ganelin
V.S.E.G.E.I.
Sredni pr. 74
199026 St. Petersbourg
RUSSIA

Dr N. Goreva
Geological Institute
Russian Academy of Sciences
Pyzhevsky per. 7
109017 Moskva, RUSSIA

Dr N.V. Gosteva
Geological Institute
Russian Academy of Sciences
Pyzhevsky per. 7
109017 Moskva, RUSSIA

Dr T.N. Isakova
Geological Institute
Russian Academy of Sciences
Pyzhevsky per. 7
109017 Moskva, RUSSIA

Dr R.M. Ivanova
Institute of Geology & Geochemistry
Russian Academy of Sciences
Pochtovyi per. 7
620219 Ekaterinburg, RUSSIA

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

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

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

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

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

Dr G.A. Rukina
Geological Institute
Russian Academy of Sciences
Pyzhevsky per. 7
109017 Moskva, RUSSIA

Dr R.A. Schecoldin
Dept. of Historical Geology
Mining Institute, 21st line V.O. 2
St Petersburg, RUSSIA

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 V.T. Zorin
Krasnoyarskgeologia, KANEMA
Prospekt Marksa, 62
660049 Krasnoyarsk
RUSSIA

SLOVENIA

Dr A. Ramovš
Katedra za geologijo in paleont.
Aškerceva 2
SLO-61000 Ljubljana
SLOVENIA

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

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

Dr J.N.J. Visser
Department of Geology
Bloemfontein University
Bloemfontein, 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

Dr Sergio Rodríguez
Depto de Paleontología
Facultad de Ciencias Geológicas
Ciudad Universitaria
28040 Madrid, SPAIN

Dr L.C. Sánchez de Posada
Depto de Geología
Universidad de Oviedo
Arias de Velasco s/n
33005 Oviedo, SPAIN

Dr Elisa Villa
Depto de Geología
Universidad de Oviedo
Arias de Velasco s/n
33005 Oviedo, SPAIN

Dr R.H. Wagner
Unidad de Paleobotánica
Jardín Botánico de Córdoba
Avenida de Linneo s/n
14004 Córdoba, SPAIN

TARTARSTAN

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

THE NETHERLANDS

Bibliotheek Palaeobotanie
Lab. Palaeobotany & Palynology
Rijksuniversit., Heidelberglaan 2
NL-3584 CS Utrecht
THE NETHERLANDS

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. Kürschner
Lab. Palaeobotany & Palynology
Rijksuniversit., Heidelberglaan 2
NL-3584 CS 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

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 C.J. Cleal
37 Lipscombe Close
Newbury
Berkshire RG14 5JW
UNITED KINGDOM

Dr R.M.C. Eagar
23 High Bond End
Knaresborough
North Yorks HG5 9BT
UNITED KINGDOM

Dr A.C. Higgins
9 Tresglos Court
Oatlands Drive
Weybridge, Surry 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

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 James W. Baxter
Illinois State Geological Survey
615 E. Peabody Drive
Champaign,IL 61820 U.S.A.

Ms Karen Braithwaite
Dept of Geology & Geophysics
University of California
Berkley, CA 94720-4767 U.S.A.

Dr Paul Brenckle
Amoco Production Company
P.O. Box 3092, Rm 1006 W3
Houston Texas, TX 77253 U.S.A.

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.

Dr J.L. Carter
Carnegie Museum of Natural History
4400 Forbes Ave.
Pittsburgh, PA 15213 U.S.A.

Dr D.R. Chesnut
Kentucky Geological Survey
228 Min.Res.Bldg, Univ. Kentucky
Lexington, Kentucky 40506-0107
U.S.A.

Dr H.H. Damberger
Illinois State Geological Survey
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
U.S. Geological Survey
Rm E-311, Museum Natural History
Washington,DC 20560 U.S.A.

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.

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 U.S.A.

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

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.

Dr G. de V. Klein
President, New Jersey
Marine Sciences Consortium
Building #22
Fort Hancock, NJ, 07732 U.S.A.

Dr R.M. Kosanke
U.S. Geol.Survey, Fed.Center
Bldg 25, Box 25046, M.S. 919
Denver, CO, 80225-0046 U.S.A.

Ms Andrea Krumhardt
Dept of Geology & Geophysics
University of Alaska
P.O. Box 775780
Fairbanks, AK 99775 U.S.A.

Dr Lance Lambert
Department of Geology
University of Iowa
Iowa City, IA, 52242-1379 U.S.A.

Dr H. Richard Lane
Amoco Production Co.USA
550 Westlake Park Blvd,
P.O. Box 3092
Houston, TX, 77253 U.S.A.

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
1920 South 101/2 Street
Springfield, IL 62703 U.S.A.

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.

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
Kansas Geological Survey
1930 Constant Ave
Lawrence, KS 66047 U.S.A.

Dr Hermann W. Pfefferkorn
Dept.Geol., Univ.Pennsylvania
240 S 33rd St.
Philadelphia, PA, 19104-6316
U.S.A.

Dr Carl B. Rexroad
Indiana Geological Survey
611 N. Walnut Grove
Bloomington, IN, 47405 U.S.A.

Dr C.A. Ross
GeoBioStrat Consultants
600 Highland Drive
Bellingham, WA 98225-6410 U.S.A.

Dr June R.P. Ross
600 Highland Drive
Bellingham, WA 98225-6410 U.S.A.

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

Dr William J. Sando
5348 Thayer Avenue
Alexandria, VA 22304 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 Lynn S. Soreghan
Amoco Production Company
P.O. Box 3092
Houston Texas, TX 77253 U.S.A.

Dr C.H. Stevens
Dept. Geology, School of Science
San Jose State University
San Jose, CA, 95192-0102 U.S.A.

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

Dr T.N. Taylor
Department of Plant Biology
Ohio State Univ., 1735 Neil Ave.
Columbus, OH, 43210 U.S.A.

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.

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.

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.

Dr R.R. West
Dept.Geol., Thompson Hall
Kansas State University
Manhattan, KS, 66506-3201 U.S.A.

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 V.K. Teteryuk
Chernigov. Otd. U.Kr. N.I.G.R.I.
ul. Shchors 8
250000 Chernigov, 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 VOTING MEMBERSHIP 1992-1996

Dr Paul L.Brenckle
Amoco Production Company
501 Westlake Park Blvd
P.O. Box 3092, Rm 1006 W3
Houston TX 77253-3092 U.S.A.

Dr Boris Chuvashov
Inst. Geology/Geochemistry
Russian Academy of Sciences
Pochtoryi per. 7
620219 Ekatezinburg, RUSSIA

Dr Marina V. Durante
Geological Institute
Russian Academy of Sciences
Pyzhevsky per. 7
109017 Moskva, RUSSIA

Dr J.T. Dutro Jr
U.S. Geological Survey
Rm E-311, Museum Natural History
Washington,DC 20560 U.S.A.

Dr Brian A. Engel
Department of Geology
University of Newcastle
Newcastle, N.S.W. 2308 AUSTRALIA

Dr Carlos R. Gonzalez
Instituto de Paleontologia
Fundacion Miguel Lillo
Miguel Lillo 251
4000 S.M. deTucumán
ARGENTINA

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

Dr Hisayoshi Igo
Institute of Geoscience
University of Tsukuba
Tsukuba, Ibaraki, JAPAN 305

Dr R.M. Kosanke
U.S. Geol.Survey, Fed.Center
Bldg 25, Box 25046, M.S. 919
Denver, CO, 80225-0046 U.S.A.

Dr H. Richard Lane
Amoco Production Company
501 Westlake Park Blvd
Rm 1086W3, P.O. Box 3092
Houston, TX, 77253-3092 U.S.A.

Dr J.P. Laveine
Lab.Paléobot.,UFR Sci.de la Terre
Univ. Sci. Techn. de Lille
F-59655 Villeneuve d'Ascq Cédex
FRANCE

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

Dr Bernard L. Mamet
Department of Geology
University of Montreal
Montreal P.Q., H3C 3J7, CANADA

Dr W.L. Manger
Department of Geology
Univ. of Arkansas
Fayetteville, AR, 72701 U.S.A.

Dr Eva Paproth
Schwanenburgstr. 14
D-47804 Krefeld,
GERMANY

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

Dr John Roberts
School of Applied Geology
The University of New South Wales
Sydney 2052 AUSTRALIA

Dr A.C. Rocha-Campos
Instituto de Geociências
Univ.de São Paulo, CP 20899
São Paulo, SP 01498-970, BRAZIL

Dr George D. Sevastopulo
Department of Geology
Trinity College, Dublin 2, IRELAND

Dr R.H. Wagner
Unidad de Paleobotánica
Jardín Botánico de Córdoba
Avenida de Linneo s/n
14004 Córdoba, SPAIN

Dr C.F. Winkler Prins
Nationaal Natuurhistorisch Museum
Postbus 9517
NL-2300 RA Leiden
THE NETHERLANDS

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