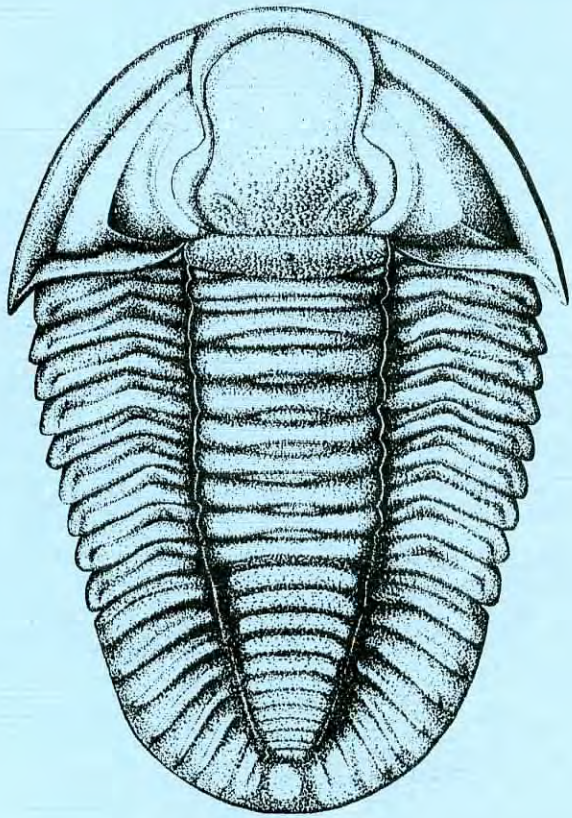
NEWSLETTER ON CARBONIFEROUS STRATIGRAPHY

Volume 9 **July 1991**



SCCS

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

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The *Newsletter on Carboniferous Stratigraphy* is distributed free of charge to Corresponding and Voting Members of SCCS. Financial support from IUGS, distributed through ICS, is gratefully acknowledged. Due to the high costs of printing and distributing the *Newsletter*, this assistance is insufficient to cover the operating expenses of the Subcommission. Small donations from members, sent to the Secretary or the Chairman, will enable SCCS to remain financial and will be acknowledged in subsequent Newsletters, subject to the donor's agreement.

THE COVER ILLUSTRATION

The diagram on the cover is a hand drawing of the trilobite species *Gitarra superba* (Mitchell 1918) which is found in strata of Mid Viséan age in New South Wales and Queensland, Australia. (magnification x6). Diagrams suitable for printing on the cover of the *Carboniferous Newsletter* would be appreciated.

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NEWSLETTER ON CARBONIFEROUS STRATIGRAPHY

Official publication of the I.U.G.S. Subcommission on Carboniferous Stratigraphy

VOLUME 9 **JULY 1991**

1.1 THE CHAIRMAN'S COLUMN

The next meeting of the Subcommission is linked to the International Congress on Carboniferous and Permian Stratigraphy and Geology, in Argentina, in September this year. The 'Carboniferous' or 'Heerlen' Congresses, as these international meetings were called until four years ago when the Permian was included in the name and research objectives, were founded by three practising biostratigraphers who collaborated successfully despite dramatic political incidents. They were the Belgian RENIER, the Dutch JONGMANS, and the German GOTHAN, officers of their national geological surveys, who had worked out detailed stratigraphical subdivisions in coal measures of several different basins in north and central Europe.

The necessity to work out correlation tables between numerous stratigraphic subdivisions made international cooperation essential. The triumvirate GOTHAN, JONGMANS and RENIER called together world specialists in 1927 to the first congress which was organised in the Dutch Heerlen Geologisch Bureau.

During that first congress, specialists presented and discussed stratigraphic subdivisions for all of Europe and USSR. The second congress, eight years later, expanded the scope of the discussion to include details of Carboniferous rocks from East Asia, America and Gondwana. Efficient international collaboration had started, thanks to the dedicated efforts and scholarship of the original triumvirate.

At present, some 64 years later, we have yet to achieve a global subdivision of the Carboniferous: the relationship between the passage of time and a successful outcome needs to be improved. The only function of the Subcommission is to serve the geological community by the production of an internationally acceptable, practical, stratigraphic subdivision of the Carboniferous. This is a fascinating goal and duty, and I should like to call on everybody - particularly members and correspondents of the Subcommission - to re-double our efforts towards achieving our primary scientific objective by emulating the zeal and scholarship of the initiators of the first Carboniferous Congress.

Eva Paproth

1.2 DONATIONS BY SCCS MEMBERS

Several members have given donations towards the operation of the Subcommission in the period since the last Newsletter. Their voluntary assistance is most appreciated. The combination of support from IUGS (ICS) and our members has enabled us to finish the year with a credit balance, without drawing down the modest reserves at our disposal. We look forward to the ongoing support of the membership by the provision of small contributions wherever it is possible.

European members of SCCS who wish to contribute to the cost of the Newsletter are asked to forward their donations to the Chairman, Dr Eva Paproth who will act as a central collection agency for the region. Funds may be sent to **DEUTCHE BANK, KREFELD** for deposit in **ACCOUNT No. 598367.**

Members in the United States should continue to use **MasterCard or Visa Card** to send their donations. Due to currency fluctuations, the amount charged to your credit card may not exactly match the donation provided since there is a double currency conversion process involved.

	Donation	AUS$
Dr J.W. Baxter, USA	US50	62.42
Dr J.L. Carter, USA	US30	32.58
Dr J.T. Dutro Jr, USA	US25	32.08
Dr E. Grossens, Belgium	DM20	16.55
Dr K. Ishizaki, Japan	US20	24.42
Dr R.M. Kosanke, USA	US25	32.30
Dr M. Legrand-Blain, France	DM100	82.77
Drs R.H. & G. Mapes, USA	US20	20.02
Dr E. Paproth, Germany	DM15	12.42
Dr G. Playford, Australia	AUS15	15.00
Dr W. Ramsbottom, UK	AUS50	50.00
Drs C.A. & J.R.Ross, USA	US40	48.84
Dr von Sperber, Germany	DM20	16.55
Dr D. Stoppel, Germany	DM15	12.42

TOTAL DONATIONS (7/90 TO 5/91) AUS$458.37

2.0 ANNUAL REPORT OF THE SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY

2.1 MEMBERSHIP AND OFFICERS

MEMBERSHIP

The Subcommission has 24 *Voting Members* comprised of 3 Bureau Officers, 1 Past Chairman, 20 Voting Members including 1 Working Group Chairman. There are 236 *Corresponding Members* on the mailing list.

SCCS holds biennial meetings, one in conjunction with the International Congress on Carboniferous Stratigraphy and Geology (four yearly intervals) and the other at a Field and General Meeting of the Subcommission midway between Congresses.

BUREAU OFFICERS

Chair - Dr Eva Paproth, Schönwasserstr. 103, D-4150 Krefeld, GERMANY

Secretary - Dr B.A. Engel, Dept of Geology,University of Newcastle, N.S.W. 2308 AUSTRALIA

Associate Secretary - Dr Hisayoshi Igo, Inst.of Geoscience, Univ.of Tsukuba, Ibaraki 305 JAPAN

It is with deep regret that we report the death of a Corresponding Member, Dr G.E. de Groot in November, 1990. She will be sadly missed by all her colleagues, especially those at the Nationaal Natuurhistorisch Museum in Leiden, The Netherlands.

2.2 ACCOMPLISHMENTS OF 1990

(A) Ballots submitted for ratification

Subcommission Voting Members endorsed eight proposals which were forwarded to ICS/IUGS for formal ratification in 1989 (Newsletter 8, p.3). To date ICS has deferred a decision on these proposals until the stratotype for the Mid-Carboniferous Boundary has been selected.

(B) Re-structuring of Subcommission Working Groups

As previously noted, reorganisation of the Subcommission Working Groups took the form of a move from numerous regional groups to a focus upon just three, namely the mid-Carboniferous Boundary Working Group, and two new ad hoc Working Groups dealing with further subdivision within the 'lower' and 'upper' Carboniferous. The Chairmen selected for each of the 'lower' and 'upper' Carboniferous subdivisions were Dr Paul Brenckle and Dr C.F. Winkler Prins. Each was charged with the responsibility of organising an ad hoc Working Group to evaluate potential boundaries which could provide further global subdivision of their respective subsystems. The SCCS General Meeting held in Provo, Utah (September 24-26, 1989) provided a forum for progress reports from each Chairman as well as detailed contributions from those specialists who were present at the meeting (Newsletter 8, p.5).

As a result of the presentations, six stratigraphic levels were nominated as being worthy of further investigation, three being located in each of the 'upper' and 'lower' subdivisions. These levels will now form the central focus of future work by the Subcommission. Current action plans require the presentation of a first evaluation of these levels in Argentina in September, 1991. The ad hoc Working Groups were discharged at the end of the Provo Meeting. The meeting unanimously carried a vote of thanks to Drs Brenckle and Winkler Prins for their major contribution in setting the future direction of the Subcommission.

(C) Mid-Carboniferous Boundary Working Group

The Working Group has completed two further field inspections of potential stratotype sections, the first in the Donetz Basin/Kiev region (USSR) and the second in Utah/Nevada (USA) in association with the Provo General Meeting. Both inspections were reported in Newsletter 7 (p.14,19-20) and Newsletter 8 (p.12). No further meetings of the Working Group were scheduled for 1990-91.

2.3 PUBLICATIONS 1990

The manuscript of the Provo Conference proceedings consisting of 350 camera-ready pages was published on March 31, 1991, after a lengthy delay at the printers. It has now appeared as volume 130 of ***Courier Forschungsinstitut Senckenberg*** and bears the title "Intercontinental Correlation and Division of the Carboniferous System". The editors Paul Brenckle and Walter Manger are to be commended for their major effort in the preparation of this publication which contains 28 contributions. Members may purchase this volume (75DM) from Professor Dr Willi Ziegler, Forschungsinstitut Senckenberg, Senckenberganlage 25, 6000 Frankfurt/Main 1, Germany.

Table of Contents - Provo Conference

Lower Carboniferous Boundaries

BRENCKLE,P.L.: Lower Carboniferous (Mississippian) Boundaries Working Group: Organization, results and future directions.

BELKA,Z.: Potential conodont levels for intercontinental division of the Lower Carboniferous.

CONIL,R., GROESSENS,E., LALOUX,M., POTY,E. & TOURNEUR,F: Carboniferous guide foraminifera, corals and conodonts in the Franco-Belgian and Campine Basins: their potential for widespread correlation.

WEBSTER,G. & GROESSENS,E.: Conodont subdivision of the Lower Carboniferous.

WANG,Z.H.: Conodont zonation of the Lower Carboniferous in South China and phylogeny of some important species.

POLETAEV,V.I., BRAZHNIKOVA,N.E., VASILYUK,N.P. & VDOVENKO,M.V.: Local zones and major Lower Carboniferous biostratigraphic boundaries of the Donets Basin (Donbass), Ukraine, U.S.S.R.

BOGUSH,O.I. & YUFEREV,V.O.: Foraminifers and problems at the Tournaisian-Visean boundary in Siberia and northeast U.S.S.R.

BRENCKLE,P.L.: Foraminiferal division of the Lower Carboniferous/Mississippian in North America.

CLAYTON,G., LOBOZIAK,S., STREEL,M., TURNAU,E. & UTTING,J.: Palynological events in the Mississippian (Carboniferous) of Europe, North Africa and North America.

PLAYFORD,G.: Australian Lower Carboniferous miospores relevant to Extra-Gondwanic correlations: An evaluation.

KULLMANN,J, KORN,D & WEYER,D.: Ammonoid zonation of the Lower Carboniferous Subsystem.

RILEY,N.J.: A global review of Mid-Dinantian ammonoid biostratigraphy.

CARTER,J.L.: Subdivision of the Lower Carboniferous in North America by means of articulate brachiopod generic ranges.

LEGRAND-BLAIN,M.: Brachiopods as potential boundary-defining organisms in the Lower Carboniferous of Western Europe: Recent data and productid distribution.

SANDO,W.J.: Global Mississippian coral zonation.

ENGEL,B.A. & MORRIS,L.N.: The biostratigraphic potential of Carboniferous trilobites from eastern Australia.

HAHN,G.: Palaeogeographic distribution and biostratigraphic significance of Lower Carboniferous trilobites: A review.

AZCUY,C.L., SABATTINI,N. & TABOADA,A.C.: Advances in the Lower Carboniferous zonation of Argentina.

SEVASTOPULO,G.D., LANE,N.G. & WATERS,J.A.: Stratigraphic distribution of crinoids and blastoids in the Lower Carboniferous.

Mid-Carboniferous Boundary

VARKER,W.J., OWENS,B. & RILEY,N.J.: Integrated biostratigraphy for the proposed Mid-Carboniferous Boundary Stratotype, Stonehead Beck, Cowling, North Yorkshire, England.

OWENS,B., VARKER,W.J. & HUGHES,R.A.: Lateral biostratigraphical consistency across the Mid-Carboniferous Boundary in Northern England.

NEMIROVSKAYA,T.I., POLETAEV,V.I. & VDOVENKO,M.V.: The Kal'mius Section, Donbass, Ukraine, U.S.S.R.: A Soviet proposal for the Mid-Carboniferous Boundary Stratotype.

GIBSHMAN,N.B. & AKHMETSHINA,L.Z.: Micropaleontologic basis for determination of the Mid-Carboniferous Boundary in the North Caspian Syneclise, U.S.S.R.

Upper Carboniferous Boundaries

WINKLER PRINS,C.F.: SCCS Working Group on the subdivision of the Upper Carboniferous s.l.("Pennsylvanian"): A summary report.

LAMBERT,L.L. & HECKEL,P.H.: The Atokan/Desmoinesian boundary in North America: Preliminary considerations for selecting a boundary horizon.

BOARDMAN,D.R., HECKEL,P.H., BARRICK,J.E., NESTELL,M. & PEPPERS,R.A.: Middle-Upper Pennsylvanian chronostratigraphic boundary in the Midcontinent region of North America.

RUI,L. & ZHANG,L.X.: Chronostratigraphic subdivision of the Upper Carboniferous of South China.

MANGER,W.L. & SUTHERLAND,P.K.: Comparative ammonoid/conodont-based and foraminifer-based Middle Carboniferous correlations.

2.4 WORK PLAN FOR 1991

With the identification of six potential levels at which it may be possible to place global boundaries for stages within the Carboniferous, the Subcommission has resolved to pursue the following action plan.

Subsequent to the Provo Meeting, six projects were offered to potential project leaders, each of whom was asked to form an international group charged with the investigation of one of these levels. To date five of the six projects have leaders who have successfully organised an international consultative panel.The leaders have been asked to prepare a preliminary report for the 1991 Argentina Congress, setting out the diagnostic faunal/floral elements which have already been identified at their chosen level together with an assessment of the potential of that level for global correlation. The six project levels presented in Newsletter 8 (p.5-6) are:

Project 1: A boundary at the late Middle to early Late Tournaisian (Upper Tn2-Lower Tn3) (Kinderhookian-Osage boundary). **Leader:** Dr Paul Brenckle.

Project 2:A boundary at the latest Tournaisian - earliest Viséan (Tn3c-V1a) (Mid Osage). **Leader:** Dr George Sevastopulo.

Project 3:A boundary at the Late Middle Viséan (approx. V3b) (late Meramecian). **Leader:** Dr Zdzislaw Belka.

Project 4: A boundary at the base of G2; *Branneroceras branneri* Zone. **Leader:** Dr J. Kullmann.

Project 5:A boundary at the base of *Fusulina/Beedeina* occurrence (Atokan - Desmoinesian boundary) (mid Moscovian). **Leader:** Not determined.

Project 6:A boundary at the base of the *Protriticites* Zone - Kasimovian; basal Missourian; mid Cantabrian. **Leader:** Dr Elisa Villa.

The objective at the conclusion of this process will be to decide if it is appropriate to create formal Working Groups with a charter to select a potential stratotype from what is expected will be a potential short list of not more than three or four possibilities. The limited time frame for such Working Groups to complete their studies will be set when the potential sections have been identified. Criteria for such sections are set out on page 6 of Newsletter 8.

2.5 PROJECT GROUP 5: REPORT ON THE BASE OF THE *PROTRITICITES* ZONE

By E. Villa, Fac. de Biología, Unidad de Geología, Universidad de León, 24071 León, Spain.

After their meeting in Provo, Utah (1989), SCCS asked me to organise an international project group to investigate the palaeontological content of the base of the *Protriticites* Zone. The objective might not only be the evolutionary history of the name-bearing taxon and its ancestor *Fusulinella*, but also evolutionary changes in the various fossil groups which could potentially help to find out the characteristic assemblages of this interval of time and to establish global correlations. Studies devoted to investigating palaeogeographical aspects and to detecting palaeoenvironmental changes also would be of great interest. The *Carboniferous Newsletter* in July 1990 published this project under the title "A boundary at the base of the *Protriticites* Zone, (basal Kasimovian; basal Missourian; mid-Cantabrian)".

For more than a year I have devoted time to organising the collaboration of specialists in several fossil groups, representing all the main Carboniferous areas of the world. So, the following researchers have agreed to participate in the project team.

Dr R. Coquel (France)	palynomorphs	N.Africa, W.Europe
Dr A.C.van Ginkel (Holland)	fusulinids	N.Spain
Dr H. Igo (Japan)	conodonts, fusulinids	Japan, Thailand
Dr B. Mamet (Canada)	algae	worldwide
Dr M. Martínez-Chacón(Spain)	brachiopods	N.Spain
Dr C.A. Ross (USA)	biogeography	worldwide
Dr L. Rui (Canada)	fusulinids	Canadian Arctic
Dr M.N. Solovieva (USSR)	fusulinids	Russian Platform, M.Asia, N.& C.Arctic
Dr R.H. Wagner (Spain)	macroflora	N.Spain
Dr C.F. Winkler Prins(Holland)	brachiopods	Spain

Replies from some more specialists who have been invited to participate have yet to arrive, The group is still open to others who may be interested. Offers from specialists in fossil groups not yet represented (ammonoids, corals, etc.) will be specially welcome as will those working in other Carboniferous regions not yet represented.

I have asked each investigator to coordinate research in diverse aspects in their areas, organising some local groups and carrying out proposals for a suitable stratotype for this boundary. Although the composition of the project group is incomplete, some local groups are already working and preparing reports on the present state of knowledge in their areas. I hope that in the near future all the local groups will have commenced and that the project group will be able to meet its objectives. Subsequently, I plan to summarise the papers coming from all the investigators in a report which will be presented at a Carboniferous Subcommission meeting. In addition, I would like to publish a volume incorporating all the individual contributions, a discussion and a summary report.

3.0 SUBCOMMISSION FINANCIAL REPORT

3.1 STATEMENT OF INCOME AND EXPENDITURE 1989-90

INCOME		Definitive AUS$	Estimated US$
IUGS Allocation for 1990		363.42	300.00
Donations of members		387.56	288.21
Bank interest		54.27	43.42
TOTAL INCOME		805.25	631.63
EXPENDITURE			
Stationery:	Envelopes	3.40	2.72
Printing Costs:	Newsletter 8	203.00	162.40
Postal Charges:	Nov.89-Oct.90	280.50	224.40
Sundry Expenses:	Typing	150.00	120.00
	Bank Charges	2.62	2.10
TOTAL EXPENDITURE		639.52	511.62

Explanatory Notes:

All banking transactions are conducted in Australian dollars and previous balance sheets have been calculated using a standard rate of exchange (AUS$1.00=US$0.78). The 1988-89 balance sheet was presented in US$ using this conversion. As a result of loss in value of the AUS$ in 1990-91, the credit balance for 1988-89 is now overstated by US$194.70. To prevent this confusion, all future balance sheets will be given in DEFINITIVE AUS$ terms with a second column showing the approximate US$ equivalent values. To demonstrate the variation, the balance sheets for 1988-89 & 1989-90 are both presented below.

BALANCE SHEET (1988-89):	Definitive AUS$	Estimated US$
Funds carried forward from 1988	1280.89	1145.89
PLUS Income 1988-1989	1476.51	1221.53
LESS Expenditure 1988-1989	1403.50	1089.60
CREDIT balance c/fwd to 1990	1353.90	1277.82

BALANCE SHEET (1989-90):	Definitive AUS$	Estimated US$
Funds carried forward from 1989	1353.90	1083.12
PLUS Income 1989-1990	805.25	631.63
LESS Expenditure 1989-1990	639.52	511.62
CREDIT balance c/fwd to 1991	1519.63	1203.13

The ability of the Subcommission to hold its expenditure to a little less than the income received is due to two factors. The first is the response of numerous members to the request for small supporting donations which have been acknowledged with great thanks. It is easy to see in the above income and expenditure account that on its own, the IUGS subsidy would have met less than half of the annual expenditure.

The second acknowledgment is made to those members and organisations who have undertaken to cover the costs of postage within their regional boundaries. The Newsletter is sent in bulk to those members by economy air postage. They then re-post the issues individually into the local mail system. This represents a saving at least equal to the Australian postage of near $300, and puts the real annual expenditure of the Subcommission close to AUS$1000. We are indeed fortunate to have such good friends.

3.2 BUDGET ESTIMATES FOR 1991

Support from IUGS was sought for the following expenditure:

ITEM	AUS $	US $
1. Printing	330	$264
2. Stationery	$115	$ 92
3. Postage Costs	$460	$368
4. Part-Time Typing Assistance	$305	$244
5. Conference Support	$625	$500
TOTAL BUDGET	$1835	$1468

The IUGS Treasurer, Dr M. Schmidt Thomé, has recently forwarded US$650 for the 1991 subsidy of the Subcommission. This represents a substantial increase over the 1990 allocation of US$300, indicating that IUGS finances have shown a considerable improvement in the past year of operation.

4.0 XII INTERNATIONAL CARBONIFEROUS CONGRESS - BUENOS AIRES, 22-27 SEPTEMBER 1991

Report by the Conference Organiser, **Dr Sergio Archangelsky**, dated May 21, 1991.

EXCURSIONS: The total number of excursion participants at present is almost 80. **The excursions which will run include 1A, 2A, 3A, 3B, 4B and the Bolivia excursion.** Due to the low number of possible participants, the following excursions have been cancelled - 1B, 2B, 4A, and 5B.

ABSTRACTS: At the end of this report there is a list of the names of symposia and sessions with the names of participants who have submitted abstracts. This list has been included because there are possibly some abstracts which have been lost in the mail. In all there are about 200 abstracts which are currently being prepared for final printing. It is possible to include extra titles up until they are sent to the printers on July 31, 1991.

PARTICIPANTS: Some 300 participants are expected to attend. There were about 400 replies to Circular 1 from which 200 have submitted an abstract and a further 60 registrations have been paid without abstracts being submitted. The countries represented so far include - Argentina, Australia, Belgium, Bolivia, Brazil, Britain, Canada, Chile, China, Egypt, France, Germany, India, Peru, South Africa, The Netherlands, Spain, United Arab Emirates, Uruguay, USA, USSR. Although many East European countries answered Circular 1, so far only abstracts from the USSR have been submitted.

CONFERENCES: Plenary lectures for the first day, Monday, September 23 include: E. Paproth, A. Cuerda, A. Rocha Campos, R.H. Wagner, C. Sengör, H.W. Hagemann and C.F.K. Diessel. The opening ceremony on the same day from 9-10:30 am will include welcoming words from A.C. Riccardi (President of the Argentine Committee for Stratigraphy), the Secretary of State in Science and Technology (or his delegate), a written letter by Yang Jingzhi, and the Congress Organiser, S. Archangelsky. These activities will be located in the one large room (Salon Grand Bourg).

TECHNICAL SESSIONS: These will occupy three rooms simultaneously on Tuesday, Wednesday morning, and all of Thursday and Friday. Wednesday afternoon will be devoted to posters, IGCP Project 211 (with probable presentation of a pre-print of the book, *The Permian System in Argentina and Uruguay*), and other meetings. The closing session will be on Friday evening. An extra room will be used on Friday by the IGCP Project 272 (Dickins). Sessions will be programmed from 9:00 am to 12:30 pm and 2:30 pm to 5:30 pm, with morning and afternoon breaks. It is expected that more contributions will be submitted in the near future and sessions can be extended or another room used.

PERMANENT COMMITTEE: The Permanent Committee for ICC will meet on Sunday, September 22, from 10 am to 12 noon at the Libertador Hotel (one Congress room). A second meeting will be held on Thursday, September 26, at 6 pm.

SCCS MEETINGS: The General Meeting of SCCS will occur on Sunday, September 22 from 3 to 5 pm. Voting Members will meet at 6 pm on Tuesday, September 24 and the Mid-Carboniferous Boundary Working Group will meet at 6 pm on Wednesday, September 25. All meetings will be held in the same room.

CIRCULAR 3: This will be printed in June and distributed to all registered members (400). It will include the Program for Technical Sessions, Opening Session, data about Excursions, climate, visas and other general information. In July and August there may be additional information for the Technical Sessions which will be added to the information in Circular 3.

POSTERS: To date seven posters have been submitted for the Wednesday afternoon.

PUBLICATIONS: During the Congress there will be a room for the sale of geological and palaeontological literature from Argentina. Mailing facilities will be provided.

ACCOMMODATION: At the Libertador Hotel there are restaurants, bars and lounges. There will be a cocktail party on Sunday evening (free) and a dinner on Thursday night is being planned (paid tickets).

ACCOMPANYING MEMBERS: Several accompanying members have booked for interesting tours in town and surroundings. On Wednesday afternoon, for those who are interested, a visit to the La Plata Natural History Museum is also planned. Visits to different laboratories before and after the Congress are also planned.

SCIENTIFIC PROGRAM

A List of Symposia with submitted abstracts

S1 - Late Palaeozoic Palynology (Playford, Owens, Azcuy)

1.& 2. Gao Lianda; 3. Highton et al.; 4 Playford; 5 Scott et al.; 6 Utting; 7 Vergel et al.; 8 Vergel; 9 Yang & Sun; 10 Van de Laer & van der Zwan (Poster).

S2 - Late Palaeozoic Palaeomagnetism (Vilas, Tarling). Cancelled.

S3 - Glacial events through Gondwana (Visser, Dickins, Gamundi)

1 Alaheren et al.; 2 Crowell; 3 Diaz et al.; Gonzalez; 5 Langenheim; 6 Soreghan; 7 Visser; 8 França et al.; 9 Gamundi & Espejo; 10 Ferrando & Andreis; 11 Alley.

S4 - Late Palaeozoic Fossil Fuels (Wolf & Viller)

1 Guan Shiqiao; 2 Correa da Silva & Wolf; 3 Petra; 4 Davis & Karyetas; 5 Dill et al.; 7 Hanley et al.; 8 Jin & Zhao; 9 Jones & Scott; 10 Little et al.(Poster); 11 Maximovich & Gorbunova; 12 Miehra; 13 Pimental, Mizusaki et al.; 14 Triguls; 15 Veld et al.; 16 Zodrow; 17 Villar & Gamundi; 18 Bahamonde et al.(Poster); 19 Toporets; 20 Gurevich; 21 Diessel.

S5 - Late Palaeozoic Tectonics (Ramos)

1 Bahamonde & Nuño; 2 Breitkreuz; 3 de Beer; 4 Goewami; 5 Kaplan; 6 Rodriguez Fernandez; 7 Windolph; 8 Kay & Mpodozia; 9 Ramos & Linares; 10 Koetadnoff; 11 Rapellni et al.

S6 - Permian Floras: problems and progress (Taylor) (with Palaeobotany sessions).

S7 - Late Palaeozoic metalliferous resources (Brodkorpb & Brodkorpb) (with Magmatism sessions).

S8 - Brachiopods and Mollusca (Winkler Prins & Sabattini)

1 Alleman; 2 Dickins; 3 Feng; 4 Gonzáles; 5 Martinez Chacón & Winkler Prins; 6 Zhang; 7 Dutro; 8 Lazarev; 9 Feng; 10 Gordon; 11 Lech; 12 Taboada; 13 Simanauskas.

S9 - Gondwana magmatism (Pankhurst & Rapela)

1 Cucchi; 2 Dalla Salda et al.; 3 Goewami; 4 Viljoen; 5 Dill; 6 De Stefano et al.

S10- Late Palaeozoic Geochronology (Cordani & Linarea) (Round table)

S11 - Preservation of plant fossils (Scott & Galtler)

1 Memaley & Scott; 2 Zodrow.

S12 - Late Palaeozoic Phytopalaeoecology (Gastaldo & Cúneo)

1 Oshurkova; 2 Alvarez Ramis; 3 Mei Metang; 4 Cúneo & Iabell; 5 Pfefferkorn & Alleman; 6 Taylor et al.; 7 Wagner et al.

R.Str. - Regional Stratigraphy

1 Andreis et al.; 2 Colmenero et al.; 3 Diaz et al.; 4 Sevesso et al.; 5 Ferrando et al.; 6 Johnson; 7 Richards et al.; 8 Sempere et al.; 9 Virgili; 10 Kholieff; 11,12 Starck et al.; 13 Englund; 14 Rodrigues et al.

Biostr. - Biostratigraphy

1 Breitkreuz et al.; 2 da Cunha Lopez et al.; 3 Guerrs Sommer et al.; 4 Ivanova; 5 Limarino et al.; 5 Morel et al.; 7 Movehovich; 8 Rodrigues et al.; 9 Villa et al.; 10 Daemon et al.; 11 Roberts et al.

Fossil Faunas - 1 Richter; 2 Brauckmann.

Palb. - Palaeobotany

1 Brown; 2 Guo y Tian; 3 Laveine; 4 & 5 Laery; 6 Lyona & Morey; 7 Srivastava; 8 Vega; 9 Zodrow; 10 Mei Meitang; 11 Taylor; 12 Cúneo et al.; 13 Pfefferkorn & Blz; 14, 15 Pant et al.

PG - Palaeogeography and Palaeobiogeography

1 Visser; 2 Canter 3 Abdesselam-Rovigvi (Devonian?); 4 Mamet; 5 Danner; 6 Laveine et al.; 7 Raymond & Kelley; 8 Cúneo; 9 Mossbruger; 10 Goganova; 11 Sablock; 12 Dutro & Isaacson.

Sedi - Sedimentology

1 Chesnut et al.; 2 Chesnut; 3 Luna et al.; 4 Neal; 5 Nuñez del Prado; 6,7,8 Zalba et al.; 9 Lyons et al.; 10 Perez et al.; 11 Andreis et al.; 12 Herbig; 13 Netto; 14 Buatois; 15 Pfefferkorn & Fuchs; 16 Galbardon.

GSCb - Global Subdivision of the Carboniferous

1 Chernikh & Remizova

MISCELLANEOUS CORRESPONDENCE AND NEWS ITEMS

NEW BOOK FOR SALE

Dr H.W.J. van Amerom of Rijks Geologische Dienst has advised that the first part (of two) of the Second Supplement of the Lycopodiales of the Fossilium Catalogus, in which many Carboniferous plants are mentioned, appeared in March, 1991. The book is published by Kugler Publications B.V., Postorder Box 516, 1180 AM Amstelveen. (ISBN 90 6299 072 X). Price Dutch f 130,–.

A CORRECTION

Contributions to Carboniferous geology and palaeontology in Japan (1988-90). Carboniferous Newsletter 8: 13-14.

Dr C.F. Winkler Prins has drawn attention to the statement in the above paper, and more specifically in the review of the paper by IGO et al. (1988), that *Cystauletes* is known only from the Middle Pennsylvanian of Oklahoma requires modification. The genus is also known to occur in the Cantabrian Mountains of Spain with two species *C. mammilosus* and *C. maior* in the Moscovian (van de Graaff, 1969) and Kasimovian (=Upper Cantabrian) (Wagner & Winkler Prins, 1985).

GRAAFF, W.J.E. VAN DE (1969): Carboniferous Sphinctozoa from the Cantabrian Mountains, Spain. *Leidse Geol. Meded.*, **42**: 239-257, 5pls.

IGO, Hisayoshi, 1990: Contributions to Carboniferous geology and palaeontology in Japan 1988-1990. *Carboniferous Newsletter* **8**:13-14.

WAGNER, R.H. & WINKLER PRINS, C.F., (1985): The Cantabrian and Barruelian stratotypes: a summary of basin development and biostratigraphic information - In: M.J. Lemos de Sousa & R.H. Wagner (eds) Papers on the Carboniferous of the Iberian Peninsula (sedimentology, stratigraphy, palaeontology, tectonics and geochronology). *An. Fac. Ciênc. Porto. Suppl.* **64** (1983): 359-410.

WORK IN PROGRESS

Chris Maples (palaeontologist with the Kansas Geological Survey), **Ron West** (Kansas State University) and **Woody Henry** (Paleontology and Stratigraphy Branch of U.S.G.S., Denver) are evaluating the biostratigraphic utility of Upper Pennsylvanian brachiopods in the midcontinent. Woody is "ramrodding" this effort. Large collections from Lawrence and Manhattan are on loan in Denver to supplement the U.S.G.S. collections. To "fill in the gaps", field collecting was started a year or so ago and is on going.

Scott Ritter (Oklahoma State University) and **Bruce Wardlaw** (U.S.G.S., Reston) are studying the conodont assemblages of the upper Pennsylvanian and lower Permian in the midcontinent. **Chris Maples** (Kansas Geological Survey) and **Ron West** (Kansas State University) have been collecting necessary samples and providing details of local stratigraphy and collecting sites for this study. This effort is part of the ICS Carboniferous-Permian Boundary study.

5.0 REPORTS FROM IUGS-ICS-SCCS BODIES

5.1 IUGS Global Sedimentary Geological Program - The Pangea Project

By **George de V. Klein**, Dept of Geology, Univ. of Illinois at Urbana-Champaign, 245 Natural History Bldg, 1301 West Green St., Urbana, IL 61801-2999 USA (Phone: 217/333-2076; Fax: 217/244-4996) and **Benoit Beauchamp**, Institute of Sedimentary and Petroleum Geology, Geological Survey of Canada, 3303-33rd Street NW, Calgary, Alberta, T2L 2A7 Canada (Phone: 403/292-7190; Fax: 403/292-5377).

Prospectus

A major number of problems concerning the nature and consequences of natural or anthropogenic environmental change can be solved only by the geological sciences. Many of these problems require separation of first-order driving mechanisms from background processes. Long-term as well as short-term variations during geological time in the numerical magnitudes of different environmental parameters are not well understood, however. The maximum and minimum rates of environmental change that occurred during geological time also remain unknown and their global as well as local consequences are poorly understood.

To address these problems and correlate them to current environmental concerns, an intensive study of the sedimentary record is mandatory because the sedimentary record is the only source from which critical data can be obtained. Additional data are needed to calibrate the sedimentary record in terms of first-order processes characteristic of Earth as a planet. These processes include both mantle-driven processes (intrinsic) that drive plate tectonics, including the assembly and break-up of super continents, as well as solar driven processes (extrinsic) that influence long-term and short-term climatic changes such as advance and retreat of continental glaciers, changes in upwelling cycles, changes in monsoonal climate patterns, and desertification. Study of the sedimentary record involves examining the preservation of both intrinsically-controlled and extrinsically-controlled depositional events during Earth's history. Expressed in another way, the sedimentary record can be viewed as a strip-chart recording of the intrinsic and extrinsic record of the Earth's history.

Many major resources are known to occur within the stratigraphic record represented by the 144.8 my record of PANGEA. These include extensive source beds and reservoirs of petroleum and natural gas, coal, evaporites including potash, and phosphate deposits. Their occurrences appear to be controlled in part by the mantle-driven tectonic history of PANGEA, whereas other occurrences can be attributed to solar-driven climatic change and associated changes in oceanic circulation and upwelling. An intensive study of the sedimentary rock record of PANGEA will improve prediction of occurrences of these resources and establishing their origin.

One of the most spectacular manifestations of concurrent intrinsic and extrinsic changes is the assembly of the supercontinent PANGEA during late Palaeozoic and early Mesozoic time, and its subsequent breakup and dispersal during latest Triassic and earliest Jurassic time that led to the present-day disposition of continents. Thus studies of PANGEA's sedimentary record to determine long-term and short-term magnitudes of environmental changes will involve cross-disciplinary aspects of geodynamics and climate modelling.

Project CRER (Cretaceous Resources, Events, and Rhythms) the first GSGP Project, focuses principally on an interval during Earth history when continents were widely dispersed, volcanism appeared to operate at a greater rate than today, ocean floor spreading operated at a rate greater than today and climates appeared to be dominated by global greenhouse influences. The alternation of broad-scale greenhouse and icehouse periods of Earth's climatic history has been correlated to long-term tectonic cycling involving the assembly and dispersal of supercontinents.

Project PANGEA, the second GSGP Project focuses on the most recent time of supercontinent accretion and dispersal when continents merged towards a geoid low, and much of its climate appeared to be disposed in an icehouse mode. The accretion and dispersal of PANGEA is the most recent example of a recurring long-term global cyclic phenomenon. The 144.8 my interval of PANGEA's history, however, was characterised by considerable climatic variability that belies the broad-scale icehouse climate suggested for times of supercontinent development, and as a consequence, its sedimentary record represents an ideal interval during Earth history from which to evaluate the processes and magnitude of environmental variability and develop a predictive rationale for evaluating current global environmental concerns. Study of PANGEA's sedimentary record is justified as a baseline for study of intrinsic and extrinsic processes and effects associated with Precambrian supercontinents, and the history of continental growth and evolution.

Research Problems

The following research problems have been identified as potential salient components in the PANGEA Project. Many were reviewed during a GSGP-sponsored symposium held prior to the 28th IGC in 1989 in Washington, D.C.

1). What is the causal connection between large-scale global climatic change, such as the icehouse-greenhouse change and the history of flux of CO_2 from the mantle? To what extent is it providing a signal of intrinsic, mantle-driven processes influencing climatic change both for the long term and the short term?

2). What is the record of variation of Oxygen, Sulphur, Strontium and Carbon Isotopic composition of sea water during Pennsylvanian, Permian, Triassic and early Jurassic time? How does this record constrain palaeoclimatic models calibrated from the sedimentary record?

3). What was the role of astronomical forcing factors (Milankovitch orbital parameters) in driving solar-driven climatic change, and how complete is the record of such deposition preserved in cyclic sequences such as the famous cyclothems of the Pennsylvanian, or the lacustrine cycles of the Triassic? Is this forcing dominant or subordinate? What is their record of preservation in both cyclic and non-cyclic stratigraphic sequences? What short-term intrinsically-forced, tectonic

processes can mimic, mask or override the preservation record of astronomical forcing?

4). What mechanism controls relative changes in sea level which existed at time scales ranging from glacial (tens of thousands of years), to intermediate (one to 10 million years) to changes in seafloor spreading rates (tens of millions of years)? To what extent are these changes representative of convergence and separation of intrinsic and extrinsic forcing factors?

5). What does widespread occurrence of Permo-Triassic evaporites indicate about global climatic change during development of the supercontinent PANGEA? How did storage of large quantities of salt in Permo-Triassic basins modify oceanic chemistry? To what extent did such evaporation develop a more brackish global ocean, and to what extent did such a chemical change contribute to late Permian extinctions?

6). What is the structure, strength and effect of both intrinsically-forced and extrinsically-forced climatic change on the preservation, life history and evolution of terrestrial and marine flora and fauna? What are the consequences of climatic changes on the distribution and deposition and preservation of petroleum and metalliferous source beds? How did these climatic changes influence the distribution of warm- and cold-climate coals? Of evaporites? Of phosphates? What specific combination of intrinsic and/or extrinsic processes favoured the deposition and preservation of glacial sedimentary facies? How did these changes influence the history of sea level during the accretion, zenith and dispersal of PANGEA?

7). What combination of intrinsic and extrinsic forcing factors influenced the variability of Permo-Triassic reef facies? How did these forcing factors influence their temporal distribution and evolutionary history? What was the rate of change in evolution and facies style of these reefs, and how can they be compared to different Holocene reef communities?

8). What are the combined or separated intrinsic and extrinsic forcing factors that produced profound biological changes during the Permo-Triassic? What were the driving forces that caused rapid change (collapse?) of existing ecosystems? Were the causes extra-terrestrial or mantle-driven?

9). How do changing continental palaeoposition, palaeoclimates and sea level change influence the evolutionary record of continental flora and fauna during the accretion, zenith and dispersal of PANGEA? How did changing palaeogeography influence palaeobiogeography during the history of PANGEA? What were the dynamics of floral and faunal replacement and the evolution of terrestrial ecosystems? How did these changes in terrestrial life history interface with changes in marine life history? What do associated palaeobiogeographic changes indicate about the magnitude and rate of climatic change?

The Program Development Committee of GSGP identified several problems likely to arise during the PANGEA Project. These include:

- absence of a preserved oceanic record;
- uncertainties in biostratigraphic correlation;
- inadequacies of biostratigraphic resolution;
- problems of matching various time-scales; and
- inadequacies of some lithofacies models requiring either the need to study additional Holocene examples, or careful counterpart computer simulation studies.

Support Structure, PANGEA Project

The scope of the PANGEA Project is interdisciplinary within the earth sciences, requiring a component involving palaeoclimate modelling, and an understanding of geodynamics and tectonics, areas of concern to the IUGS Commission on the Lithosphere. This project also involves problems dealing with accurate chronostratigraphy and biostratigraphy which are of concern to the IUGS Commission on Stratigraphy.

Because of these interdisciplinary aspects, the PANGEA Project should establish a scientific liaison structure with both the Commission on the Lithosphere and the Commission on Stratigraphy. The IUGS Commission on Global Sedimentary Geology should act as the principal agency with primary responsibility for administrative and liaison functions.

Implementation

This prospectus should be viewed by the GSGP Program Development Committee and a member of the International Commission on the Lithosphere and the IUGS Commission on Stratigraphy. This review panel should consider both the scientific and organisational aspects of the project and suggest modifications.

The modified prospectus should be submitted to the three commissions (Sedimentary, Lithosphere, Stratigraphy) for substantive consideration, including project endorsement, its relation to other existing or proposed projects, organisational arrangements, and extent of funding support.

On the expectation of endorsement by these commissions, the PANGEA Project should commence formally with a major planning workshop similar to the one held for the CRER Project in 1988 at Digne. A tentative workshop is scheduled in May or early June, 1992 at a site to be selected later. Strong organisational support is anticipated from the geoscience academic and industrial community and governmental geoscience institutions. At the workshop, ongoing working groups will carry forward specific aspects of the PANGEA Project.

5.2 Progress Report of the Working Group on Middle Pennsylvanian Stratigraphy in North America

By **Patrick J. Sutherland**, School of Geology & Geophysics, University of Oklahoma, Norman, OK 73069, USA.

The Middle Pennsylvanian Working Group in North America continues to work actively on the evaluation of biostratigraphic units and intervals that may have intercontinental significance, and on the evaluation of potential sequences as candidates for boundary stratotypes for the Morrowan-Atokan, Atokan-Desmoinesian and Desmoinesian-Missourian boundaries in North America. The Working Group includes the following 12 members: Darwin Boardman, Robert Grayson, Mackenzie Gordon, John Groves, Philip Heckel, Thomas W. Henry, Ralph Langenheim, Walter Manger, Walter Nassichuk, Russell Peppers, Patrick Sutherland (Chairman) and Gary Webster.

During the past seven years, we have made group field trips to numerous areas in the United States including Arrow Canyon, Nevada, the type Morrowan sequence in northwestern Arkansas, the type Desmoinesian sequence in Iowa, and the type Derryian sequence in southern New Mexico. During July, 1990, seven of our members (Grayson, Groves, Langenheim, Manger, Nassichuk, Sutherland and Webster) went on a truly extraordinary 10-day trip to Ellesmere Island, in the far north Canadian Arctic. We went at the invitation of one of our members, Walter Nassichuk, Director of the Institute of Sedimentary and Petroleum Geology in Calgary, Alberta. One purpose of the trip was for the group to examine the exceptionally well exposed Lower and Middle Pennsylvanian sequences through the shelf carbonates of the Nansen Formation and the adjacently exposed basinal clastic and evaporitic sequences of the Otto Fiord and Hare Fiord Formations. In addition, members of the group collected stratigraphically placed conodont and foraminiferal samples through these sequences which range in age from Early Morrowan through the Early Desmoinesian. In addition, significant collections were made of goniatites, brachiopods and corals from these reference sections.

Members of our Working Group are currently processing and studying the collections made in the Arctic. It is hoped that these studies will provide a basis for refining correlations between shelf margin and basinal sedimentary sequences within the Sverdrup Basin. Also, these studies by our group should provide a basis for comparing Arctic Pennsylvanian faunal sequences with those of the Midcontinent and western United States and should give us a better basis for understanding faunal changes at the Morrowan-Atokan and Atokan-Desmoinesian boundaries in North America.

5.3 Subcommission on Geochronology

By **G.S. Odin**, Département de Stratigraphie, Laboratoire de Géochronologie et Sédimentologie Océanique. Université P. et M. Curie, Tour 26 4è étage, 4 Place Jussieu, F75252 Paris Cedex 05.

Editorial note: The following organisational plan for the ICS Subcommission on Geochronology (SOG) was issued by Dr Odin in October, 1989. Since then there have been further Bulletins issued of which the contents for Bulletin 8 (31/1/90) and 9 (31/1/91) are listed below. In response to an urgent request from Dr Odin for the nomination of a corresponding member from SCCS , the Chairman, Dr Eva Paproth, has agreed to act in that capacity.

Selected actions for the Subcommission

Voting members are requested to make at least one yearly contribution to one of the five themes proposed as the main domain of activity of SOG (contribution in the form of sample collection, sample preparation, laboratory analyses or discussions published as a formal or informal report to the Subcommission, or as an oral or written presentation in a meeting or journal). Themes are:

Theme 1: Phanerozoic time scale calibration (TS): multimethod geochronometer datings are strongly recommended.

Theme 2: Reference materials for dating purpose (RM): preparation of interlaboratory analytical material, distribution of analyses of same. Emphasis will be made on K-bearing minerals, but a U-bearing mineral (zircon) could be considered as well.

Theme 3: Fission track dating (FT): normalisation, time scale calibration, reference materials, (zircon and apatite) reliability of geochronometers.

Theme 4: Conventions for dating result publication (CP): including recommended processes of calculation, sample treatments before dating, units and abbreviations,... in order to make the analytical data homogeneous and easier to understand and interpret for non specialists.

Theme 5: Reliability of specific geochronometers (RG): methodological studies able to allow a better understanding of the geological meaning of isotopic analyses, a proper selection of the best geochronometers, and multimethod studies.

From preliminary correspondence (March-May, 1989), it seems that each of the above quoted five themes will be considered by at least two of the proposed members, and might be developed into efficient working groups. An additional theme would be the difficult question of the Precambrian time scale for which a working group should be organised and a leader nominated (suggestions welcome).

Subcommission members 1989-1993

Honorary members (ex officio members=past chairmen):
W. Compston, E. Jäger, N.J. Snelling

Country	Voting Members	Corresponding members*
Australia	Page,R.	Claoué-Long,J.(TS-RG-RM)
Canada	Baadsgaard,H.(TS-RG)	
China	Zhang Zichao(RM-TS)	Wang Songshan(RM)
France	Bonhomme,M.G.	Gillot,P.Y.(TS-RM)
	Odin,G.S.(TS-RM-Chair)	
Germany	Lippolt,H.(RM-TS-ViceChair)	
Italy		Nicoletti,M.(RM-RG)
Japan	Kaneoka,I.(RG)	
S.America		Riccardi,A.C.(TS)
U.K.	Hurford,A.J.(FT-Sec.)	Rex,D.C.(RM-TS-RG)
		Pankhurst,R.J.(CP)
U.S.A.	Drake,R.E.(RM-TS-RG)	Montanari,A.(TS-RG)
	Kunk,M.J.(RM-TS)	Naeser,C.W.(FT)
U.S.S.R.	Shcherbak,N.P.(RG-TS)	Semikhatov,M.A.

TS=Time scale: RM=Reference materials; RG=Reliability of Geochronometers; FT=Fission tracks; CP=Conventions for publication. In addition to the above list, a further 2 to 5 members of other ICS Subcommissions were to be nominated.

Administration of SOG

- Prof. H.J. Lippolt was proposed as Vice Chairman and A.J. Hurford as Secretary.
- A yearly "Bulletin of Liaison" will include progress reports and contributions from voting members, corresponding members, and members of the working groups.
- Five working groups (WG) including people contributing to one of the five themes suggested above could be formally agreed. These members should be gathered into a WG, chaired by a voting member.
- General Meetings of the members will be held during the usual international meetings in order to offset the lack of travel funding; national or regional meetings could be proposed by all members as well, and suggested to the board of SOG.

Role for the Subcommission and its members

Role of the SOG - The SOG is a body of the International Commission on Stratigraphy (ICS); therefore, the role of SOG is to make available, and easy to understand, the data provided by the geochronologists to the stratigraphic community. The SOG should: 1. Prepare information; 2. Gather and select information; 3. Circulate the information through the stratigraphic community.

Role of the Chairman - The first job of the chairman is to select subjects of particular interest in order to concentrate the efforts in these selected directions; in this connection, the next job is to suggest and nominate members able to contribute to the aims selected. The third task is to initiate and contribute to a synthesis of the views on the subjects selected.

Role of the Secretary - The Secretary may be seen as the thinking arm of both the Chairman and members; it is also the source for organisation of supplementary meetings and actions.

Role of Voting Members - Voting Members are presumed to gather information and give their opinion in their domains of activity at their initiative and, specifically, when they are requested to do so by the Secretary, the Chairman or the leaders of working groups to which they are bound.

Role of Corresponding members - Corresponding members are the councillors of the Subcommission; they are presumed to point out specific facts and data and answer requests for information from other members.

Honorary members - Past Chairmen (and women) of the SOG are ex-officio honorary members. These honorary members are invited: (a) To help the Chairman in selecting subjects; (b) To help keep some sort of continuity in the action of SOG; and (c) To contribute to the action of the SOG at their initiative. Honorary members are voting members; they may contribute to postal ballots with one vote each.

Supplementary to the specific role proposed above, all members of the SOG are selected for their activity, and are supposed to follow up with yearly contributions to the creation of new data of interest to the domains of activity of the SOG.

Specific tasks of presently nominated members

Name	Specific task (not exclusive)
Baadsgaard, H.	(TS-RG-RM), general study and U-Pb analyses on zircon
Claoué-Long, J.	(TS-RG-RM),μU-Pb, Delegate for Oceania,ICOG7,1990
Drake, R.E.	(TS-RG), K-Ar, Ar-Ar, laser fusion analysis
Gillot, P.Y.	(TS) analyses, (RM) IVry reference, volcanics
Hurford, A.J.	(FT) leader WG, general study, FT analyses, Secretary
Kaneoka, I.	(RG) volcanics, Japanese literature, 1991 IGC org.
Kunk, M.J.	(RM) preparation, distribution, Ar-Ar analyses, (TS)
Lippolt, H.	(TS) general, (RM) distribution analyses, Vice Chair
Montanari, A.	(TS) calibration of rare events, (RG) biotite
Naeser, C.W.	(FT) general
Nicoletti, M.	(RM-RG)
Odin, G.S.	(TS) Phanerozoic, (RM) general, Chair
Pankhurst, R.J.	(CP) Rb-Sr isochron data, tectonics
Rex, D.C.	(RM) analyses, (TS-RG, K-Ar, Ar-Ar analyses
Riccardi, A.C.	(TS) sampling Jurassic Argentina
Shcherbak, N.P.	(RG-TS) Precambrian, Russian literature
Wang Songshan	(RM) qualification of BSP 1 hornblende
Zhang Zichao	(TS-RM) general, Delegate for China

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Accuracy and reliability of geochronometers in volcano-sedimentary Tertiary minerals - A. Montanari

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Analyse d'ouvrage - M.A. Geyh & H. Schleicher, 1990

List of references related to the Five Themes of interest to SOG

Development in ESR dating in Japan

Meeting presentations: Grenoble (RST), San Francisco (AGU), Dallas (GSA)

Numerical scale of geological times in 1990 by G.S. Odin and C. Odin

This paper by G.S. and C. Odin has been published in *Géochronique, 1990,* 35: 12-21. It contains a proposal for a unique stratigraphic column which has been put forward for wide comment and subsequent redefinition. The columns record Eras, Systems, Series, Stages, absolute boundary ages and an index to relevant comments. In view of the importance to the Subcommission of some of the commentary, relevant parts of the table have been reproduced together with a free translation of the associated comments. Those comments are numbered from 24 to 33 and should be read in conjunction with Figure 1 to which they refer. Comments on other parts of the column should be consulted in the original paper:

COMMENT 24: The very detailed dating of the volcano-sedimentary levels of the Silesian from the continental basins made effective at Heidelberg indicate an age near 300 Ma for the base of the **Autunian**, 305 Ma for the base of the **Stephanian** and 315 Ma for the base of the **Westphalian**. The marine stages of the Upper Carboniferous are not dated directly and the **Stephanian - Autunian** and **Gzhelian - Asselian** limits are not necessarily synchronous.

COMMENT 25: The **Gzhelian** is subdivided into **Klazminskian** then **Noginskian**.

COMMENT 26: The **Kasimovian** (Moscow Basin, as with 25) is subdivided into **Krevyakinskian, Chamovnicheskian** and **Dorogomilovskian**, from the base up.

COMMENT 27: The **Moscovian** (Moscow Basin) is subdivided into **Vereiskian, Kashirskian, Podolskian** and **Myachkovskian**, from the base up.

COMMENT 28: The **Bashkirian** (Urals) is subdivided into **Kinderscoutian, Marsdenian, Yeadonian** and **Langsettian** (Great Britain and Ireland), this last subdivided into **Cheremshanskian** and **Melekesskian**.

ERA	SYSTEM	PERIOD	SERIES	STAGE	Ma	Note
PALAEOZOIC	PERMIAN	UPPER	THURINGIAN	TATARIAN	245	
				KAZANIAN	250	20
		LOWER	SAXONIAN	KUNGURIAN	258	21
				ARTINSKIAN	265	22
			AUTUNIAN	SAKMARIAN	275	23
				ASSELIAN	285	
	CARBONIFEROUS	SILESIAN	STEPHANIAN	GZHELIAN	295	24 25
				KASIMOVIAN	305	26
			WESTPHALIAN	MOSCOVIAN		27 28
			NAMURIAN	BASHKIRIAN	315	
				SERPUKHOVIAN	325	29 30
		DINANTIAN	VISEAN	BRIGANTIAN		
				ASBIAN		
				HOLKERIAN		31
				ARUNDIAN		
				CHADIAN	350	32
			TOURNAISIAN	IVORIAN		
				HASTARIAN	360	33
	DEVON-IAN		UPPER	FAMENNIAN	365	34
				FRASNIAN		

FIGURE 1: An extract containing Upper Devonian to Permian units from the proposed standard stratigraphic column of Odin,G.S. & Odin,C.,1990 (Echelle numérique des temps géologique, mis à jour 1990. *Géochronique*, Paris, 35: 12-21).

COMMENT 29: The **Serpukhovian** (Ukraine) is subdivided into **Pendleian, Arnsbergian, Chokierian** and **Alportian**. The 18 subdivisions of the Silesian are difficult to remember but, above all, it appears unreasonable to subdivide into 18 intervals, the one unit which lasted for about 30Ma; these stages would be difficult to recognise outside their basin of definition. From another angle, intervals lasting on average about 6 Ma for 5 subdivisions would conform to the length of stages found in other systems.

COMMENT 30: The equivalence between the base of the continental **Namurian** and that of the marine **Serpukhovian** is not precisely assured.The age of 325 Ma generally corresponds to the **Dinantian-Silesian** limit but these two terms have tended to disappear.

The subdivision of the Carboniferous into two Subsystems - **Mississippian** and **Pennsylvanian** - is used in North America; their limit would be placed preferably between the **Serpukhovian** and **Bashkirian**. The Carboniferous SubCommission holds the view that the boundary lies within the **Serpukhovian**. These modern definitions remain to be firmly established.

COMMENT 31: The subdivision of the 'super' stage **Viséan** into 5 stages is reasonable if one considers the duration factor. No age is actually cited for their limits. These 5 "English" subdivisions correspond to the 3 Belgian subdivisions of **Moliniacian, Livian** and **Warnatian**.

COMMENT 32: The limits are badly dated but the relative lengths of the **Viséan** and the **Tournaisian** appear well supported by the proposed ages. The **Tournaisian** stages are named in Belgium.

COMMENT 33: For the Devonian-Carboniferous Boundary an age around 355 Ma is also very plausible; after Claoué-Long (1990) from results by ion probe suggest an age of 3534 Ma in Germany and Australia.

5.4 Annual Report of the Carboniferous-Permian Boundary Working Group

The Working Group was re-established in 1987 under the leadership of Dr Wu Wang-shi together with 14 Voting Members and 15 Corresponding Members from Australia, USSR, Canada, Argentina, France, India, Thailand, USA, China, Japan, Germany and Hungary.

The Working Group planned to hold two field meetings in 1990, namely in Akiyoshi in Japan and a South Ural excursion in the USSR. The latter had to be postponed to 1991. Twenty-one participants joined the Akiyoshi excursion. All participants were interested in the proposal made by the Japanese hosts that the zone of *Spheroschwagerina fusiformis* could be used to define the base of the Permian. This reinforced an informal decision on the position of the boundary taken at the meeting of the IGC in Washington in 1989.

Plans for 1991 include two meetings or excursions in 1991 - the first in association with the 12th ICC-P in Buenos Aires and the other at the International Congress on the Permian System in Perm in August, 1991. Further details of the activities of the Group are given in the following Circular 6 which was distributed to members in October, 1990.

Circular No. 6 Oct. 28, 1990

According to the 1990 plan made by the International Carboniferous-Permian Boundary Working Group at the Washington Meeting during 28th IGS in 1989, two field meetings should be held, including the Akiyoshi excursion in Japan and the South Ural meeting in the Soviet Union. For the purpose of celebrating the 150th Anniversary of the establishment of the Permian System, the Soviet specialists have decided to postpone the Ural meeting to August, 1991. However, the Akiyoshi excursion was held as scheduled.

Originally, the Akiyoshi excursion was scheduled after the Benth' 90 Symposium held in Sendai, Japan in September,1990. Prof. Kato had made every effort to make contact with the leaders of the excursion, Drs Ozawa and Kobayashi, for their permission before he distributed the information and invitation to the members and scientists. About 20 participants from Austria, Canada, China, Japan, The United States and Switzerland joined the Akiyoshi excursion from Oct. 3 - 5, 1990.

The Akiyoshi Limestone Group is one of the most complete Carboniferous and Permian stratigraphic successions in the world, lying as an organic complex on the top of a basaltic seamount on the late Palaeozoic ocean floor. Many visitors are attracted by the particular features in the stratigraphy and structure of the accreted oceanic rock complex and the surrounding Permian terrigenous clastic rocks especially their relationships. In the Akiyoshi area, the Upper Carboniferous to Lower Permian deposits are continuous and yield abundant fossils, especially fusulinids and foraminifera. With regard to the boundary position between Carboniferous and Permian in Japan, the Japanese scientists took *Spheroschwagerina fusiformis* as the marker for the base of the Lower Permian. Many people are interested in this suggestion, but there are still problems to be solved, such as how to make a correlation between the *Spheroschwagerina fusiformis* zone and the *Pseudoschwagerina uddeni* zone, whether the latter is higher than the former and whether conodonts have been found in the Akiyoshi limestone. On the field trip, participants also believed that these problems will be solved in the near future.

During the Akiyoshi excursion, the International Carboniferous-Permian Boundary Working Group held a formal meeting to exchange results and opinions among members and discuss the working plan for 1991. Fifteen members and scientists attended the meeting, including Drs Sheng Jinzhang, C. Ross, P. Brenckle, S. Pinard, M. Kato, H. Igo, J. Yanagida, Wu Wang-shi and others. At the meeting, the participants all knew very well that although the *Pseudofusulina fecunda - Schwagerina moelleri* zone had been taken as the base of the Lower Permian, through a straw vote in 1989, there still exist different views on the C/P Boundary position. For example, in the information distributed to the Working Group the Soviet specialists noted that their opinion on the boundary position between Carboniferous and Permian has not been changed since Dr V. E. Ruzhentsev assigned the base of the Lower Permian to the zone of *Spheroschwagerina fusiformis - S.vulgaris*.

The meeting also discussed how to make a further improvement of the boundary work. For this purpose, Dr Ross suggested that since some arguments on the boundary position are caused by the confused nomenclature of fusulinids, it is necessary to hold a special meeting to solve this problem as soon as possible. Another problem is how to correlate *Spheroschwagerina fusiformis* with *Pseudoschwagerina uddeni*. The latter was proposed by the United States specialist as the base of the Lower Permian. At the formal meeting, members also suggested that attention should be paid to the bearing of conodonts on the determination of the boundary position and the establishment of the global stratotype section. Finally, some members proposed that while studying the boundary position, the Working Group should call on people to recommend the candidate stratotype section, thus the biomarkers in the candidate stratotype section can lead to a revision of the boundary level. On the other hand, people can make a detailed study of the candidate section for improving the determination of the boundary.

Concerning the working plan for 1991, the Working Group considered that its members should take part in two congresses. The first is the XII International Congress of Carboniferous and Permian stratigraphy and Geology to be held in Argentina (September 22 - 27, 1991) and the second is the International Congress on Permian System of the Globe to be held in Priuralye, U.S.S.R. in August, 1991. During both congresses, the International C/P Boundary Working Group will hold meetings and field trips. All members are expected to join the Congress and present their paper or progress reports at the Congress.

Besides the above mentioned activities, several other items related to the C/P boundary work were also arranged to take place in Japan and China in 1990, as indicated in the appendix of the circular.

Appendix 1 (by Wang Keliang)

Prof. E.J. Leven the geologist and palaeontologist from USSR visited the Nanjing Institute of Geology and Palaeontology from September 10 to 15, 1990. He has rich experiences in examining fusulinids. Prof. Sheng and his colleague exchanged their own views with him on the Lower Permian boundary. Meanwhile, he visited Carboniferous sections in Kongshan, Qixa Mountains in Nanjing suburb. They discussed the features, geographic distribution, classification and evolution of fusulinids. They also concluded that *Spheroschwagerina fusiformis* may be the marker in defining the base of Lower Permian.

Appendix 2 (by Zhang Shanzhen)

J. P. Laveine of the University of Sciences and Technics of Lille, France and Y. Lemoigne of the University of Claude Bernard, Lyon 1, France travelled with Zhang Shanzhen of Nanjing Institute of Geology and Palaeontology, Academia Sinica in Inner-Mongolia, China in September, 1990. They visited a Stephanian coal mine there on the suggestion of Wu Wangshi. The fossils collected reveal a fairly well established relationship with the European elements, and will be published in the **Review of Palaeobiology**. It is hoped that the study will throw light on the correlation of Cathaysian floras with the Euroameric floras and the relevant stratigraphy as well.

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5.5 IGCP-272: Late Palaeozoic and Early Mesozoic Circum-Pacific Events and their Global Correlation

Project Leaders: Dr J.M. Dickins, Bureau of Mineral Resources, Canberra, Australia ; and **Professor Yang Zun-yi**, China University of Geosciences, Beijing.

Project Secretary: Professor Yin Hong-fu, China University of Geosciences, Wuhan.

Meeting in Sendai, Japan, 20/9/90-23/9/90

The meeting was held jointly with the symposium Shallow Tethys III and was followed by a field visit to the Kitakami Mountains, 24-25 September 1990. One day of the symposium was entirely devoted to scientific papers of the project, during which eleven papers were given. Other papers outside this part of the program also represented a contribution to the project.

Two discussion meetings were held which considered the business of the project and discussed in particular correlation of the Permian and the Triassic of the Circum-Pacific and Tethys regions. New correlations of the Carboniferous-Permian boundary sequences were made which allows a better understanding of the time relationships and of the associated geological events. Emphasis was also placed on the significance of the Midian-Dzhulfian Boundary and mid-Triassic events which have displayed widespread and somewhat synchronous orogenic, eustatic, volcanic and biotic changes. Discussion took place on the subdivision of the Permian system (two fold or three fold subdivision). These and other topics are to be continued in future meetings and study groups. The scientific papers are being published in the proceedings of the meeting.

The excursion examined sequences from Silurian to Cretaceous to enable comparison with other parts of the Pacific. Of particular significance to the project is the erosional unconformity between the Lower Permian and the Carboniferous. The strong orogenic, fold mountain building phase beginning at the end of the Lower Permian and continuing into the Triassic, the regression at the end of the Permian and the angular unconformity of the Lower Triassic. Also very significant is the strong siliceous volcanic phase associated with the mountain building beginning at the end of the Lower Permian and the marked changes associated with the Triassic-Jurassic Boundary.

An important publication of the project "Midian Regional Stage in the USSR", Leningrad Publishing House, 1989, under the editorship of G.V. Kotlyar and U.D. Zakharov, was noted.

Meetings 1991

The first project meeting will be held at Gondwana 8 in Hobart, Tasmania, 24-28 June 1991.

The second meeting will be held at the 12th International Congress on Carboniferous-Permian in Buenos Aires, Argentina, 22-27 September. Information can be obtained from: XIICC-P, Division Paleobotanica, Museo Argentino de Ciencias Naturales "B Rivadavia", Av. Angel Gallardo 470-1405 Buenos Aires, Argentina.

Would colleagues who intend to contribute towards the IGCP-272 program, inform the project leader of their intention, sending a copy of their abstract; as well as to the conference organisers.

The project is organising a meeting at the Permian Congress in the Soviet Union, 5-10 August 1991. Information on this Congress is available from: Dr Boris I. Chuvashov, General Secretary, IPC, Institute of Geology and Geochemistry, Uralian Branch, Academy of Sciences, Pochtovyi per. 7, 6200219 Sverdlovsk USSR; OR Dr Alan E.M. Nairn, General Secretary, IPC, Earth Sciences and Resources Institute, University of South Carolina, Columbia, SC 29208 USA.

Also, it is possible that a meeting will be arranged in Thailand. Further information on these meetings will be made available in a later newsletter. A project symposium will be held at the 29th International Geological Congress, Kyoto, Japan, 24 August to 3 September 1992 and a meeting is being organised in France, Spain and probably, Austria in 1993. Other meetings being held in 1992 are a meeting in Vladivostok in the Soviet Far East, arranged to fit in with the International Geological Congress. A meeting in 1992 will also be held in North America, in conjunction with the North American Paleontological Convention in late June and early July. Arrangements for these will be indicated later.

6.0 REPORTS BY SCCS MEMBERS

6.1 Research on the Devonian and Carboniferous at Marburg University, Germany

By Dr. H.-G. Herbig, Institut für Geologie und Paläontologie, Universität Marburg, Hans-Meerwein-Strasse, D-3550 Marburg, Germany

The Institute of Geology and Palaeontology, University of Marburg is traditionally aligned with palaeontological and biostratigraphical research on Devonian and Carboniferous strata, especially in the Rhenish Slate Mountains. The well-known names of E. Kayser, R. Wedekind, C.W. Kockel, and Wo. Schmidt, as well as numerous famous students document a continuing research history in this field for more than one hundred years - and still Marburg is one of the leading German university institutes concerned with research in the Late Palaeozoic.

Though an immense amount of data has been gathered on the Rhenish Slate Mountains, the rise of new techniques and new fields of research opened new accesses which concern stratigraphic correlation of strata - and between different fossil groups, facies development, geochemistry, palaeogeography, basin evolution, and geodynamic framework of this Variscan segment. Thus, the Rhenish Slate Mountains are still one of the main targets of Devonian and Carboniferous research at Marburg, though further Carboniferous belts in Germany and abroad are under investigation.

Herein we give an overview on current research of the Devonian-Carboniferous working group of the Institute with the intention of stimulating interest in our work and to foster new contacts:

Dr M. Amler is mainly working on systematics and evolution of Carboniferous bivalves, especially on the genera *Parallelodon* (Arcoida) and *Streblochondria* (Pectinina). Regional topics include bivalves and biostratigraphy at the Devonian-Carboniferous boundary in central and western Europe, bivalves from the Carboniferous Limestone and the adjacent Culm basin in the western part of the Rhenish Slate Mountains, and allochthonous invertebrate faunas from Dinantian flysch sediments in central Europe (Rhenish Slate Mountains, Harz Mountains, Franconian Forest, Vosges). Moreover M. Amler is interested in general biostratigraphy and palaeogeography of the central European Dinantian.

Dr P. Bender is working on Late Devonian and Early Carboniferous biostratigraphy, mainly by means of conodonts. Regionally he is studying the structural and palaeogeographic development of the eastern part of the Rhenish Slate Mountains (Lahn-Dill area, Hörre) in the course of the same epochs.

Dr A. Braun conducts research on systematics, evolution and biostratigraphy of Silurian - Permian radiolarians from Germany ((Rhenish Slate Mountains, Harz Mountains, Franconian Forest) and the USSR (Urals, western Siberia).

Dr H.-J. Gursky is studying sedimentology, sedimentary petrography and diagenesis of Devonian and Dinantian cherts of the German Rhenohercynian (Rhenish Slate Mountains, Harz Mountains) and Saxothuringian realms (Franconian Forest).

Prof. Dr G. Hahn studies evolution, systematics, biostratigraphy, and ecology of Carboniferous and Permian trilobites on a global scale.

Dr H.-G. Herbig started to work on foraminifers, calcareous algae and microfacies of Dinantian limestone turbidites and limestone clasts within the German Rhenohercynian culm basin, biostratigraphic correlations with existing zonations of the basin (ammonoids, conodonts), and correlations with the Carboniferous Limestone province of western Europe (mainly Belgium). A further attempt is directed towards the (partly reworked) Dinantian corals of shallow-water facies within the Rhenish Slate Mountains. Up to now H.-G. Herbig has been mostly involved in Late Devonian and Carboniferous stratigraphy, facies patterns, palaeogeography and geodynamic evolution of the western Mediterranean Palaeotethys (mostly the ALKAPECA-realm).

P. Königshof is about to finish his doctorate on conodont colour alteration patterns (CAI) in Devonian and Carboniferous sediments of the Rhenish Slate Mountains, a comparison with vitrinite reflexions, and relations between carbonate microfacies/geochemistry and CAI-values.

K. Leuschner continues her doctorate about systematics and biostratigraphy of trilobites from the Devonian-Carboniferous transition and the Gattendorfia-stage (early Dinantian) of the Rhenish and Thuringian Slate Mountains.

P. Lorenz works for his doctorate on the revision of the Carboniferous to Permian bivalve genus *Streblochondria* (Pectinina). His studies include taxonomy, morphology, biostratigraphy and palaeoecology.

Prof. Dr R. Schmidt-Effing is working on pelagic sediments and their microfaunas from the European Palaeozoic. Most interest is devoted to sedimentary cherts and radiolarians from the Late Devonian and Early Carboniferous of western and central Europe.

Dr B. Schnetger has started a project about inorganic geochemistry of Silurian and Carboniferous black shales in central Europe. Main topics are the interpretation of the sedimentary environments and the differentiation between syngenetic and epigenetic trace metal anomalies.

G. Schraut is engaged in preparing his doctorate about systematics, stratigraphy, palaeoecology and palaeogeographic relations of the trilobites and ostracods from the Carboniferous of Nötsch (Carinthia, Austria).

6.2 Calibration of the Carboniferous & Early Permian of the Southern New England Orogen by Shrimp Ion Microprobe Zircon Analyses

By **J. Roberts**, University of New South Wales, Sydney, **J. C. Claoué-Long**, Australian National University, Canberra and **P.J. Jones**, Bureau of Mineral Resources, Geology & Geophysics, Canberra.

(Reproduced with permission from the Proceedings of the *25th Newcastle Symposium on Advances in the Study of the Sydney Basin*, April 1991, 38-43).

INTRODUCTION

Volcanics interbedded within Carboniferous-Early Permian marine and non-marine successions within the southern New England Orogen (SNEO) have been dated by SHRIMP ion microprobe U-Pb zircon analyses. The aims of the project include: 1) calibrating the eastern Australian Early Carboniferous biozones which are cosmopolitan in nature and can be correlated with type sections in Europe, providing more accurate information on the age of stratotype sections; 2) dating the Late Carboniferous Gondwanan cold water marine assemblages which are endemic to Australia and South America and cannot be correlated with those from elsewhere; 3) determination of the temporal extent of the Late Carboniferous glaciation; and 4) assessment of the age relationships between Late Carboniferous sequences of the SNEO and the Early Permian of the Sydney Basin and adjacent regions.

The stratigraphic succession utilised in this project is located within the Rouchel, Gresford and Myall Blocks of the SNEO in the northern Hunter Valley and Myall districts of NSW (ROBERTS & ENGEL, 1987; ROBERTS et al., in press). It was chosen because of frequent interfingering between volcanogenic non-marine and fossiliferous marine rocks. The andesitic and dacitic ignimbrites, rhyolite and tuff analysed are either biostratigraphically constrained by fossils, located in stratigraphic positions controlling minimum or maximum ages for fossiliferous marine strata, or have an important geological and/or stratigraphic significance. The stratigraphic locations and ages of successfully dated samples are given in Figure 2.

The SHRIMP zircon data are at a preliminary stage of interpretation and final ages with appropriate uncertainties will not be presented here. The purpose of this abstract is to present our interim assessment of consequences for the timing of events, some of which are so major as to merit further work.

RESULTS

1.Tuffs from the Kingsfield Formation at the base of the succession, which contain the conodont *Siphonodella sulcata* and are overlain by units with the *S. crenulata* Zone, have an age of 355.8+5.6 Ma (CLAOUÉ-LONG et al., in press(a)). This date is within error of the 353.2+4 Ma age for a bentonite, from within the *sulcata* Zone in the Hasselbachtal stratotype, used to redefine the age of the Carboniferous-Devonian boundary (CLAOUÉ-LONG et al., in press (a)); the system boundary is taken at the base of the *sulcata* Zone.

2.Volcanics from the non-marine Waverley and Isismurra Formations provide an indication of age for the *Schellwienella burlingtonensis* Zone and a maximum age for the *Orthotetes australis* Zone. The Kurra Keith Tongue of the Isismurra Formation has an age of around 345 Ma and provides an approximate minimum age for the *burlingtonensis* Zone. Conodonts of the *Scaliognathus anchoralis* Zone in the upper part of the *burlingtonensis* Zone enable this to be used as an estimate for the Belgian Tn3c-V1a. An unnamed pyroxene andesite within non-marine Waverley Formation sediments intertonguing with the Dangarfield Formation (*burlingtonensis* Zone) provides a less well defined constraint of around ~350 Ma for the maximum age of the zone.

3.The Gilmore Volcanics Group and Nerong Volcanics are used to constrain the ages of the *Delepinea aspinosa* and *Rhipidomella fortimuscula* Zones. The Martins Creek Ignimbrite Member underlies marine sediments (Chichester Formation) containing the *fortimuscula* Zone (note that there are possible *fortimuscula* fossils beneath the ignimbrite south of Dungog) and overlies units containing the *aspinosa* Zone. The Nerong Volcanics similarly overlie units with *aspinosa* (Conger Formation) and either upper *aspinosa* or *fortimuscula* Zone assemblages (Boolambayte Formation; ROBERTS et al., in press). The Lambs Valley Ignimbrite Member overlies sediments containing the *fortimuscula* Zone and provides a minimum age for that zone. Foraminifera from the upper *aspinosa* Zone belonging to zones 13-15 of Mamet (ROBERTS, 1975) are of V2b-V3b age, and ammonoids from the *fortimuscula* Zone (CAMPBELL et al., 1983) are now considered to be B2-P1 (=V3b) in age (after RILEY, 1990). The V3b lies within the range 340-330 Ma.

4. The Paterson Volcanics have an important stratigraphic position beneath the glacial Seaham Formation and also signal the beginning of the Kiaman Magnetic Interval. The volcanics were dated from two separate localities and have an age of around 330 Ma, which is late Viséan rather than Westphalian, as indicated from previous K-Ar dates (ROBERTS et al., in press).

5. Two volcanics within the Seaham Formation have yielded Namurian and Westphalian ages, but units at the top of the formation contain zircons which have been obviously recycled; the upper limit on the glaciation has not been determined.

6.Rhyolites from the upper part of the Booral Formation and the McInnes Formation provide a minimum age of around 285 Ma for the *Levipustula levis* Zone and an even younger age for the overlying non-marine units.

7.Rhyolite from the Alum Mountain Volcanics dates the incoming of the *Glossopteris* flora and Stage 3a Microflora at around 275 Ma.

GEOLOGICAL CONSEQUENCES

1. The major geological consequence of the new dates concerns the usage of 'Late Carboniferous' and 'Permian' in eastern Australia and most of Gondwana. The top of the Stephanian Stage in Europe is around 300 Ma (LIPPOLT & HESS, 1985) or 295 Ma (JONES, 1988) in age, and is overlain by the Autunian, the basal Permian unit in Europe. On the basis of palaeobotanical evidence, the Autunian is equated with the Asselian in USSR (RAUSER-CHERNOUSOVA et al., 1979), the base of which is currently favoured as the defined base of the Permian System. Provided these ages and correlations are correct, the upper part of the *Levipustula levis* Zone (upper Booral Formation) and the overlying McInnes Formation, Koolanock Sandstone, and Johnsons and Muirs Creek Conglomerates are Permian and not Late Carboniferous as previously indicated. The interval of time assigned to the

'Permian' Period in eastern Australia is therefore quite short (~25 Ma), extending from around 275 Ma to the beginning of the Triassic (around 251 Ma; CLAOUÉ-LONG et al., in press (b)); this age is compatible with that of 256±4 for the Awaba Tuff from 50 m below the top of the Newcastle Coal Measures in the Sydney Basin (Gulson et al., 1990).

2.If these indications are confirmed, the *Nothorhacopteris* flora in eastern Australia (e.g. in the McInnes Formation) extends into the Permian, and the incoming of the *Glossopteris* flora and the Stage 3a Microflora, which some authors (e.g. BALME, 1980) have taken to indicate the beginning of the Permian, took place some 20 Ma after the commencement of that period and is consistent with Early Permian faunal dating of pre-Stage 3 palynofloras elsewhere in Australia (FOSTER & WATERHOUSE, 1988). The first appearance of the *Nothorhacopteris* flora is also older than previously suspected because dates from the Paterson Volcanics confine the Mt Johnstone Formation to well within the Viséan, probably the late V3b or earliest V3c.

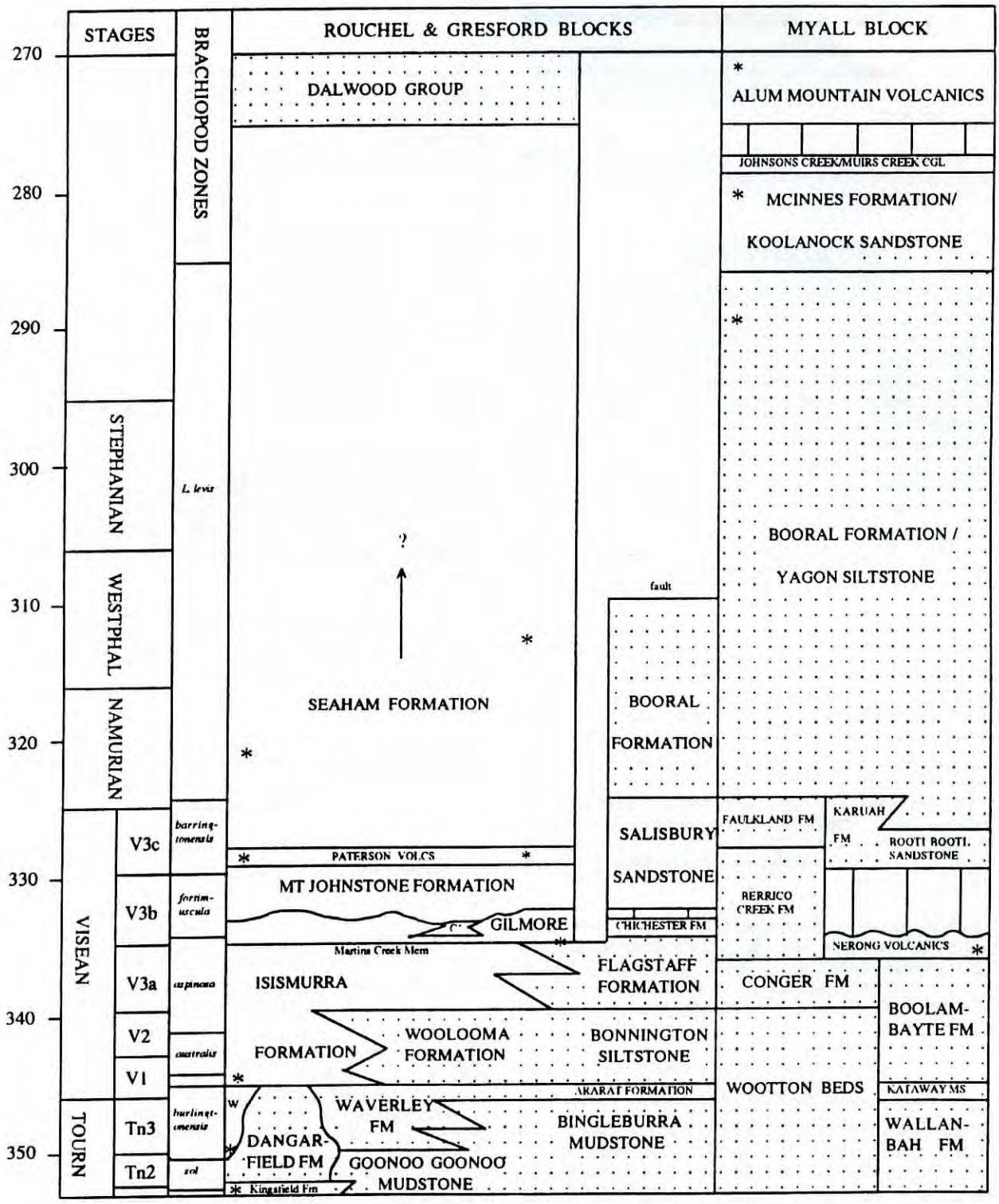

FIGURE 2: Preliminary correlation chart of Carboniferous and Early Permian units of the southern New England Orogen based on stratigraphic information and new data from zircon analyses. Marine rocks are stippled.

3.The duration of the *L. levis* Zone, from near the base of the Namurian (~325 Ma) to about 285 Ma is approximately equal to the duration of the entire Early Carboniferous and far longer than that of the 'Permian' Period in eastern Australia. This requires testing with further work. Support for the new interpretation is provided by the co-incidence of the cold water fauna with onshore deposition of the glacial Seaham Formation and widespread glaciation throughout Australia (POWELL & VEEVERS, 1984).

4.The major outburst of Carboniferous volcanogenic activity and deposition of volcanogenic sediments took place in the Viséan and now includes the Paterson Volcanics and Mt Johnstone Formation. The prominent disconformity beneath the latter unit, previously regarded as having tectonic significance, is best interpreted as a brief but widespread uplift within the volcanic arc.

5.Changes in the correlation of non-marine units (Fig. 1) mean that most Late Carboniferous macro- and microfloral zones require substantial revision. For example, the 'enriched *Nothorhacopteris*' flora recorded from the Mt Johnstone Formation (now Viséan) and the McInnes Formation (now Permian) was regarded as significant for correlation (see MORRIS, 1985, fig. 42); it may have been climatically controlled. The *Potonieisporites* Assemblage of Helby (1969), from just above a tuff dated as Westphalian in the Seaham Formation at Paterson, is older than the *Diatomozonotriletes birkheadensis* Assemblage (previously assigned to the *Spelaeotriletes yberti* Assemblage) in the McInnes Formation; this apparent reversal of the succession of palynofloras is probably the result of changes in the criteria used for zonal recognition (e.g. the first appearance of monosaccate pollen, which originally defined the base of the *Potonieisporites* Assemblage of Helby, was later taken by KEMP et al., 1977 to define the base of the *Spelaeotriletes yberti* Assemblage, or its equivalent in eastern Australia.

6.The age of the base of the Carboniferous Period (353.2±4) is younger than the previous ages of 363 Ma (HARLAND et al., 1990) and 360+5-10 Ma (ODIN, 1982).

ACKNOWLEDGMENTS

Stephanie Maxwell is thanked for her assistance with the microprobe analyses.

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6.3 Devonian - Carboniferous Palynological Notes

By **Geoffrey Playford**, Department of Geology & Mineralogy, University of Queensland, St Lucia Campus, Brisbane, Queensland, 4072, Australia.

Colin McGregor (Geological Survey of Canada, Ottawa) and Geoff Playford (University of Queensland, Brisbane) have been collaborating on various aspects of Devonian-Lower Carboniferous palynology of Canada and Australia since the time of the Seventh International Palynological Congress which was held in the University of Queensland in August-September, 1988. Colin spent a year at the University after the Congress, and Geoff recently worked for five months (July-December 1990) in Ottawa at the Geological Survey of Canada (GSC). Two large manuscripts have materialised from their research and have been submitted for publication as GSC Bulletins: 'Canadian and Australian Devonian spores: correlation and zonation' (McGREGOR & PLAYFORD) and 'Spores and organic-walled microplankton of the Bakken Formation (Late Devonian-Early Carboniferous), southern Saskatchewan: a systematic and stratigraphic appraisal' (PLAYFORD & McGREGOR). The McGregor-Playford paper on the distribution of the stratigraphically significant Late Devonian miospore *Teichertospora torquata* (Higgs) was published recently in *Palynology* (vol. 14, p.7-18; 1990).

6.4 Correlation of Shallow Marine & Continental Late Carboniferous to Early Permian Sediments of the Southern & Eastern Alps (Austria/N-Italy)

By **Karl Krainer**, Institut für Geologie und Paläontologie der Universität, Innrain 52, A-6020 Innsbruck, Austria.

Based on systematic investigations concerning the stratigraphic evolution of plant fossils and plant fossil assemblages, a more precise correlation of the Late Carboniferous - Early Permian shallow marine sequence of the South Alpine Carnic Alps (with a well established fusulinid stratigraphy) with the continental sequence of the Upper Austroalpine Gurktal Nappe of the Eastern Alps was possible.

The Late Carboniferous to Early Permian sequence of the South Alpine Carnic Alps along the Austrian/Italian border is characterised by shallow marine clastic and carbonate sediments (Bombaso Formation, Auernig and Rattendorf Groups). The sediments were deposited in mainly WNW-ESE oriented basins formed by block and wrench faulting.

The Bombaso Formation is characterised by immature clastic sediments derived from the Herzynian orogenic belt (Paleocarnic chain), which were deposited on alluvial-deltaic fans and submarine slopes.

The Auernig Group with a maximum thickness of approximately 1200m is divided into Meledis, Pizzul, Corona, Auernig, and Carnizza Formations. The sequence is composed of conglomerates (fluvial-deltaic and nearshore), trough- and hummocky crossbedded sandstones (fluvial-deltaic to lower shoreface), pelitic sediments with thin coal seams (coastal swamps and offshore) and limestones rich in calcareous algae and fusulinids amongst other bioclasts. Pelitic sediments contain plant fossils.

In the upper part of the sequence the lithofacies types form prominent transgressive-regressive cycles (cyclothemes) ranging in thickness from about 10-40m. Conglomerates indicate relative sea-level lowstands, and limestones signify sea-level highstands. Cycle duration lies in the order of 100,000 years and cycle formation is related to sea-level fluctuations caused by the Gondwana glaciation.

The Early Permian (Asselian) sequence is represented by the Rattendorf Group, which is divided into Lower Pseudoschwagerina Limestone (max 160m), Grenzland Formation (125m), and Upper Pseudoschwagerina Limestone (175m).

The Lower Pseudoschwagerina Limestone is a sequence of well bedded to massive shallow marine limestones with thin clastic sediments (sandstones, siltstones) intercalated. The sediments were deposited in nearshore and inner-shelf environments, massive limestones represent algal mud mounds and reef mounds formed by phylloid algae.

The Grenzland Formation is a clastic sequence (conglomerates, sandstones and pelitic sediments similar to the Auernig Group) with intercalated limestone horizons (oncoid wackestones and grainstones, bioclastic wackestones). The sediments formed in shallow marine, near-shore environments.

The Upper Pseudoschwagerina Limestone is a cyclic sequence of dark-grey, thin bedded limestones (frequently oncoid limestones), massive limestones (algal mounds) and thin clastic intercalations. The sediments formed in open marine platform environments. Cycles within the Rattendorf Group are also related to sea-level fluctuations caused by the Gondwana glaciation.

Fusulinid Zones (KAHLER 1986)		CARNIC ALPS (shallow marine)		Megaflora Zones (WAGNER 1984)	EASTERN ALPS (Gutktal Nappe)	NORTH SPAIN
Zellia heritschi	ASSELIAN (Upper)	RATTENDORF GROUP	Upper Pseudoschwagerina Limestone	*Callipteris conferta* Zone	Werchzirm Fm.	AUTUNIAN
Pseudoschwagerina carniolica *Pseudoschw. aequalis*	ASSELIAN (Middle)		Grenzland Formation			
Occidentoschwagerina alpina *Rugosofusulina praevia*	ASSELIAN (Lower)		Lower Pseudoschwagerina Limestone			
Pseudofusulinoides	GZHELIAN	AUERNIG GROUP	Carnizza Fm.	*Sphenophyllum angustifolium* Zone	Stangnock Fm. (Upper)	STEPHANIAN C
Pseudofusulina Dutkevitchia			Auernig Fm.			
Pseudofusulina multiseptata			Corona Fm.			
Daixinia ? *Jigulites jigulensis*			Pizzul Fm.	*Alethopteris zeilleri* Zone	Stangnock Fm. (Middle)	STEPHANIAN B
? *Triticites rossicus* *Montiparus umbonoplic.* *Protriticites*	KASIMOVIAN		Meledis Fm.	*Lobatopteris lamuriana* Zone	Stangnock Fm. (Lower)	BARRUELIAN
Fusulina *Fusulinella* *Quasifusulinoides*	LATE MOSCOVIAN (MJATCH - KOVIAN)	Bombaso Formation		*Odontopteris cantabrica* Zone		CANTABRIAN

FIGURE 3: Correlation of the Late Carboniferous/Early Permian shallow marine sedimentary sequence of the Carnic Alps (Southern Alps) with the continental sedimentary sequence of the Gurktal Nappe (Eastern Alps).

Biostratigraphy of the South Alpine Bombaso Formation, Auernig and Rattendorf Groups is well established by fusulinids which were intensively studied by KAHLER. The Bombaso Formation is of late Moscovian (Mjatchkovian) age, the Auernig Group is of Kasimovian and Gzhelian age, and the Rattendorf Group is of Asselian age. The Carboniferous/Permian boundary lies within the Lower Pseudoschwagerina Limestone where it is drawn with the first occurrence of *Occidentoschwagerina alpina*.

Within this Late Carboniferous/Early Permian sequence more than 20 different horizons containing well preserved plant fossils (more than 100 taxa) are known and have been studied in recent times. The fossil flora changes significantly from the base (Bombaso Formation) to the top (Grenzland Formation) and three different plant fossil assemblages can be clearly distinguished.

a) A plant fossil assemblage, characterised by the frequent occurrence of *Linopteris neuropteroides* and Lycophyta, is limited to the uppermost Bombaso and Meledis Formations and corresponds to the *Protriticites* Zone (Kasimovian or Stephanian A of the Heerlen Division). This assemblage lacks Upper Stephanian plant fossils and contains only rare Pecopterids. It should also be noted that from the Late Carboniferous sequence of the Carnic Alps, a typical Westphalian flora or Westphalian elements are not known.

b) A plant fossil assemblage rich in Pecopterids and other typical Upper Stephanian taxa like *Aphlebia elongata, Pseudomariopteris busquetii, Sphenophyllum alatifolium, Sphenophyllum angustifolium*, Neuropteroids (e.g. *N. cordata, N. ovata*), Alethopterids (e.g. *A. bohemica, A. serlii*). *Linopteris neuropteroides* is completely absent, Lycophyta are rare. Also absent are *Callipteris* and *Walchiacea*. This plant fossil assemblage is significant for the Pizzul, Corona, Auernig and Carnizza Formations of the Auernig Group (Gzhelian, Stephanian B-C-D of the Heerlen Division).

c) A plant fossil assemblage characterised by *Sphenophyllum angustifolium* and *Callipteris*. In the Carnic Alps this assemblage is limited to the Grenzland Formation which is of middle Asselian age (from the Lower Pseudoschwagerina Limestone no plant fossils are known).

From the continental Late Carboniferous Stangnock Formation and Early Permian Werchzirm Formation of the Upper Austroalpine Gurktal Nappe (Eastern Alps, Austria) plant fossils are also known from many horizons.

The Stangnock Formation is a more than 400m thick clastic sequence of quartz-rich conglomerates and sandstones (different bars and channel fills) and pelitic sediments (overbank fines formed on floodplains and in oxbow lakes). The sediments show characteristic features of braided and meandering stream systems and were deposited in an approximately E-W oriented intramontane basin under humid climatic conditions.

Early Permian sediments (red beds) formed under semiarid to arid climatic conditions and represent deposits of proximal to distal alluvial fans, grading into fine-grained sandflat-playa complexes with caliche crusts. Plant fossils occur in greenish-grey, fine-grained intercalations in the lowermost part of the sequence.

The plant fossil assemblage within this continental Late Carboniferous - Early Permian sequence contains nearly the same taxa (about 80) that occur in the Carnic Alps, and from the base to the top, the same three different assemblages have been recognised which allow a close correlation of the shallow marine sequence of the Carnic Alps with the continental sequence of the Eastern Alps based on plant fossils.

The lower part of the Stangnock Formation characterised by the *Linopteris neuropteroides* assemblage, therefore is of Kasimovian age, the middle and upper part, characterised by the frequent occurrence of Pecopterids and other typical Upper Stephanian elements, corresponds to the Gzhelian, and the uppermost part of the Stangnock Formation and overlying Werchzirm Formation, containing *Callipteris* and Walchiacea, are of Early Permian (Asselian) age due to the correlation based on plant fossil assemblages.

It should be tested if in other continental Late Carboniferous - Early Permian (Stephanian/Autunian) sequences of Europe similar plant fossil assemblages occur which would allow correlation with marine, plant fossil bearing sediments of the Carnic Alps with a well established fusulinid stratigraphy and therefore a better biostratigraphic classification of continental sequences.

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6.5 Early Carboniferous Foraminiferal Zonation in Moravia (Czechoslovakia) and its Correlation

by **Jiří Kalvoda**, Dept. Geol. Paleont., Kotlářská 2, 611 37 Brno.

Recently thirteen foraminiferal zones have been defined in Moravia in the Late Devonian - Early Carboniferous interval (KALVODA 1990). They have been correlated with standard conodont and ammonoid zones which have served as a good base for a better comparison with other foraminiferal zonations in the Tethyan, Siberian, and North American Realms. The modified versions of these correlations are presented in Figures 4 and 5.

The Moravian foraminiferal zonation contributes substantially to a better stratigraphical correlation of the Early Carboniferous, especially in the Tethyan Realm. It forms a link between the data from the classical region in Belgium and the data from Eastern Europe. The most important results obtained can be summarised in the following points:

1). The occurrence of *Tournayellina beata pseudobeata* REITL. et KUL. defines the base of the Upper *Q. konensis* - *Q. kobeitusana* Zone in the Middle *S. praesulcata* conodont zone and approximates the Devonian - Carboniferous boundary in terms of foraminiferal biostratigraphy.

2). The disappearance of *Quasiendothyra* in Moravia can be traced only in the *S. sandbergi* conodont zone at the end of the Early Tournaisian. It accords well with the data from the Omolon Massif (SIMAKOV et al., 1983) as well as from Eastern Europe (BOGUSH et al., 1987). In this respect the disappearance of *Quasiendothyra* cannot be regarded as a criterion for the definition of the Devonian - Carboniferous boundary horizon.

3). The *Paraendothyra* Zone defined in Moravia can be recognised both in the Tethyan Realm (Western Europe, Moravia, Eastern Europe, Ural, China, Tian-Shan) and in the Siberian Realm (Omolon and Kolyma Massif, Verkhoyanian Anticlinal Zone). The occurrence, widespread dispersal and rapid evolution of the species of *Paraendothyra* seems to be promising for a finer stratigraphical subdivision of the lower Early Tournaisian.

4). The detailed correlation of the foraminiferal and conodont zonation in the Late Tournaisian - Early Viséan of Moravia underlines an endemic character of the Late Tournaisian foraminiferal fauna in the Dinant Basin. The data from Moravia can be instrumental in the definition and correlation of a new boundary between the lower and upper parts of the Early Carboniferous.

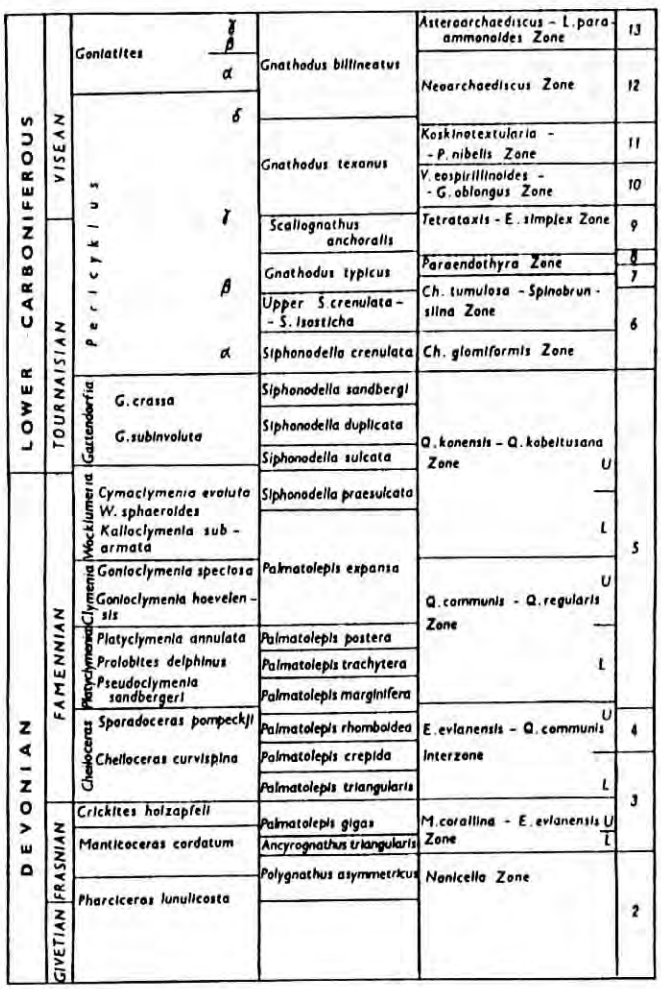

FIGURE 4: A correlation chart of thirteen foraminiferal zones in the Late Devonian - Early Carboniferous of Moravia with standard conodont and ammonoid zones.

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6.6 Carboniferous Epidermal Characteristics and Biochemistry

By **Erwin L. Zodrow**, Department of Earth Sciences, University College of Cape Breton, Nova Scotia, Canada B1P 6L2.

The National Science and Engineering Research Council of Canada awarded Dr Erwin L. Zodrow a three year operating grant totalling $45,000. This money is earmarked for research on cuticles from pecopterids, neuropterids, alethopterids, and pteridosperm seeds of unknown affinity (alethopterids?), using scanning and transmission electron microscopy. Samples for study originated mainly from the Sydney Coalfields of Nova Scotia (Westphalian C - Cantabrian age) and also included are some from Germany. Particularly for the fern foliage, interest not only centres on epidermal charac-

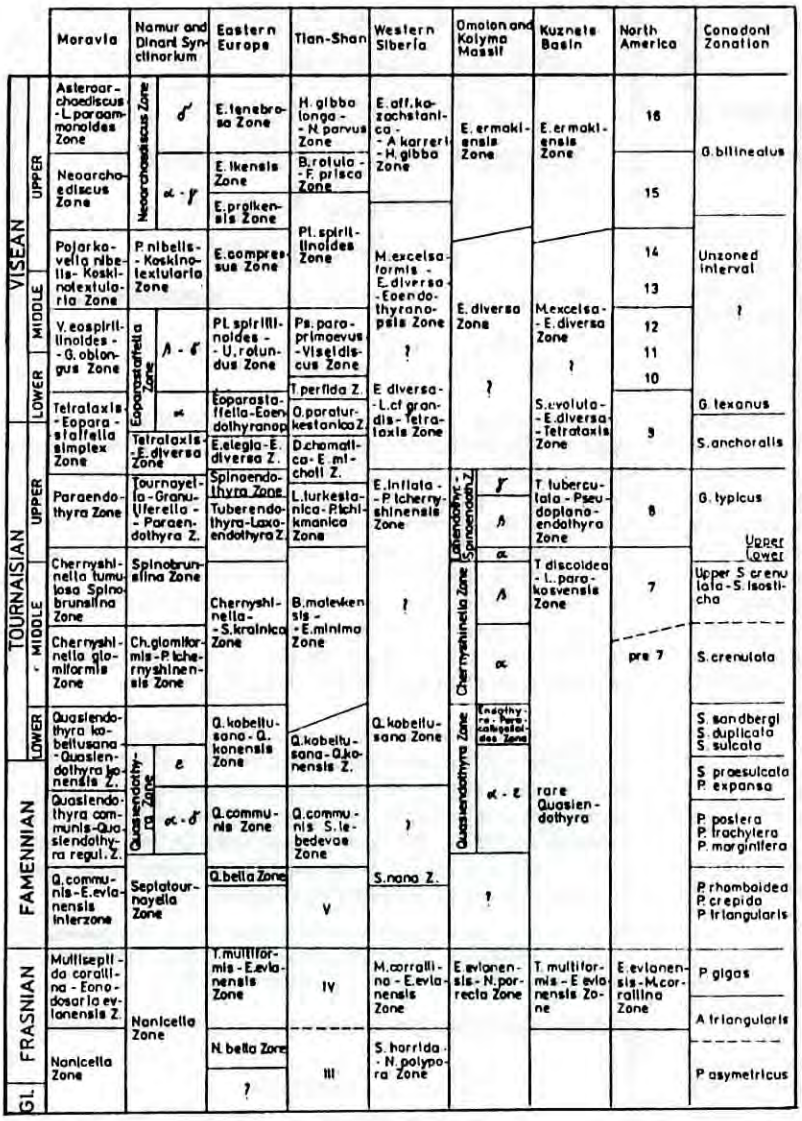

FIGURE 5: A comparison of the Late Devonian - Early Carboniferous foraminiferal zones of Moravia with other zonations in the Tethyan, Siberian and North American Realms.

teristics for refining taxonomy but also on architecture of stomatal apparatuses. The later is largely an unexplored field in Carboniferous fern palaeobiology. Our investigations have shown that, from examination by transmission light microscopy, biased pictures emerge and SEM work is necessary to reconstruct reliably stomatal apparatuses in three dimensions. Another novel line of research is the biochemical composition of cuticles by gas chromatography coupled with magnetic resonance capabilities. First attempts at obtaining results are with neuropterids. Palaeoenvironmental and palaeoecological understanding of plant communities is possible from the studies of cuticles and cuticle-wall layerings. Biostratigraphic potential exists as a result of increased taxonomic data sets and from refined floristic correlation on Pangea. This exciting work is being done in collaboration with Dr C.J. Cleal (Great Britain) and Prof. Gao Zhifeng (University College of Cape Breton).

6.7 Papers by Bamber, Mamet, Richards & Utting et al.

By **B.L. Mamet**, Département de Géologie, Faculté des arts et des sciences, Université de Montréal, C.P.6128, succursale A, Montréal (Québec), Canada and **E.W. Bamber**, Inst. of Sed. and Pet. Geology, 3303-33rd Street N.W., Calgary, AB T2L 2A7, Canada.

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6.8 Carboniferous Studies in the Canadian Arctic

By **Benoit Beauchamp**, Geological Survey of Canada, 3303, 33rd St NW, Calgary, Alberta, Canada T2L 2A7.

From late June to early August 1991, a team of a dozen geologists will visit Ellesmere Island, in Canada's High Arctic, where they will conduct stratigraphic and sedimentologic studies on Carboniferous and Permian strata. These rocks are exposed in various mountain ranges north of Otto Fiord on northwestern Ellesmere Island. A base camp will be established on the north shore of Otto Fiord. From the base camp, fly camps and daily traverses will be set out by helicopter. This project is part of an ongoing research project of the Geological Survey of Canada (GSC Calgary) to assess the Carboniferous and Permian basin analysis of the Sverdrup Basin, The Carboniferous succession of the basin comprises more than 3 km of fine to coarse clastics, evaporites, carbonates, deep water mudrocks, and minor volcanics that were deposited during various phases of continental rifting. Dr B. Beauchamp will be the party chief. He will be accompanied by Drs H.P. Trettin and A.F. Embry (GSC), I. Nilsson and G. Elevakk (Norway), P. Thériault (Ottawa), and a number of student assistants from Canada. Recent papers produced through the project include:

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6.9 Biostratigraphy of Late Carboniferous - Early Permian Cyclic Shelf Sediments of West-Central Ellesmere Island, Arctic Archipelago

By **Sylvie Pinard**, Pinard Consulting, 143 Hillgrove Crescent S.W., Calgary, Alberta, Canada T2V 3K9.

Eight stratigraphic sections for sedimentological and biostratigraphic studies have been measured and sampled east and west of Tanquary Fiord, and on Fosheim and Hamilton Peninsulas. This area is part of a subbasin of the Sverdrup Basin in which clastics, carbonates and evaporites accumulated. These rocks belong to the Moscovian to Sakmarian Canyon Fiord, Belcher Channel, Antoinette, Mount Bayley, Tanquary and Nansen Formations. In the field, the succession of cycles has been divided into a pre-, a syn, and a post-evaporite assemblage; the preliminary correlations of the sections are based on these assemblages.

The zonation of small calcareous foraminifers previously established by Pinard (PhD thesis, 1989) for the Sverdrup Basin is used in this study for more precise correlations. The biostratigraphic study in progress will permit confirmation or modification of the correlations established from field work. So far, the results from the foraminiferal faunas support the sedimentological interpretation.

PINARD, S., 1989: Taxonomie des petits foraminifères du Carbonifère-Permien inférieur du bassin de Sverdrup, Arctique canadien. *PhD thesis* (unpublished), *Université de Montréal*, 782 pp.

6.10 Unifying Stratigraphic Terminology for the Pennsylvanian in the Illinois Basin

By **Heinz H. Damberger**, Geologist & Head, Coal Section, Illinois State Geological Survey, Natural Resources Building, 615 East Peabody Drive, Champaign, IL 61820-6964, USA.

The Pennsylvanian System of the Illinois Basin extends through three states, Illinois, Indiana, and Kentucky. The respective state geological surveys have developed their own stratigraphic terminologies which reflect different philosophies and some differences in the character of the rocks themselves within the three states.

Cooperation during preparation for the 9th International Congress for Carboniferous Geology and Stratigraphy in 1979 in Urbana, Illinois, (IX-ICC) led to the establishment of the Tri-State Committee on Correlations in the Pennsylvanian System of the Illinois Basin.

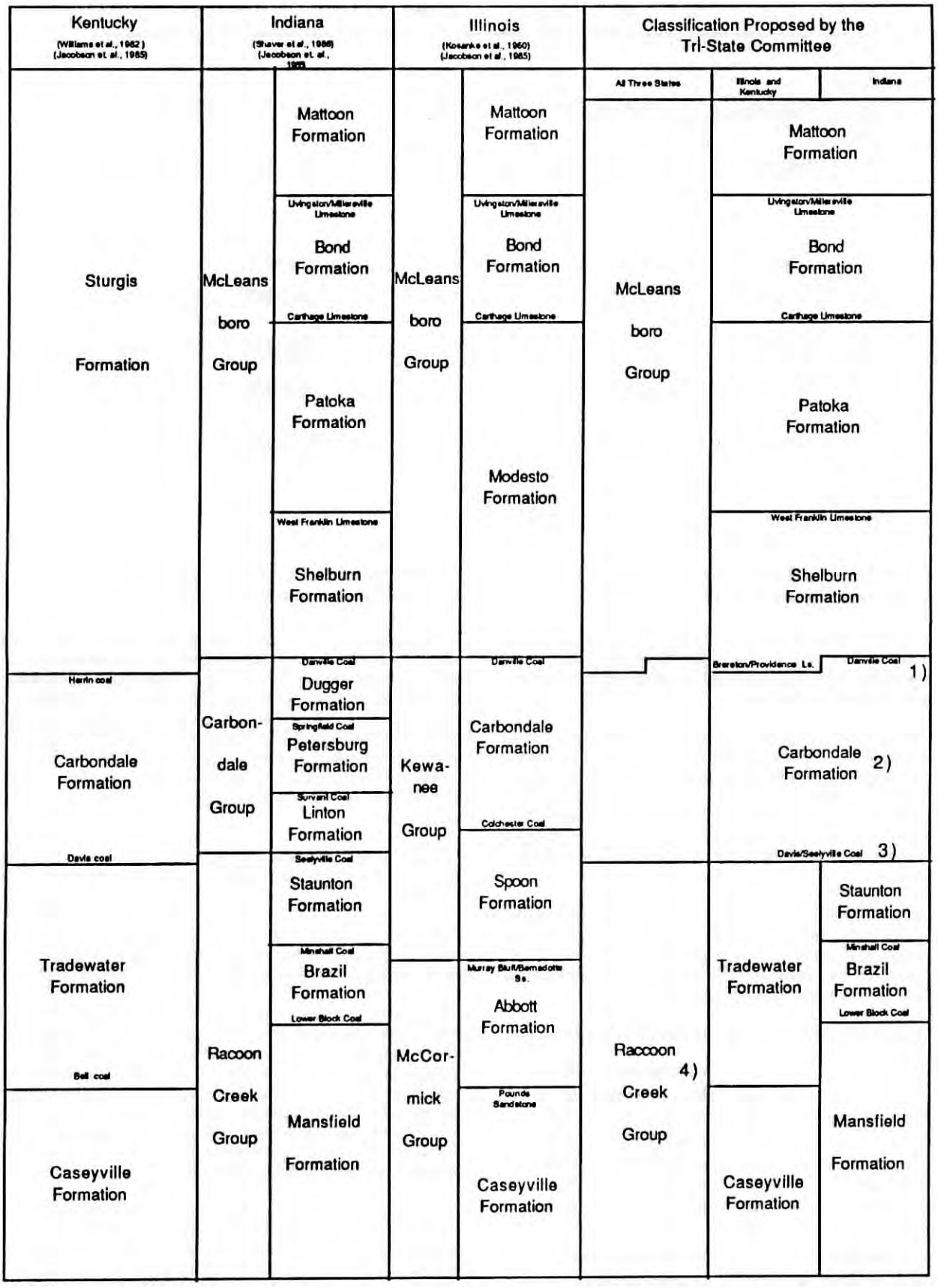

FIGURE 6: Previous and proposed Pennsylvanian nomenclature for Kentucky, Indiana, and Illinois

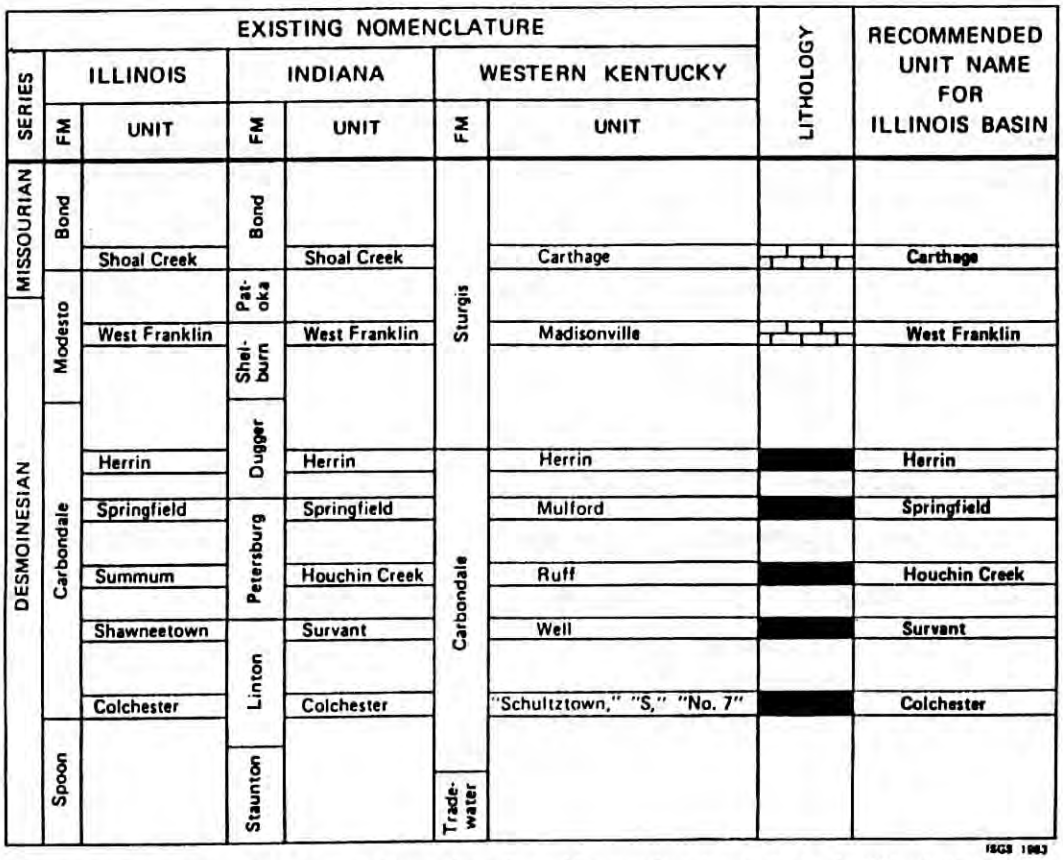

FIGURE 7: Existing and recommended nomenclature for selected Pennsylvanian units in the Illinois Basin.

Initially, the Committee had representatives from the three state geological surveys active in the basin. In recent years the Committee was expanded to include representatives from industry and academia.

One of the goals the Committee set for itself early on was to work on unifying the stratigraphic terminology for the Pennsylvanian system throughout the basin. In 1985, the Committee published a paper (JACOBSON et al., 1985) that reported the agreement on basinwide terminology for five coal beds and two limestones. The agreement was based on stratigraphic cross sections that connected type areas in the three states for these units.

In recent years the Committee has worked on unifying the terminology of formations and groups. Final agreement has not been reached yet but a manuscript has been completed and is under review. Figures 6 and 7 reflect the current status of agreement on basinwide stratigraphic terms.

A list of current members of the Tri-State Correlation Committee includes:

Curtis Ault	IGS	Russ Jacobson	ISGS
James C. Cobb	KGS	Ralph Langenheim	UI
Heinz Damberger	ISGS	John Nelson	ISGS
Don Eggert	IGS	Russ Peppers	ISGS
Steve Greb	KGS	Charles M. Rice	USGS
Nancy Hasenmueller	IGS	Pius Weibel	ISGS
Walt Hasenmueller	IGS	Dave Williams	KGS
M.E. Hopkins	PDC		

IGS=Indiana Geological Survey; PDC=Peabody Development Co.;
ISGS=Illinois State Geological Survey; UI=University of Illinois;
KGS=Kentucky Geological Survey; USGS= U.S. Geological Survey

1. The Kentucky and Illinois Geological Surveys will use the base of the Brereton/Providence Limestone Members as the boundary between the Carbondale and Modesto Formations. The Indiana Geological Survey will continue to use the top of the Danville Coal as this formation boundary because the Herrin Coal and Brereton/Providence Limestone are missing or not recognised over much of Indiana. The Energy Shale occurs in limited areas of Illinois between the Herrin Coal and the Brereton Limestone; it is considered part of the Carbondale.

2. The Indiana Geological Survey will continue to treat the Carbondale Formation as a group, subdividing it into three formations.

3. The base of the Carbondale Formation at the Davis Coal may be difficult to trace in some areas of Illinois and may require adoption of a substitute boundary in such areas.

4. For the time being the Raccoon Creek Group will be divided into the Caseyville and Tradewater Formations in Illinois and Kentucky where the boundary between these formations has been extensively traced.In Indiana, the boundaries of the Mansfield, Brazil and Staunton Formations represent the best established subdivisions of the Raccoon Creek Group; the Caseyville and Tradewater Formations are difficult to trace into southern Indiana and the boundary between them has not been mapped.

JACOBSON, R.L., TRASK, C.B., AULT, C.H., CARR, D.D., GRAY, H.H., HASENMUELLER, W.A., WILLIAMS, D. and WILLIAMSON, A.D., 1985. Unifying nomen clature in the Pennsylvanian System of the Illinois Basin. *Transactions of the Illinois Academy of Science*, **78**: 1-11.

6.11 Carboniferous Biostratigraphy of NW Serbia, Yugoslavia

By **Ivan Filipovic**, Institute for Geological and Geophysical Research, Belgrade, **Smiljana Stojanovic-Kuzenko**, Department of Geology & Geophysics, University of Adelaide, and **Vera Pajic**, Institute for Geological and Geophysical Research, Belgrade.

The authors have been involved in geological mapping of NW Serbia since 1959. During the past three decades the biostratigraphy of the Carboniferous was established in detail. Mapping was done at a scale of 1:25,000 and in some areas 1:5,000 (I.F.). The zonation of the Carboniferous is based on foraminifera and algae (V.P.), conodonts (V.P. and S.S.) and brachiopods (S. S. and, in a separate study, N. Archbold). A proposed monograph will present the compilation and revision of all our published and unpublished results.

The Late Devonian marine sedimentation continued during the Tournaisian and Viséan. This is an arenite-alevrolite sequence with rare dark limestones and some cherts. The limestones yield several conodont associations (*Siphonidella, Scaliognathus anchoralis, Gnathodus bilineatus bilineatus* etc.). The upper part of the sequence shows the turbiditic character of the "Kulm" of middle Europe. The deep water sedimentation of the whole sequence was developed in the "Jadar" trough (KRSTIC, GRUBIC, RAMOVS, FILIPOVIC, 1987).

The change in sedimentation probably occurs at the beginning of the Serpukhovian with the "Djulim" Formation which consists of interlayered limestones and alevrolites. The limestones from the base of the "Djulim" yield a conodont association with *Paragnothodus nodosus* (Upper Viséan- Lower Serpukhovian). Conodonts from the upper part belong to the *Idiognathoides* group (Bashkirian).

The main palaeogeographic changes began in the Bashkirian (Severokeltmenian). Uplift on a regional scale occurred causing the communication with middle Europe to be discontinued and establishing a new link with Eastern Europe, North Africa and the Pyrennees.

After this palaeogeographical reconstruction two units are recognised in NW Serbia. In the central, western and northern parts the autochthonous "Likodra" unit consists of shallow water carbonate-terrigenous sediments with Bashkirian and Moscovian faunas. The oldest are foraminiferal limestones with *Pseudostafella, Milrella* and *Eostaffella* in association with numerous archeodiscids. The overlying alevrolites contain rich brachiopod faunas of Late Bashkirian and Early Moscovian age. In association with the brachiopods are bivalves, gastropods, bryozoans and trilobites. The last Carboniferous in this unit consists of Late Moscovian recrystallised "Stolica" limestones containing rare foraminifera.

In the other palaeogeographical unit, the "Krupanj", marine Bashkirian and Lower Moscovian are missing and we assume that the area at this time was land. An allochthonous olistostrome deposit corresponding to the Kashirskian and Podolskian Stages contains olistoliths with a rich fauna of Late Devonian conodonts, styliolines and tentaculites, and Tournaisian, Viséan and Serpukhovian conodonts. The only reworked macrofossils are "Namurian" goniatites (STEVANOVIC AND KULMAN, 1962) found in a large olistolith in Milivojevici quarry. These macrofossils have not yet been found in the autochthonous unit. Overlying limestones contain three fusilinid associations. The first corresponds to Podolian with *Pseudostafella sphaeroidea cuboides, Ozawainella mosquensis, Fusiella papilionacea* etc. The middle part of the succession is Late Moscovian and contains *Fusulinella* ex. gr. *bocki, F.* ex. gr. *pseudobocki, Pseudoendothyra* ex. gr. *dagmare* etc. *Rugosofusulina, Quasifusulina, Triticites* and *Schubertella* are found in the uppermost part of the limestones which are overlain by Middle Permian.

6.12 Carboniferous Brachiopoda of NW Serbia, Yugoslavia

By **N.W. Archbold**, Faculty of Applied Science, Victoria College, Rusden Campus, Clayton, Vic. 3168, Australia and **S. Stojanovic**, Department of Geology and Geophysics, University of Adelaide, S.A. 5000, Australia.

Detailed descriptive work has now commenced on the diverse Carboniferous brachiopod faunas of North Western Serbia. Preliminary analysis of these faunas was provided by STOJANOVIC-KUZENKO (1968). Initially, work is concentrating on a rich Early Moscovian (Vereian or possibly Kashirian) fauna from near Obradovici Hamlet. This fauna includes the following forms (preliminary identifications only) which provide an indication of the diversity of the assemblage:

Rhipidomella cf. *R. michelini* (L'Eveille)
Orthotetes cf. *O. radiata* (Fischer de Waldheim)
Schuchertella cf. *S. asturica* (Martinez Chacon)
Meekella cf. *M. eximia* (Eichwald)
cf. *Drahanorhynchus* sp.
Isogramma serbica (Stojanovic-Kuzenko)
Alexenia sp.
Plicatifera? sp.
Antiquatonia or *Reticulatia* sp.
Linoproductus sp.
Echinoconchus sp.
Karavankina cf. *K. rakuszi* Winkler Prins
Pugnax sp.
Choristites sp.
Brachythyrina sp.
Cruruthyris cf. *C urii* (Fleming)
Martinia sp.
Cleiothyridina sp.
Zaissania? sp.
as well as additional stenoscismatacean, elythid and martiniid elements.

Links with the brachiopod faunas of Spain are pronounced (WINKLER PRINS, 1968; MARTINEZ CHACON, 1979; RIO GARCIA and MARTINEZ CHACON, 1988). Of particular interest is the occurrence of the small *Isogramma* species *I. serbica*, a member of a group of small species characteristic of the Early Moscovian of the Moscow Basin, Donets Basin and Manchuria (HATAI AND OMURA, 1940; IL'KHOVSKY, 1978).

The Obradovici fauna is regarded as being of Vereian or possibly Kashirian age (Early Moscovian, Middle Carboniferous of Soviet usage or the Middle part of the Late Carboniferous in a two-fold subdivision of the Carboniferous, (HARLAND et al., 1990).

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

Contributions for the next issue (Volume 10, July 1992) must reach the editor before May 31, 1992. Material supplied well before this deadline would be appreciated. Contributions can be sent through your Voting Members who will send out an alert early in 1992.

To facilitate the setting up of the *Newsletter* and reduce typing errors, it would be of great assistance if copy could be sent on BOTH paper and a computer disk (returnable). However, contributions without a disk are still very welcome.

The ***Newsletter*** is prepared using ***WordPerfect 5.1*** and ***Ventura Publisher 3.0***, however we can convert the output of most other word processing packages. Material can be forwarded on either 5¼ inch IBM compatible or 3½ inch IBM and Macintosh disks. If you can supply a disk, you should observe the following requirements.

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