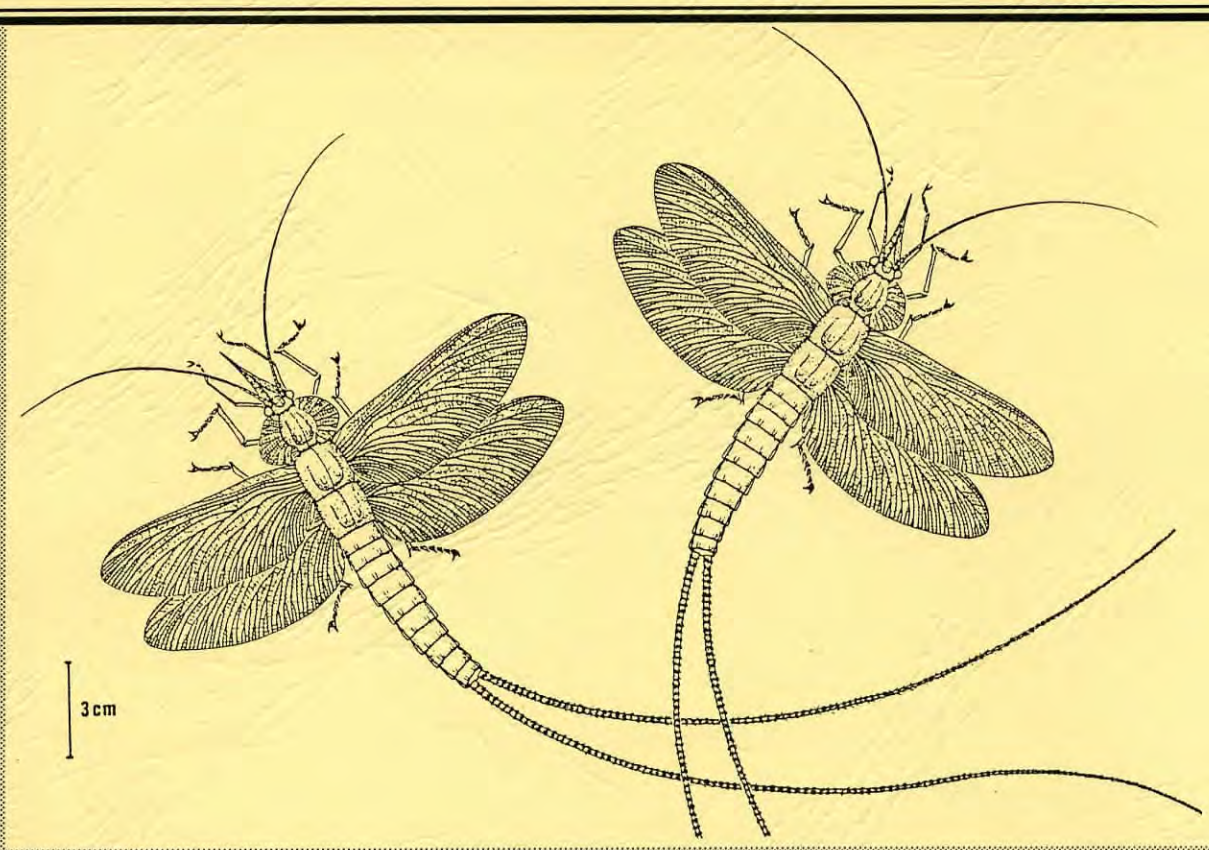
NEWSLETTER ON CARBONIFEROUS STRATIGRAPHY

Volume 10 July, 1992



SCCS

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

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THE COVER ILLUSTRATION

Reconstructions based on five specimens of the Carboniferous insect *Homoioptera vorhallensis* Brauckmann & Koch 1982. The complete animal had a wingspan of 16-21 cm and a total length, including the cerci, of more than 33 cm. Upper Namurian B; Hagen-Vorhalle, Ruhr area, Germany. [Reproduced with permission from Brauckmann, C., 1991: *Geologica et Palaeontologica* **25**: 193-213].

NEWSLETTER ON CARBONIFEROUS STRATIGRAPHY

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

VOLUME 10 **JULY 1992**

1.1 THE CHAIRMAN'S COLUMN

The Subcommission mourns the loss of O.L. Einor and Mackenzie Gordon Jr, both active members of SCCS, who passed away a few months ago, Dr Einor on 9 December 1991 and Mackenzie Gordon on 30 January 1992. Both devoted their lives to science and the results of their life-long service are documented in numerous fundamental publications which will form the basis for scientific progress in future years.

Both encouraged the international geological community to agree upon a basic subdivision of the Carboniferous System. Perhaps I may be permitted to speak for many in expressing the wish that we shall soon achieve this worthy objective of global consensus.

Let us look forward to the start of a new term of SCCS activities at the forthcoming International Geological Congress in Kyoto. Thank you for having elected me as your chairman for the 1992-96 term of office; I shall try my very best to reach our common goal in a practicable way and a reasonable time. Please, help me to achieve this! We intend to carry this most honourable burden in the friendly (and hopefully efficient !!) way we did last term.

Our first task is the definition of the Mid-Carboniferous boundary. We expect to reach a realistic and feasible solution for the stratotype definition this very year. Parallel to this activity it is expected that studies concerning the five levels at which it may be possible to define international biostratigraphic levels will show significant progress (base Kasimovian-Missourian; base zone of *Br. branneri*; base *Gn. bilineatus* zone; base of the Viséan; base of the Osage). Please contact the appropriate Project Leaders (see section 6.2), Brian Engel or myself if you are willing to help.

Eva Paproth

1.2 DONATIONS BY SCCS MEMBERS

Several members have made donations towards the operation of SCCS since the last Newsletter. Their voluntary assistance, added to financial support from IUGS (ICS), funds the publication of this Newsletter.

European members of SCCS wishing to contribute may send their donations to the Chairman, Dr Eva Paproth who will act as a collection agency for the region. Funds should be sent to **DEUTSCHE BANK, KREFELD** for deposit in **ACCOUNT No. 598367.** European members are asked **not** to send cheques to Australia since the bank charges can exceed the value of the donation.

North American & UK members should use **MasterCard, Visa** or personal cheques to send their donations direct to the Secretary in Australia. Because of currency fluctuations, the amount charged to your credit card account may not exactly match the donation indicated.

Donations

Dr N. Archbold, Australia	Dr W. Ramsbottom, UK
Dr R.L. Austin, USA	Dr H.P. Schönlaub, Austria
Dr J.W. Baxter, USA	Dr B.A. Skipp, USA
Dr K.J.Englund, USA	Dr C.A. Stevens, USA
Dr W.H. Gillespie, USA	Dr S. Stojanovic, Australia
Dr B.F. Glenister, USA	Dr P.K. Sutherland, USA
Drs G.&R. Hahn, Germany	Dr K. Watanabe, Japan
Dr K. Ishizaki, Japan	Dr G.D. Webster, USA
Dr F. Kahler, Austria	Dr E. Zodrow, Canada
Dr J. Kullmann, Germany	Anonymous (2), Canada
Dr G. DeV. Klein, USA	Anonymous (1), France
Dr H.R. Lane, USA	Anonymous (1), Germany
Dr R.L. Langenheim, USA	Anonymous (3), USA
Dr S. Pinard, Canada	Donor Group, Spain

2.0 ANNUAL REPORT OF THE SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY

2.1 MEMBERSHIP, OFFICERS

Membership

Commencing in August 1992, the Subcommission will have 22 *Voting Members*, comprised of 3 Bureau Officers and 19 Voting Members. There are 248 *Corresponding Members* on the mailing list.

SCCS conducts 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

Chairman - Dr Eva Paproth, Schönwasserstrasse 103, D-4150 Krefeld, GERMANY

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

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

2.2 SCCS ELECTIONS 1992-96

Bureau Officers

As a result of a recent ballot by the Voting Members of SCCS, Dr Eva Paproth and Dr Engel were re-elected to their positions for a further four-year term commencing with the IGC Meeting in Kyoto, Japan in August 1992, an election now ratified by ICS and IUGS.

Voting Members

Continuing Voting Members (1992-96) include: Tom Dutro Jr, Guo Hongzun, Robert Kosanke, Rich Lane, Jean Pierre Laveine, Li Xingxue, Bernard Mamet, Eva Paproth, Bill Ramsbottom, John Roberts, A.C. Rocha Campos, Robert Wagner, Cor Winkler Prins, and Yang Shipu.

We record with gratitude the contributions of the retiring members: Sergio Archangelsky, Gao Lianda, Maria Solovieva, Patrick Sutherland, and Marcel Weyant; and, with regret, the sad loss of Professor Einor and Mackenzie Gordon Jr.

With these departures from active participation, a postal ballot of all current Voting Members has resulted in the Chairman putting forward the following names for membership: Paul Brenckle, Boris Chuvashov, Marina Durante, Brian Engel, Carlos Gonzalez, Hisayoshi Igo, Walt Manger, and George Sevastopulo. These colleagues have now had their election ratified by the Chairman of ICS and we welcome them to the ranks of the 1992-1996 SCCS Voting Members, commencing with the IGC Congress in Kyoto, Japan later this year.

2.3 ACCOMPLISHMENTS OF 1991

Work of the Subcommission

In 1987, the Subcommission Working Groups changed from numerous regional groups to focus upon just three, namely the mid-Carboniferous Boundary Working Group (Chair - Dr Rich Lane) and two new ad hoc Working Groups (Chairs - Paul Brenckle and Cor Winkler Prins) dealing with further subdivision within the 'lower' and 'upper' Carboniferous. Each of the latter two Chairmen was charged with organising an ad hoc Working Group to evaluate potential boundaries which could provide further global subdivision of their respective subsystems. The SCCS meeting held in Provo, Utah (September 1989) provided a forum for final reports from each Chairman, combined with 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. Five of these levels have since become the central focus for future work by the Subcommission.

The proceedings of the Provo Conference appeared in March 1991 as volume 130 of *Courier Forschungsinstitut Senckenberg* bearing the title **"Intercontinental Correlation and Division of the Carboniferous System"**.

Carboniferous Congress, Argentina

The Subcommission took an active part in the very successful 12th Carboniferous Congress held in Buenos Aires, Argentina in September 1991. Meetings of the Voting Membership and the Mid-Carboniferous Boundary Working Group were held subsequent to the General Meeting of the Subcommission membership on 21 September 1991. Minutes of those meetings are recorded below.

2.4 MINUTES OF SCCS MEETINGS, BUENOS AIRES, ARGENTINA, 1991

2.4.1 SCCS General Meeting

ATTENDANCE: H.W.J. van Amerom, C.G. Brauckmann, S. Archangelsky, D.R. Chesnut, J. T. Dutro Jr, B.A. Engel, K.J. Englund, K.-H. Josten, M.M. Kholief, H.R. Lane, B.L. Mamet, C.G. Maples, J.T. Oliveira, E. Paproth (Chairman), W.H. Ramsbottom, J. Roberts, G.S. Soreghan, E. Villa, R.H. Wagner, J. Windolph, C.F. Winkler Prins.

Introduction

The meeting was declared open by the Chairman at 15:00 on 22 September 1991, in the Carboniferous Congress venue, Hotel Libertador, Kempinski, Buenos Aires, followed by introductory remarks on the work of the Subcommission in its quest for a global subdivision of the Carboniferous System.

The Secretary then presented preliminary reports on behalf of the leaders of the five Project Groups which were formed at the Provo Meeting in Utah in 1989 (see later section). Each report detailed the progress which had been made in the evaluation of the respective levels for their potential as global stratigraphic boundaries. Supplementary contributions by JENKINS and ENGEL were then presented detailing some aspects of the implementation of these boundary levels in regions formerly situated outside the Carboniferous palaeoequatorial belt. Mention was made of the importance of combining age dating with the traditional methods of correlation.

Several members (WAGNER, ROBERTS, LANE, ARCHANGELSKY, MAMET, DUTRO, KHOLIEF, PAPROTH) then contributed to a general discussion on the direction which the Subcommission has adopted in its approach to global correlation and upon particular aspects of the relative importance of event stratigraphy versus the adopted evolutionary/biostratigraphic approach.

LANE then presented a brief update of progress with the Mid-Carboniferous Boundary Working Group. The meeting closed at 17:00.

2.4.2 SCCS Executive Meeting

ATTENDANCE: S. Archangelsky, J.T. Dutro Jr, B.A. Engel, J.P. Laveine, H.R. Lane, B.L. Mamet, E. Paproth, W.H. Ramsbottom, J. Roberts, R.H. Wagner, C.F. Winkler Prins.

Introduction

The Chairman declared the meeting open at 18:00 on 24 September 1991, in the Carboniferous Congress Centre venue, Hotel Libertador, Kempinski, Buenos Aires. Introductory remarks of the Chairman included reference to:

- A request for suitable material to be supplied for radiometric dating;
- A report on the Permian System Meeting in the USSR;
- An announcement that an invitation had been received from Professor Maurice Streel and Marie-France Perret to hold the next Field and General Meeting in Belgium, Germany and France in April 1993.

This invitation generated considerable discussion concerning the most appropriate timing for the meeting.

It was moved, seconded and adopted that ***the offer to hold the next meeting at the venue suggested be accepted subject to further executive negotiation on the most appropriate timing for the meeting.***

Balance Sheet

The Secretary reported upon the balance sheet (see Section 3.0) indicating that, with the assistance of donations by members, it had been possible to return a balanced statement of income and expenditure for the 1990-1991 financial year. This result was made possible only by the generous support of organisations and individuals who have subsidised the internal postage of the *Carboniferous Newsletter* in the various countries to which it is forwarded in bulk. It was then moved that ***the financial report be adopted.***

Elections

As a result of a call for nominations, two candidates stood for the position of Chairman of SCCS. As a result of the ballot, Dr EVA PAPROTH was elected for a second term. The names of PAPROTH and ENGEL were then forwarded to ICS for formal ratification by IUGS as Bureau Officers for the 1992-96 period.

Mid-Carboniferous Boundary W G

The Chairman of the Working Group (LANE) indicated that prior to this meeting it was intended there would be three more sections inspected after which a final decision and recommendation would be presented at the 1995 Carboniferous Congress. After discussion ***it was agreed that the decision point should be moved forward to the 1993 Field and General Meeting.***

Candidate sections which have remained in consideration after field inspections include **Stonehead Beck, UK** and **Arrow Canyon, USA.** Three further visits were proposed including:

- the Gissar Ridge and South Fergana exposures in South Tian Shan, Central Asia;
- the Luodian and Nandan exposures in South China;
- the Col de Tantes section in the High Pyrénées in France.

In order to expedite the process, it was agreed that a small contingent should make a preliminary visit to each of these sites in 1992 to decide if a full inspection by the Working Group was warranted. The details of a South China visit are presented in this Newsletter and the Pyrénées section will be inspected later this year. In view of the political instability in the former USSR, it is unlikely that the Tian Shan Section will be visited at this time.

Previous Ballots

Members are advised that ICS has deferred consideration of the SCCS ballots which decided that the Carboniferous System will be subdivided into two Subsystems, the names of which have yet to be decided. This deferral will continue until the Mid-Carboniferous Boundary stratotype has been defined and appropriate names for the two Subsystems have been selected.

In respect of the previous ballots on Western European Stage names, the formal decision accepting these proposals by the Subcommission does not require further ratification. These stage names have therefore been given formal status, dating from their acceptance by the ballot of the Voting Membership of SCCS.

Project Groups

The Chairman noted the reports presented at the General Meeting for each of the five extant Project Groups. The meeting then formally endorsed the procedure adopted for those five Project Groups and abandoned the proposal for a sixth Project at a boundary situated at the base of the *Fusulina/Beedeina* occurrence (Atokan-Desmoinesian; mid-Moscovian boundary). It was also suggested that the Bureau should place some time limits on this stage of the boundary evaluation process since it needs to be established fairly soon that further effort is justified.

Further discussion included the necessity for all biotypes (not just the nominated ones) to be considered and that it should be signalled to the Project Leaders that their preliminary evaluation needs to be concluded over the next two years.

Carboniferous of the World

The Editors reported that the USSR and Middle East volume was approaching completion. The text has been computerised and all figures have been redrawn. Drafting is now in progress and publication is possible in 1992.

Voting Membership

The process for the replacement of retiring members was endorsed in the form of a ballot for new members. A request was made that future membership changes should endeavour to incorporate greater participation by stratigraphers in the affairs of the Subcommission.

Future Plans

Immediate plans call for progress with the Project Group evaluation process and the opening of the debate on suitable names for the two Subsystems.

Other Business

(a). A proposal was read out by LAVEINE for the definition of the Stephanian Series for which the work on relevant floras had been completed. The committee noted the verbal proposal and requested LAVEINE to have the proposal brought forward as a formal document for discussion at the next meeting in Liège in 1993.

(b). A formal vote of thanks was endorsed by all present to those Voting Members of the Subcommission who will stand down in August 1992.

(c) Members observed that the Global Correlation Chart produced by ICS contained a number of errors of fact which required formal correction by the Subcommission. It was resolved that a new chart for the Carboniferous System should be developed and that WINKLER PRINS and WAGNER would prepare a first draft for circulation and updating by all members.

(d) Dr DICKINS (visitor) requested from the floor that some changes be set in train for the organisation of future Carboniferous Congresses which had now incorporated the Permian in their scope. Dr DICKINS was advised that the Permanent Committee of the Congress was the correct body to whom he should address his concerns together with his request for formal Permian representation on the organisational committee.

2.5 FAREWELL TO OLGERD LEONARDOVICH EINOR (1908-1991)

PROFESSOR O.L. EINOR, a learned stratigrapher, a wise scientist, and a most deserving member of the scientific community passed away on 9 December 1991. He was born on 26 May 1908 in the town of Poltava, Ukraine, into the family of a well known doctor Leonard Yurievitch Einorus who ran a private hospital in Poltava.

Even as a school student young Einor demonstrated brilliance and in 1930 he graduated from the Geological Faculty of the University of Leningrad. Afterwards he worked for the Uralian Geological Board and then the Institute of Arctic Geology in Leningrad.

In 1941 he began work in VSEGEI in Leningrad and carried out field work in the Pechora Basin, the Pay-Khoy mountain range, the Vorkuta region and the Tunguska Basin. Later he conducted field investigations dealing with the Caucasus, the Russian Platform, Southern Ukraine and the south of Middle Asia.

In 1936 he was awarded the degree of Bachelor of Geological-Mineralogical Science followed by his Doctoral degree in 1946. In 1949 he worked for the Geological Board of Kazakhstan in the Alma-Ata region and in 1950 he took up the appointment of Professor of Palaeontology in Kiev University.

Professor Einor's work was marked by an original and creative approach. He made significant contributions in the areas of geological structure, stratigraphy, palaeontology, palaeogeography, mineral resources and the history of geological science. His scientific work is contained in 220 publications, including 17 monographs and a two volume textbook *The Geology of the USSR*. He was the first to discover the Gremjatahensk coal deposits in the Urals and the Nizhne-Silovsk coalfield in Pechora. He created a set of lithological-palaeogeographical maps of the Carboniferous of the USSR He played a leading role in the development of national stratigraphy and palaeobiogeography.

He was an accomplished pianist, and a brilliant chess player, once competing against and defeating the World Chess Champion Kapablanka. He had a profound knowledge of Russian literature and because of his skill with foreign languages, a wide acquaintance with world literature.

He was an extremely honest and principled man, kind to his colleagues, and a devoted friend. To complement his natural ability he always worked very hard. Amongst his many duties he served as a loyal Member of the Subcommission on Carboniferous Stratigraphy where he supported the aims and ideals of our organisation for a great many years. The loss of his vast experience and knowledge will be sorely missed by all who follow in his footsteps.

Maria N. Solovieva

2.6 FAREWELL TO MACKENZIE GORDON JR (1913-1992)

MACKENZIE GORDON JR, 78, world renowned geologist and palaeontologist for more than 40 years with the US Geological Survey, died of cardiac arrest at his home in Washington DC on 30 January 1992.

Mac Gordon specialised in the geology of the Carboniferous System for much of his career. His paleon-

tological interests were concentrated on two main groups of fossils - cephalopods and brachiopods, especially the spiny-shelled productoids. He published more than 100 scientific papers during his career. Retired in 1981, he continued to work on various geological manuscripts for the Survey and also as a research associate of the Smithsonian Institution.

Mac Gordon was also an acknowledged expert in ancient Chinese art and history and had accumulated one of the world's finest private collections of bronze mirrors. He and his wife Barbara were collectors of western contemporary art and were active in local art circles. Gordon served on the Board of Directors of the Friends of the Corcoran Art Gallery and was Chairman of its Acquisitions Committee. The Gordons were also deeply involved with the Washington Society for the Performing Arts.

Born in San Francisco on 4 April 1913, Gordon attended Bates High School, graduating in 1929. He received an A.B. in geology from Stanford University in 1934 and attended graduate school there, studying geology in 1935-36.

Gordon's early geological work, just before and during World War II, involved mineral resource appraisal in three major metal commodities. He studied tungsten deposits in California and Arizona, manganese in Arkansas and played a critical role in the government's Arkansas bauxite project from 1942-1945. During this early period, Gordon also participated in strategic mineral mapping in the Dominican Republic and studied Carboniferous and Permian stratigraphy in south Brazil from 1945-1947.

In 1950, Mac Gordon transferred to the Survey's Paleontology and Stratigraphy Branch where he conducted his research for most of the next 40 years. He was in charge of the Upper Paleozoic Unit from 1951-1956 and spent 1956-1958 in the Survey's office in Menlo Park, California, where he assisted in establishing the regional research centre.

Gordon returned to Brazil in 1958-1960 where he participated in the United States Government's international program to establish geology departments in certain Latin American universities. Gordon organised and taught courses in stratigraphy, paleontology, and sedimentology, in Portuguese, and also established a summer field camp, at the Universidade do Rio Grande do Sul in Porto Alegre. For these efforts, he was cited by the Brazilian Geological Survey in 1964.

Mac Gordon was a fellow of the Geological Society of America and the Californian Academy of Sciences, a past-director of the American Geological Institute and a member of several other scientific societies including the American Association of Petroleum Geologists, American Malacological Union, Paleontological Society, Geological Society of Washington, Paleontological Society of Washington and the Society of Economic Paleontologists and Mineralogists.

In particular, Mac Gordon was the president of the Congress and editor-in-chief of the Proceedings of the 9th International Congress on Carboniferous Stratigraphy and Geology, held in the United States in 1979 as part of a year-long celebration of the Centennial of the US Geological Survey He recently retired from the position of United States representative on the Permanent Committee for the International Carboniferous Congress, and at the time of his death he was a titular member of the Carboniferous Subcommission.

Thomas Dutro Jr

NEW JAPANESE PUBLICATION

PALAEONTOLOGICAL SOCIETY OF JAPAN
SPECIAL PAPERS
NUMBER 32

FUSULINE BIOSTRATIGRAPHY OF THE UPPER CARBONIFEROUS AND LOWER PERMIAN OF JAPAN, WITH SPECIAL REFERENCE TO THE CARBONIFEROUS-PERMIAN BOUNDARY

By
Kozo WATANABE

PUBLISHED BY THE SOCIETY
December 5, 1991

By Kozo Watanabe, 1991: Palaeontological Society of Japan, Special Papers 32, 150 pp., 51 figs, 8 tables.

This paper deals with a fusuline biostratigraphy based on inflated schwagerinids of Upper Carboniferous and Lower Permian age in Japan. As a result of studying 10,000 thin-sections of systematically collected, inflated schwagerinids, the author has designated twelve standard fusuline zones - *Obsoletes obsoletus, Montiparus matsumotoi inflatus, Schwagerina? satoi, "Pseudoschwagerina" morikawai, "Pseudoschwagerina" minatoi, Sphaeroschwagerina fusiformis, Sphaeroschwagerina pavlovi-Pseudoschwagerina muongthensis, "Alpinoschwagerina" saigusai- Pseudoschwagerina* cf. *robusta, Schwagerina globulus japonicus-Pseudoschwagerina miharanoensis, Paraschwagerina akiyoshiensis-Pseudofusulina firma, Robustoschwagerina schellwieni pamirica-Schwagerina krotowi* and *Robustoschwagerina schellwieni schellwieni-Pseudofusulina vulgaris globosa* Zones, and ten datum levels have been established in the upper Carboniferous and lower Permian sequences. It was also revealed that the Carboniferous-Permian boundary in Japan can be drawn between the *"Pseudoschwagerina" minatoi* Zone and the overlying *Sphaeroschwagerina fusiformis* Zone, which are correlated respectively with the Upper Gzhelian and Lower Asselian Stages of the stratotypes in the upper Carboniferous and Lower Permian of Russia.

3.0 SUBCOMMISSION FINANCIAL REPORT

3.1 STATEMENT OF INCOME AND EXPENDITURE 1990-91

INCOME	Definitive AUS$	Estimated US$
IUGS Allocation for 1991	824.65	650.00
Donations of members	270.09	216.31
Bank interest	59.17	47.34
TOTAL INCOME	1153.91	913.65
EXPENDITURE		
Stationery:	27.25	21.80
Printing Costs: Newsletter 9	367.00	293.60
Postal Charges: Nov.90-Oct.91	369.50	295.60
Conference Contribution	240.00	200.00
Sundry Expenses: Typing	150.00	120.00
Bank Charges	2.35	1.88
TOTAL EXPENDITURE	1156.10	932.88

Explanatory Note: Definitive income and expenditure is quoted in Australian Dollars. US$ income has been converted to AUS$ at the rate prevailing on the day of exchange. All other AUS$ income and expenditure has been converted back to US$ at a standard exchange rate of AUS$1.00=US$0.80 where necessary.

BALANCE SHEET (1990-91):	Definitive AUS$	Estimated US$
Funds carried forward from 1990	1519.63	1203.13
PLUS Income 1990-1991	1153.91	913.65
LESS Expenditure 1990-1991	1156.10	932.88
CREDIT balance c/fwd to 1992	1517.44	1183.90

3.2 BUDGET ESTIMATES FOR 1992

Support from IUGS was sought for the following expenditure:

ITEM	AUS $	US $
Printing & Stationery	565.00	480.00
Postage Costs	620.00	527.00
Part-Time Typing Assistance	298.00	253.00
TOTAL BUDGET	$1483.00	$1260.00

The ICS Secretary General, Prof. J. Remane, has recently advised that the 1992 subsidy for the Subcommission will be US$300.00, well short of the expected expenditure.

3.3 BACK ISSUES OF THE NEWSLETTER

The Secretary is holding a limited number of back issues of the *Newsletter on Carboniferous Stratigraphy*. Members are welcome to request these back copies to complete their holdings for the cost of packing and postage which is detailed below.

EUROPEAN MEMBERS can pay by credit card (MASTERCARD or VISA) or send an equivalent amount in DM direct to DEUTSCHE BANK, KREFELD for deposit in ACCOUNT No. 598367. As well as notifying Dr Paproth, they should send a copy of their order (stating the amount paid) to the Secretary in Australia from where the volumes will be dispatched by economy air mail. **Please do not send personal cheques from European countries.**

ALL OTHER MEMBERS should send their payment by credit card (MASTERCARD or VISA), by a bank draft or a personal cheque in **US, Canadian or Australian Dollars or Sterling** direct to the Secretary.

Number of copies available include:

Volume 1 (1980) - 36; Volume 6 (1988) - 19
Volume 2 (1981) - 63; Volume 7 (1989) - 18
Volume 3 (1982) - 60; Volume 8 (1990) - 13
Volume 4 (1983) - 17; Volume 9 (1991) - 5
Volume 5 (1984) - 41

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	5 to 9 issues -	US$18.00;	(AUS$24.00)

4.0 FIELD AND GENERAL MEETING - EARLY CARBONIFEROUS STRATIGRAPHY - LIEGE ,1993

4.1 Notes on the First Circular, issued July 1992

Under the auspices of the 175th anniversary of the foundation of the Université de Liège, Belgium, the laboratories of Plant Palaeontology (Director: Professor M. Streel) invite the IUGS Subcommission on Carboniferous Stratigraphy to hold its Field and General Meeting in Liège in early June 1993.

The meeting will be organised in cooperation with:

- The Belgian Geological Survey (Director: Professor J. Bouckaert);
- The Palaeontological Laboratories of the University of Louvain (Professor E. Groessens);
- The Belgian Committee for Dinantian Stratigraphy (Chairman: Professor E. Poty);
- The Laboratory of Structural Geology and Tectonophysics of the University of Toulouse, France (Dr. M-F. Perret).

The organisation will be supported by:

- The National Fund for Scientific Research of Belgium;
- The Ministry of Economic Affairs of Belgium;
- La Société Géologique de Belgique.

It is 24 years since the Subcommission held its first meeting in Liège in April, 1969. Professor Maurice Streel wishes to remind members of the Subcommission that the proceedings of the last SCCS meeting at Liège are still available free of charge except for mailing costs. Interested members should make direct contact with Professor Streel if they wish to obtain a copy.

MEETING DATES - JUNE 1993

Sunday 6: Registration

Monday 7: Field Trip to the Upper Famennian / Lower Carboniferous of Belgium

Tuseday 8: Session in Liège

Wednesday 9: Morning Session in Liège
Afternoon excursion to Upper Famennian and Lower Carboniferous near Liège

Thursday 10: Morning Session in Liège
Afternoon end of session; travel to Germany

Friday 11: Field Trip to Upper Famennian/Lower Carboniferous of the Rheinisches Schiefergebirge

Saturday 12: End of German excursion; travel to Pyrénées (France)

Sunday 13 to Wednesday 16: Field Trip to the Pyrénées, organised by Dr. M-F. Perret (see below)

ACCOMMODATION

The following arrangements are planned:

June 6-10: in Liège (Belgium)
June 10-11: in Hasselbach (Germany)
June 11-12: in Drewer (Germany)
June 12-16: in the region of Toulouse (France)

THEME OF THE SESSIONS IN LIEGE

Members are invited to contribute any papers related to the aims of the Subcommission including those dealing with the final report of the former international Working Group on the Devonian-Carboniferous Boundary.

PUBLICATIONS

A special volume of the Annales de la Société Géologique de Belgique on the final report of the above Working Group, to be published at the end of 1992, will be distributed to the participants.

Another special volume might be devoted to the Proceedings of the Carboniferous Subcommission Meeting to be published in 1993/94 if there is sufficient interest in this meeting.

Field Guidebooks will be produced for each excursion.

PLEASE RETURN CIRCULAR 1 AS SOON AS POSSIBLE

If Circular 1 has been removed from this issue please contact the organiser at the following address:

Dr. M. Streel, Paléontologie, Université de Liège, Place du Vingt-Août 7, B-4000 LIEGE, Belgium.

4.2 Field Notes on the High Pyrénées Field Excursion

MARIE-FRANCE PERRET (Univ. Paul Sabatier, Toulouse, France) has proposed that members of SCCS should visit a carbonate facies sequence in the Carboniferous of the East Pyrénées with a view to considering it as a potential stratotype for the Mid-Carboniferous Boundary.

The section has been studied by scientists from Toulouse (M.F. PERRET, J.J. DELVOLVE, CI. MAJESTE-MENJOULAS) and Nottingham (N. RILEY). It contains very interesting sedimentological and palaeontological features, with representative conodonts, ostracods, crinoids, goniatites and other molluscs.

Although the section crops out at high altitude (2100m), it has the advantage of being accessible by road transport. Climatic conditions are not very severe and it is possible to work there from May/June to October/December, depending upon weather conditions. Vegetation is not a problem and there is no risk of destruction by intensive land use.

Finally, the locality is part of the National Park of the Pyrénées and is therefore already protected from commercialisation.

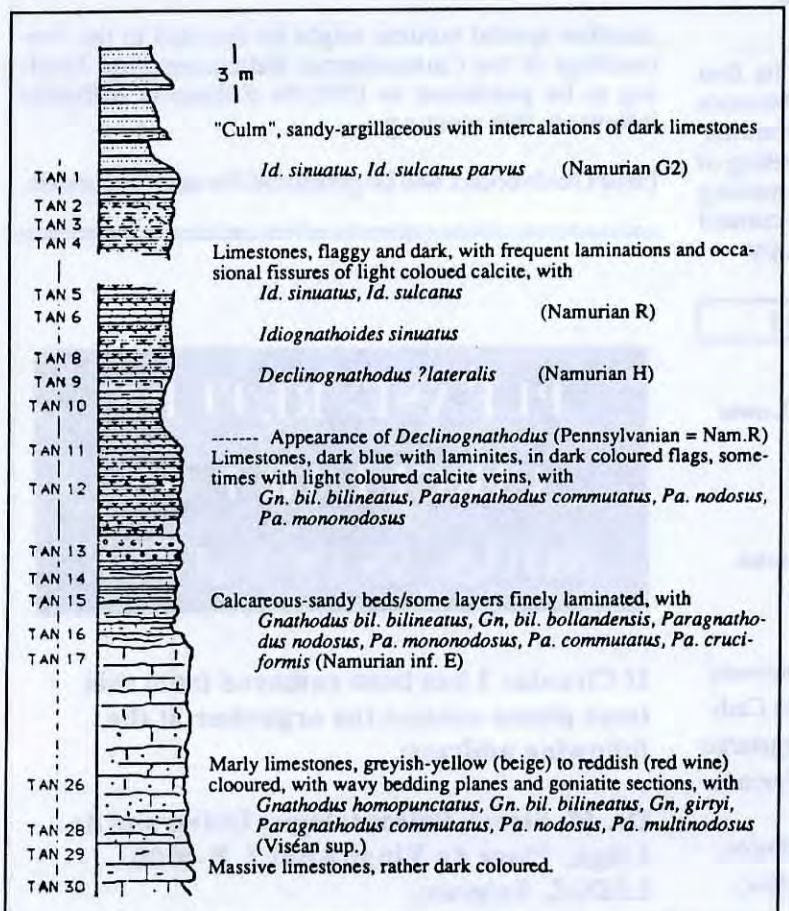

Figure 1: Section of the Carboniferous limestones in the Plateau St André / Col de Tantes district (High Pyrénées).

Tantes Section, Plateau Saint-André (High Pyrénées)

The Gave de Pau valley cuts into the alpine nappe of Gavarnie. The Carboniferous rocks that belong to that nappe, together with other Palaeozoic rocks, are rather easy to approach in the hills of the Saint-André Plateau, along the side of the road from Gavarnie to the Col de Boucharo, uphill from the skiing station at Especières.

The non-detrital rocks of the pre-Variscan Carboniferous can be seen in a normal, near horizontal position (although they are cut into elongated segments running NNE-SSW by similarly oriented thrusts) at the road level and above, immediately east of the high tension electric line.

The oldest accessible unit, above massive, rather dark limestones, are beige coloured irregularly noduliferous limestones, at times with rose coloured patches, and many sections of Goniatitides and Merocanitides.

These are (PERRET in MIROUSE et al.,1983) micritic limestones, a little marly, often with schistosity, mainly of wackestone type, then mudstone with many fossil sections; beside *Goniatites* there are *Globochaetes*, thin shelled molluscs, crinoids and ostracodes; bioclasts are slightly more abundant near the base (Figs. 1, 2).

These limestones provide an association of conodonts including *Pseudognathodus homopunctatus*, *Gn. bilineatus bilineatus*, some transitional forms of *Gn. bilineatus bollandensis* and also *Paragnathodus commutatus*, *Pa. nodosus*, and *Pa. multinodosus* that indicate a late Viséan age (samples 30-26).

These are overlaid by dark limestones which are a little sandy with some levels (packstones) of laminites; besides locally abundant goniatites and crinoids, there is an association of conodonts with *Gn. bilineatus bilineatus*, *Gn. bilineatus bollandensis*, *Paragnathodus nodosus*, *Pa. mononodosus*, *Pa. commutatus*, and *Pa. cruciformis* that indicate a lower Namurian age (E1-E2) (samples 25-12).

In the overlying, well-bedded, dark limestones, laminations become very abundant locally; these are calcareous mudstones containing a network of calcite veins (regular networks - fine, en-echelon, tension fissures, etc.). Conodonts at this level include *Gn. bilineatus bilineatus*, *Paragnathodus commutatus*, *Pa. nodosus*, *Pa. mononodosus*, and a platform fragment of *Idiognathoides* which would indicate Pennsylvanian R (sample 11).

The highest beds of this unit (samples 10 to 1) have delivered *Declinognathodus ?lateralis*, then *Declinognathodus noduliferus* together with *Id. sinuatus*, and finally *Id. sinuatus* is found together with

CONODONT SPECIES	SAMPLE NUMBERS - TANTES/ESPIERES SECTION (HIGH PYRÉNÉES																							
	30	29	28	27	26	25	23	22	21	20	19	18	17	16	15	14	13	12	11	9	8	6	5	4	1
Vogelgn. campbelli	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gnathodus	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	-	-	-	-	-	-
Gn. praebilineatus	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gn. girtyi girtyi	-	*	-	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gn. gyrti meischneri	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gn. girtyi intermedius	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gn. girtyi soniae	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gn. bil. bilineatus	-	*	*	*	*	*	*	*	*	*	*	*	*	-	*	*	*	*	*	-	-	-	-	-	-
Gn. bil. bollandensis	-	-	*	*	-	-	*	*	?	-	*	*	*	*	-	-	*	-	*	-	-	-	-	-	-
Paragnathodus	*	*	*	*	-	*	*	*	*	*	*	*	*	-	*	-	*	-	*	-	-	-	-	-	-
Paragn. commutatus	*	*	-	*	-	-	*	*	*	*	*	*	*	-	*	-	*	-	*	-	-	-	-	-	-
Paragn. mononodosus	-	*	-	-	-	-	-	-	-	-	-	*	-	-	-	-	*	-	*	-	-	-	-	-	-
Paragn. nodosus	-	-	*	*	-	*	-	?	*	*	-	*	*	-	*	-	*	-	*	-	-	-	-	-	-
Paragn. cruciformis	-	-	*	-	-	-	-	-	-	-	-	*	-	-	-	-	*	-	-	-	-	-	-	-	-
Paragn. multinodosus	-	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudognathodus	*	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ps. homopunctatus	*	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Declinognathodus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*	*	-	-	-	-
Decl. nevadensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*	-	-	-	-
Decl. noduliferus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	cf	-	-	-	-	-	-
Decl. ?lateralis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*	-	-	-	-	-
Idiognathoides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*	*	*	*	*
Id. sinuatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*	*	*	*	*
Id. sulc. sulcatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*	*	-	cf
Id. cf. sulc. parvus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*

Figure 2: Conodonts observed in samples taken from the Tantes/Especières section (High-Pyrénées) (See Figure 1)

Id. sulcatus cf. *parvus* all of which are dated as Namurian R1 to G2. It must be noted that these black, hard, somewhat siliceous and smelly limestones (MIROUSE 1962; 1966, p.167, Pl.16, Fig.13) - amongst others - have provided one specimen of *Proshumardites karpinskyi* RAUS which is in the BRESSON collection in the Laboratoire de Géologie of Toulouse University, and also one specimen of *Dimorphoceras thallassoide* in the HAUG collection of the Sorbonne, described and figured by DELEPINE (1937, p.83, fig.13); these organisms provide good confirmation of a Namurian age for these black conodont-bearing limestones.

Above this appear the first detritic beds of the "Culm" which still yield a few intercalations of bluish-black limestone. A similar section, which was sampled by J.J. DELVOLVE (1987, p.139), has also been found 250m north of the "Ruines napoléoniennes". The few conodonts present there have confirmed the results described above.

The dark limestone/laminite unit which occurs in the Estiva/Chinipro section, together with identified microorganisms from all levels of the Plateau Saint André section, make it possible to state that this dark limestone/laminite unit begins here in the lower Namurian, replacing at that time the light-coloured, micritic limestones with *Goniatites*.

In this section, it is possible to localise the Mississippian - Pennsylvanian Boundary (with the appearance of *Declinognathodus*) and to state that the pre-Variscan (pre-"Culm") carbonate sedimentation lasted here until Namurian G times.

CONTRIBUTIONS TO THE NEWSLETTER

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

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

Contributions for the next issue (Volume 11, July 1993) must reach the Editor before 31 May 1993. Material supplied well before this deadline would be appreciated.

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* but 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.

- Include a printed copy and the name of the word processing package that you have used.
- Supply two copies of your file on disk. The first can be the normal output of your word processor which may include underlining and bolding but no indents. Do not use any unusual formatting features of packages. The second copy of the file should be saved as a plain ASCII text (i.e.without enhancement).
- Please ensure that all typing is done with only ONE space after each full stop at the end of each sentence.

Please use AIR MAIL to send your contribution to the Editor or your Voting Member.

5.0 REPORTS FROM SCCS-ICS-IUGS BODIES

5.1 Mid-Carboniferous Boundary Working Group Report

By H.R. Lane, Amoco Production Co., 501 Westlake Park Blvd, P.O. Box 3092, Houston TX 77253, USA

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 held in 1990-91. During the 12th Carboniferous Congress in Buenos Aires, Argentina it was announced that three further sections were to be visited in 1992-93. These included the Nandan exposure, Guilin, China, the Gissar Ridge Section, South Tian Shan, Central Asia, USSR and a section on the Plateau Saint-André, at the Col de Tantes in the High Pyrénées, France.

5.2 Field Meeting to Guizhou Province, China

The Mid-Carboniferous Boundary Working Group plans to visit two potential stratotype sections in a rather remote, but exquisitely beautiful area of south China in mid-November 1992. Because of lack of hotel space and general logistical conditions, only a limited number of members will be able to attend.

Dr Ruan Yi-ping and Prof. Yang Jing-zhi of the Nanjing Institute of Geology and Palaeontology have kindly offered to lead the excursion to two important exposures in the south China province of Guizhou and Guangxi. These sections, Luodian and Baping, are continuously deposited sequences across the mid-Carboniferous interval in a predominantly carbonate environment of deposition. They are especially rich in calcareous microfossils and conodonts. There are scattered goniatites, but that fossil group is much better developed at the boundary level in another, less accessible, but nearby exposure.

As requested by Chairman Paproth at the Carboniferous Congress in Buenos Aires, the Working Group is to have a final recommendation for Subcommission consideration at the time of the SCCS Field and General Meeting in Liège, Belgium, in June 1993, rather than at the Polish Carboniferous Congress in 1995 as originally planned. Therefore a great deal of final business will need to be transacted at the Guizhou-Guangxi meeting in preparation for the final recommendation in Liège. It is very important that as many members of the Working Group attend the Guizhou-Guangxi Field Meeting, as it will be our last one.

A provisional program for the field visit is detailed below but is subject to modification. In the meantime, the Working Group Chairman, Rich Lane, needs to hear urgently from those WG members who have a definite intention of attending so that they can be kept informed of the details of the visit as they come to hand. It is important that contact is made with Rich as soon as possible so that our Chinese colleagues can arrange for a proper letter of invitation to be sent to you, so that you can obtain a Chinese visa.

Even though attendance must be kept to a minimum, any seriously interested members who wish to attend but who are not necessarily members of the Working Group, should make contact with Rich LANE as soon as possible. Costs for food, lodging and transport will be about US$120 per day plus the cost of your travel to and from Guilin.

Tentative Excursion Itinerary - Luodian and Baping Stratotype Candidates Field Meeting; 14-22 November 1992

Nov.14: Arrive Guiyang, Guizhou Province, on flights from Guilin, Beijing, Guangzhou or Shanghai. Overnight Guiyang.

Nov.15: Travel to and overnight in Anshun. Sightseeing stops include the Dragon's Palace, an underground lake and cave, and the Huang Guo Shu Waterfall.

Nov.16: Travel to and overnight in Luodian. Visit Muhua Section, a final candidate for the Devonian-Carboniferous Boundary Stratotype. Also visit the Daihua exposure, an excellent section containing *Reticuloceras* Zone cephalopods.

Nov.17: Overnight in Luodian. Visit and study the Luodian Stratotype candidate.

Nov.18: Travel to and overnight in Dushan. Study the Carboniferous platform facies at a couple of localities along the way.

Nov.19: Travel to and overnight either in Duyan, Guizhou Province or Hechi, Guangxi Province (to be advised). Visit and study the Baping Stratotype candidate.

Nov.20: Travel to and overnight in Guilin, Guangxi Province. Various sightseeing opportunities will be available.

Nov.21: Overnight in Guilin. Sightseeing in Guilin area. Alternatively participants may depart on 21 or 22 November from Guilin airport.

5.3 Stratotype Candidate, Gissar Ridge, Aksu River, South Tian Shan, Central Asia

Recent work on this section by T. Nemirovskaya and I. Nigmadganov has revealed a complete sequence across the Mid-Carboniferous Boundary. The exposure is approximately eight metres thick at the boundary interval and consists dominantly of deep water carbonates and shales of the Badavinskaya Suite (formerly Khodgyrbulak Suite) and corresponds to the *Eumorphoceras* and *Homoceras* Zones. Conodonts and ammonoids are abundant throughout the exposures, and foraminifers, brachiopods and other fossil groups are present in nearby outcrops at South Fergana. The presence of a palynological sequence has not yet been confirmed. The section below the eight-metre boundary interval is carbonate with ammonoids of the E_2 Zone, and associated conodonts, including *Gnathodus bilineatus bollandensis*. At sample NN-17, *Eumorphoceras* sp. occurs together with *Isohomoceras* aff. *I. subglobosum* and *Proshumardites delepinei*, indicative of the *Homoceras* Zone. One sample higher (NN-18), the first *D. noduliferus*-group conodont appears. Overlapping in range at this level with the *noduliferus* are *Gnathodus bilineatus* and representatives of *Paragnathodus*, *Adetognathodus* and *Rachistognathodus*. These ranges of conodonts are exactly like those in western North America and south China, where their association with the *Homoceras* Zone has been difficult to prove. Various representatives of *Isohomoceras* range throughout the eight-metre interval where they are in association with the sequential appearances of the conodont genera *Idiognathoides* and *Neognathodus*, a range relationship known to occur in several other areas of the world, but not developed in the Stonehead Beck section in England.

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

By P. K. Sutherland, School of Geology and Geophysics, University of Oklahoma, Norman, Oklahoma 73019, USA

The Middle Pennsylvanian Working Group in North America was organized in 1984 at the request of the Subcommission on Carboniferous Stratigraphy. Its current members include Darwin Boardman, Oklahoma State University; Robert Grayson, Baylor University, Waco, Texas; John Groves, Amoco Production Company, Houston, Texas; Philip Heckel, University of Iowa; Thomas W. Henry, U.S. Geological Survey, Denver, Colorado; Ralph Langenheim, University of Illinois; Walter Manger, University of Arkansas; Walter Nassichuk, Geological Survey of Canada, Calgary, Alberta; Russell Peppers, Illinois Geological Survey; Patrick Sutherland (Chairman), University of Oklahoma; and Gary Webster, Washington State University.

It is with much regret that we report the recent death of Mackenzie Gordon Jr, US Geological Survey, Washington, DC, an internationally known specialist on Carboniferous goniatites and brachiopods, a valued member of the Working Group, and friend of many who are involved with the SCCS. He will be missed. Other changes in the Working Group: Walter Nassichuk has stepped down from the position of Director of the Institute of Sedimentary and Petroleum Geology, Canadian Geological Survey, in Calgary. Reports are that he is enjoying his return to full-time research at the Institute. Among other things, he is involved in a project examining Upper Carboniferous-Permian stratigraphy and ammonoid successions in the Ural Mountains. In addition, Darwin Boardman has recently joined the faculty at Oklahoma State University, Stillwater, where he will continue his work on Pennsylvanian cycles in the Midcontinent.

Most of our focus over the past eight years has been (1) to identify biostratigraphic horizons that have potential for intercontinental correlation, (2) to work towards developing better correlations of the Pennsylvanian across North America, based on all fossil groups, and (3) to work towards the selection of boundary stratotypes in North America for the Morrowan-Atokan, Atokan-Desmoinesian and Desmoinesian-Missourian boundaries.

Further progress toward the latter goal, just mentioned, has in part been accomplished during the past year. In October 1991, five members of the Working Group (Grayson, Henry, Langenheim, Manger and Sutherland) visited the Arrow Canyon sequence in southern Nevada and examined the Morrowan-Atokan and Atokan-Desmoinesian boundary sequences. We were accompanied by Blaine Cecil, US Geological Survey, Reston, Virginia, and Ronald West, Kansas State University. We collected samples from the intervals above and below three key faunal horizons:

- (1) lowest known occurrence of *Pseudostafella* (which marks the base of Mamet's Zone 21),
- (2) lowest known occurrence of *Profusulinella* (the earlier traditional base of the Atokan Series)
- (3) lowest known occurrence of *Fusulina* (=*Beedina*), which marks the base of the Desmoinesian Series.

Both a large conodont sample and a hand sample for thin sectioning were taken at 30 cm intervals, including 10 to 12 samples from below each key horizon and 2 to 3 samples above the same horizon. We are indebted to Robert Grayson who is now having the conodont samples processed at Baylor University. The rock samples are being thin sectioned at the University of Oklahoma (Sutherland). We hope to precisely document cono-

dont and foraminiferal changes across each boundary, with additional collections made in the future as needed. The Arrow Canyon sequences are being evaluated as possible series boundary stratotypes.

The several members of the Working Group who are interested in the Desmoinesian-Missourian boundary are now in the process of proposing a number of different sequences that need to be analyzed biostratigraphically before they can be evaluated as boundary stratotype candidates.

In February 1992, the Oklahoma Geological Survey published Circular 94 with the title: "Recent Advances in Middle Carboniferous Biostratigraphy - A Symposium." The editors are: Patrick Sutherland and Walter Manger. The volume, which was a project of the Working Group, includes papers by the following eight members: Grayson, Gordon, Groves, Henry, Manger, Nassichuk, Sutherland and Webster. A broad range of topics include: Chesterian brachiopods, Chesterian bryozoans, analyses of the Mississippian-Pennsylvanian boundary in both Illinois and Utah, Early-Middle Pennsylvanian biostratigraphy in southern Oklahoma and Iowa, Early-Middle Pennsylvanian foraminiferal biostratigraphy in both southern New Mexico and central Texas, biostratigraphic utility of *Chaetetes* and upper Paleozoic reefs in the Canadian Arctic Archipelago. This important volume can be obtained from the Oklahoma Geological Survey, University of Oklahoma, Norman, OK 73019 (Price: $10).

Walter Manger and Patrick Sutherland have been invited to give a paper on Pennsylvanian depositional history in the Southern Ozark Mountain area at a symposium entitled **"Pennsylvanian History of the Ozark Uplift"**. This symposium is being convened by Wallace B. Howe, of the Missourian Geological Survey, at the annual meeting of the North-Central Section of the Geological Society of America, in Rolla, Missouri, in Spring, 1993. For further information at this point, contact Wally at P.O. Box 250, Rolla, MO 65401.

Patrick Sutherland has recently resigned as Chairman of the Working Group and his place is being taken by Walter Manger.

5.5 NOTICES FROM ICS

Advice received in October 1991 from the Chairman of ICS, Dr J.W. COWIE, has indicated that a new subcommission was to be formed called the *Subcommission on Stratigraphic Methods (SSM)* which was to subsume the activities of three former constituent bodies, namely:

- Subcommission on Stratigraphic Classification (SSC);
- Subcommission on Geochronology (SG);
- Committee on Quantitative Stratigraphy (CQS) and its Working Group on Stratigraphic Correlation of Oceanic and Continental Records (WG SCOCR).

The new subcommission was created to include a variety of areas formerly encompassed by the above groups together with a number of newer disciplines which have not previously been represented.

In a second change, all Working Groups on System Boundaries have now been transferred from direct ICS management to an existing subcommission for which the boundary is located at the BASE of each particular interval. This was intended to reduce the number of subcommissions reporting to ICS to 15, including the new subcommission listed above. The list includes:

- Subcommission on Precambrian Stratigraphy (incl. Terminal Proterozoic System WG)
- SC on Cambrian Stratigraphy (Pc/Camb Boundary WG completed, disbanded)
- SC on Ordovician Stratigraphy (incl. Camb/Ord. Boundary WG)
- SC on Silurian Stratigraphy
- SC on Devonian Stratigraphy
- SC on Carboniferous Stratigraphy (Dev/Carb. Boundary WG completed, disbanded)
- SC on Gondwana Stratigraphy
- SC on Permian Stratigraphy (incl. Carb/Perm. Boundary WG)
- SC on Triassic Stratigraphy (incl. Perm/Trias. Boundary WG)
- SC on Jurassic Stratigraphy (incl. Trias/Juras. Boundary WG)
- SC on Cretaceous Stratigraphy (incl. Juras/Cret. Boundary WG)
- SC on Palaeogene Stratigraphy (Cret/Palaeogene Boundary WG completed, disbanded)
- SC on Neogene Stratigraphy (incl. Palaeogene/Neogene BoundaryWG)
- SC on Quaternary Stratigraphy
- SC on Stratigraphic Methods

In correspondence dated 15 April 1992, the Chairman has advised that the IUGS Executive Committee has ratified the election for the 1992-96 period, of the new Chairman for ICS (Professor J. Remane) and the 2nd Vice-Chairman (Prof. Tadashi Sato). For procedural reasons, the nominee for 1st Vice-Chairman (Dr M.G. Bassett) was not ratified and this will require a new nominating committee plus a new ballot. Further the IUGS ratified the election of 12 Chairmen of subcommissions with an election, followed by ratification, still being necessary for the Chairmen of the Cambrian, Silurian, Devonian, and Stratigraphic Classification Subcommission as well as the 1st Vice-Chairman. This implies an increase to a total of 16 subcommissions and the apparent continued separate existence of the Subcommission on Stratigraphic Classification.

6.0 S.C.C.S. SYMPOSIUM ON GLOBAL SUBDIVISION OF THE CARBONIFEROUS SYSTEM

6.1 The S.C.C.S. Global Correlation Program

By B. A. Engel, Department of Geology, University of Newcastle, Newcastle, NSW 2308 Australia

During the last decade, the Subcommission on Carboniferous Stratigraphy (SCCS) has significantly modified its approach to the global subdivision of the Carboniferous System by moving away from the difficult task of trying to reconcile detailed regional stratigraphic units with their associated zonal schemes, into a global picture. Many of these well known regional stratigraphic sequences have been extrapolated into some form of local zonal arrangement based upon their faunal/floral content (e.g. Belgium, United Kingdom, Australia) but all suffer from the fact that they lack global compatibility so that none has achieved chronostratigraphic status.

The first step in this change in approach came at the 10th Carboniferous Congress (Madrid, 1983) at which agreement was reached on the criteria to be used to define the placement of the Mid-Carboniferous Boundary. A Working Group was formed (Chairman - H.R. Lane) to select an appropriate stratotype, a task which has yet to be finalised.

As a result of decisions taken at the 11th Carboniferous Congress (Beijing, 1987), ratified by a postal ballot of all SCCS Voting Members, it was accepted that the Subcommission would recognise only two subdivisions of the Carboniferous System. Although as yet unnamed, these two Subsystems will be given formal nomenclature and definition as soon as the Mid-Carboniferous Boundary stratotype has been ratified by SCCS and the International Commission on Stratigraphy (ICS).

It was further agreed in Beijing (1987) to create two ad hoc Working Groups which were set up to identify potential global subdivision levels within the Carboniferous, in addition to the Mid-Carboniferous Boundary. Paul Brenckle (lower Carboniferous) and Cor Winkler Prins (upper Carboniferous) were invited to chair appropriate Working Groups with the task of assembling a report for the SCCS Field and General Meeting which was scheduled to be held in Provo, Utah in September 1989.

With the assistance of the Working Group members, each Chairman compiled a great deal of information about the most significant faunal and floral groups within their respective Subsystems. The immediate objective was to identify evolutionary changes in the various groups which had the potential to delineate stratigraphic horizons at which it might be possible to establish one or more levels of global correlation.

Each Chairman presented a summary of this data at Provo where they nominated several potential chronostratigraphic intervals which appear to contain well documented, widely dispersed, evolving lineages suitable for further palaeontological investigation. By design, this study avoided existing time-stratigraphic and zonal terminology in order to minimise possible bias. In the longer term, there is no reason why currently available boundaries should not be used, if the evolutionary palaeontology supports their nomination. The aim was to present a global perspective, unfettered by the constraints of existing regional schemes.

The results of this global analysis (BRENCKLE & MANGER, 1991), combined with discussion at the meeting, saw the acceptance of the recommendations of the two Chairmen that there were six faunal/floral assemblages, three in each of the two Subsystems, worthy of further detailed investigation. They include:

Project 1: A chronostratigraphic boundary in the late Middle to early Late Tournaisian. This interval starts approximately at the appearance of the foraminifers *Palaeospiroplectammina tchernyshinensis* up to that of *Spinoendothyra costifera*. For the conodonts, it includes the changeover from siphonodellids to *Gnathodus typicus* and associated forms (e.g. *G. cuneiformis*).

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

Project 3: A chronostratigraphic level around the Viséan V3a/V3b boundary, which includes the first occurrence of *Gnathodus bilineatus bilineatus* and the Asteroarchaediscidae.

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

Project 5 (Now abandoned): A boundary at the base of the *Fusulina - Beedeina* Zone. (Atokan-Desmoinesian; mid Moscovian). This project has been formally abandoned, for the time being, due to the lack of a Project Leader.

Project 6 (Now renumbered to Project 5) A boundary at the base of the *Protriticites* Zone. (basal Kasimovian; basal Missourian; mid-Cantabrian).

At the conclusion of the meeting, it was agreed that the two Chairmen, in consultation with the SCCS executive, should extend an invitation to six colleagues, each with a special interest in the chosen interval, to head up a Project Group of appropriate specialists. After nomination and acceptance, these Project Leaders were asked to undertake the following program of investigation:

1. By correspondence, the Project Leaders would be asked to gather around them a group of appropriate specialists who have an expert knowledge of the particular chronostratigraphic interval assigned for their investigation. Membership should include specialists in all relevant aspects of faunal/floral evolution, stratigraphy and sedimentology.

2. The prime objective of each group was to prepare a preliminary report for the Subcommission Meeting, to be held in conjunction with the 12th Carboniferous Congress (Buenos Aires, 1991). Each report was to contain:

(a) An evaluation of the most promising fossil horizons for global correlation (if any) within the Project's nominated time interval and,

(b) A small selection of stratigraphic sections, distributed on a global basis, which could profitably be the subject of further investigation. For this purpose, it was decided that only previously studied sections are needed at this time.

3. If the outcome of this exercise demonstrates that the interval has substantial potential for global correlation, the Voting Membership of the Subcommission would then be invited to create one or more Working Groups charged with carrying the investigation forward by specifically defining the indicative evolving faunas/floras and choosing a boundary stratotype section.

In order to set the pattern of investigation for the different projects, it was decided at Provo that potential stratotype sections should have as many as possible of the following attributes:

1. Selected potential localities must be fully accessible by normal transport without logistical, political, or other restrictions.

2. The section(s) should be reasonably continuous (or composite) with good exposure, a lack of structural complexity, and a diverse and abundant fossil content.

3. Faunal studies of evolving lineages should be completed or at least well advanced; ideally, they should include conodonts, foraminifera, ammonoids and spores, where appropriate.

4. The chosen section(s) should have available fossil lists based on the first occurrence of relevant species on a sample-by-sample basis through the critical interval.

5. Each section will require information about its geological setting and the presence of any tectonic influences. The sedimentology of chosen sites needs to be documented or at least under active study.

The relevant Project Leaders have been asked to:

1. Document evolving fossil groups in the selected interval, ignoring all spot occurrences and obvious 'gaps' in the fossil record which should not be used as a basis for stratigraphic definition.

2. Establish the global distribution of those groups which survive the 'evolving lineage' test.

3. If any groups remain, nominate those sections where these occurrences are present.

4. Select from those sections a few which go closest to meeting the ideal conditions set out above.

5. Prepare a report for the next Subcommission Meeting detailing the results of the 'lineage' investigations and if appropriate a short list of sections (geographic location; a lithological column; a list of fossils on a sample-by-sample basis) which are considered worthy of further investigation.

It is clear from the above decisions that the SCCS has stepped back from its traditional role of trying to achieve harmony in correlation between the various regional developments of Carboniferous strata. We have examined our accumulated knowledge of fossil distribution throughout the System and have perceived that at some time intervals there are apparent widespread (?global) occurrences of particular fossil groups which have been the subject of investigation by many specialists. It is possible that no useful conclusions will be achieved but it was considered important that an effort should be made to examine these intervals closely to see if there is any significance in the global distribution of particular evolving lineages. If there is, then we will have achieved an important step in the reliability of global correlation.

REFERENCE

BRENCKLE, P.L. & MANGER, W.L. (Eds) 1991. Intercontinental Correlation and Division of the Carboniferous System. Contributions from the Carboniferous Subcommission Meeting, Provo, Utah, September 1989. *Courier Forschungsinstitut Senckenberg* 130, 1-350.

Personal Notes

Dr. sc. Heinz Kozur of 1029 Budapest, Rézsü u.83, Hungary reports that his current activities span the study of the Carboniferous - Permian boundary (worldwide); correlation of Upper Carboniferous and Lower Permian marine and continental beds of the Northern Hemisphere; conodont, ostracod, radiolarian chronology around the C/P boundary; and conchostraca, arthropod trails and tetrapod footprints of the latest Carboniferous and early Permian of USA and Europe. Correspondence with other specialists in these areas would be most appreciated.

6.2 PROJECT GROUP REPORTS

6.2.1 *Project Group 1*: A boundary at the late Middle to early Late Tournaisian (Upper Tn2-Lower Tn3) (Kinderhookian-Osage boundary)

By *Project Leader* - Paul L. Brenckle, Amoco Research Center, Tulsa, Oklahoma, USA

With contributions from ERIC GROESSENS (Belgian Geological Survey, Brussels, Belgium), ALAN C. HIGGINS (British Petroleum Research Centre, Sunbury-on-Thames, UK), VLADISLAV I. POLETAEV (Institute of Geological Sciences, Ukrainian Academy of Sciences, Kiev, USSR), BARRY C. RICHARDS (Institute of Sedimentary and Petroleum Geology, Calgary, Alberta, Canada), WILLIAM J. SANDO (US Geological Survey, Washington, DC, USA), GEORGE D. SEVASTOPULO (Geology Department, Trinity College, Dublin, Ireland) and WU XIANGHE (Institute of Geology, Guizhou Bureau of Geology, Guiyang, China).

Information presented at the 1989 Carboniferous Subcommission meeting in Provo, Utah, indicated that numerous, widely distributed fossils appeared within the middle to lower Upper Tournaisian, making this interval potentially attractive for defining an intercontinental boundary within the Lower Carboniferous. Characteristic faunal appearances spanning the interval include, among others, the conodonts *Siphonodella crenulata, Gnathodus typicus* and *G. cuneiformis*, and the calcareous foraminifers *Palaeospiroplectammina tchernyshinensis, Tuberendothyra tuberculata* and *Spinoendothyra costifera*.

Project Group 1 was organized to study this interval, and its initial assignment for the forthcoming Subcommission meeting in Buenos Aires was to identify previously studied stratigraphic sections containing appropriate fossil data for boundary definition. The results of this exercise were not optimistic. Literature survey and correspondents' responses (or lack thereof) showed that few comprehensive biostratigraphic studies have been published on the middle to upper Tournaisian. To compound the problem, the facies-dependent distribution of some groups restrict co-occurrences in the rock column. For example, calcareous foraminifers flourished on the shallow shelf whereas conodonts evolved most rapidly in deeper water. These distribution problems are not insurmountable but point out that successful results depend upon knowledge of local paleogeography in selection of stratigraphic sections for biostratigraphic analysis. Presumably, outcrops near the shelf edge should be examined preferentially because they more likely contain interfingered autochthonous shallow- and deeper-water beds.

In short, previously published literature generally has not provided the stringent biostratigraphic data necessary to trace an intercontinental boundary within the Tournaisian. Project Group 1 should now focus its efforts on locating new stratigraphic sections or restudying old ones that hold the greatest promise of providing multidisciplinary information. Geographic areas most likely to contain appropriate rock sequences are discussed below.

North America. The Cordilleran region is the most favorable area in North America to look for boundary sections. Extensive stratigraphic work by the US Geological Survey and others in the northern Cordillera shows that the upper Lodgepole and Mission Canyon formations of the Madison Group and equivalent units contain useful micro- and macrofaunas. Coeval beds in the southern Cordillera are represented extensively by shallow-water deposits such as the Crystal Pass and Dawn limestones in the Arrow Canyon Range of southern Nevada and the Joana Limestone in eastern Nevada and western Utah. Good foraminiferal sequences are found in these units but siphonodellid conodonts are rare, being replaced by a patrognathid assemblage.

GARY WEBSTER of Washington State University has recently begun a coordinated conodont-foraminiferal study of Tournaisian rocks in southern Idaho and western Wyoming. His objective is to locate shelf-edge sections that yield assemblages of both microfossil groups. If successful, this project will generate valuable occurrence data for recognizing potential boundary horizons.

Favorable facies also extend throughout the Canadian Cordillera where biostratigraphers of the Canadian Geological Survey and others have reported pertinent microfaunal, macrofaunal and palynological successions from the upper Banff, Pekisko and Shunda formations and equivalents. Although few publications have completely integrated occurrence data of the various fossil groups, detailed collections are available for multidisciplinary study at the Institute of Sedimentary and Petroleum Geology in Calgary.

Northwestern Europe. Many faunal and floral changes occurred within the subject interval in northwestern Europe; some have been documented whereas others are poorly understood. Exposures are good and facies varied. Three fossil groups, conodonts, foraminifers and palynomorphs, are well-known with lesser knowledge of brachiopods, corals, trilobites and goniatites. No one section includes all groups in continuous succession and few lineages have been documented in each group.

Sections in Belgium and Ireland probably represent the best possibilities for a stratotype. The Belgian successions are primarily carbonates around the middle (Tn2)/upper (Tn3) Tournaisian boundary, and the facies are quite varied because of widespread deformation at that time. The faunas include conodonts, foraminifers (both well-known), goniatites, brachiopods and corals. The Tn2/Tn3 boundary coincides with the disappearance of siphonodellid conodonts, which are distributed worldwide, and the appearance of *Polygnathus communis carina, Dollymae hassi* and gnathodids such as *Gnathodus typicus* and *G. cuneiformis*. Eric Groessens is of the opinion that all of the newly appearing species are facies-controlled. He suggests, however, that a pseudopolygnathid lineage cul-

minating in *Pseudopolygnathus multistriatus* would provide a widespread, reliable boundary indicator in this part of the Tournaisian. This lineage is well represented in Soignies (Carrières du Perlonjour) where foraminifers have been studied extensively by RAPHAEL CONIL. The middle to upper Tournaisian interval is characterized by a change from widespread species having Eurasian/Cordilleran affinities (Tn2) to largely endemic species (Tn3). Correlation of Mamet foraminiferal zones 7 and 8 with the Tn2/Tn3 boundary suggests a possible link to North America.

Extensive work in Ireland in recent years has demonstrated the presence of many well exposed and complete sections crossing the Tn2/Tn3 boundary. The Ringabella section in Cork Bay has siphonodellid conodonts followed by large numbers of gnathodids, including *Gnathodus cuneiformis*, together with *Polygnathus communis carina* and *Dollymae hassi*. It is complicated by some reworking of siphonodellids into the *carina* Zone. Further north, a substantial section at Ardmore and Whiting Bay, County Waterford, has rich siphonodellid faunas followed by faunas with *Gnathodus cuneiformis* corresponding to the change from Tn2 to Tn3. Palynomorphs are well known from Ireland. There is no change in that group at the Tn2/Tn3 boundary although the PC/CM miospore zonal boundary should occur a little higher than the Tn2/Tn3 boundary near or at the incoming of *Pseudopolygnathus multistriatus*. Foraminifers are not well known.

Soviet Union. In 1990 the Soviet Stratigraphic Commission for the Carboniferous System established working groups to reevaluate Tournaisian-Viséan correlations within the Soviet Union and clarify their relationship to western European chronostratigraphy. V. I. POLETAEV (Institute of Geology, Kiev) and O. A. SHCHERBAKOV (Perm' Polytechnical Institute, Perm') head an intratournaisian committee that will initially concentrate on Uralian correlations within the Cherepetskiy, Kizelovskiy and Kos'vinskiy horizons. In connection with this project, Amoco Research Center (Tulsa) and Soviet institutes have arranged a joint field program (Fig. 3) to collect stratigraphic sections or cores from these horizons in the Middle and South Urals and North Caspian Syneclise. Information on conodont, foraminifer and macrofossil distributions may be available later next year. Certain intervals within these horizons also have great potential for palynology.

SOVIET - AMOCO
JOINT FIELD PROGRAM
MIDDLE URALS

Figure 3: Logo of the joint field program of Soviet institutes and Amoco Research Center (Tulsa).

China. Shelf to basinal beds in South China are apparently the most prospective in the country to investigate Tournaisian correlations. The *Palaeospiroplectammina - Tuberendothyra - Spinoendothyra* foraminiferal sequence is known from the Tangpakou Formation and equivalents at the Xiasi section in Guizhou Province and the Yanfang section in Yunnan Province.

Early Carboniferous conodonts and megafossils have been reported from other sections in those two provinces and Guangxi as reviewed, for example, in publications distributed at the Carboniferous Congress in Beijing, 1987. Some fossil groups are excluded from these articles and it is unclear whether this reflects environmental restriction or lack of multidisciplinary investigation.

Geographic areas and sections besides those mentioned above may contain equally promising paleontological sequences for determining an intercontinental boundary within the middle to lower Upper Tournaisian. We would appreciate receiving any relevant information on potential boundary-defining sections and their contained biota. Please send information to any of these three people: Carboniferous Subcommission Chairman, EVA PAPROTH; Subcommission Secretary/Vice-Chairman, BRIAN ENGEL; or Project Group 1 leader, PAUL BRENCKLE.

6.2.2 *Project Group 2:* A boundary at the latest Tournaisian - earliest Viséan (Tn3c-V1a) (Mid Osage).

By *Project Leader* - George Sevastopulo, Trinity College, Dublin

Up to the present time, there has been almost no response to requests for suggestions on a practical level for the 'mid-Dinantian' boundary. Exceptions include a suggestion from JIRI KALVODA who seems to favour the base of the *anchoralis* biozone, and information from TAMARA NEMOROVSKAYA that ISKANDER NIGMADGANOV, Vice-President of the Soviet Tournaisian-Viséan Boundary Working Group, is studying sections in the Tian-Shan where it is possible to relate ammonoid, conodont and shelly facies. NIGMADGANOV favours a level at the first appearance of *Gnathodus texanus*, not an horizon that is considered to be particularly attractive. However the sections themselves appear to be very interesting and worthy of further consideration.

6.2.3 *Project Group 3:* The basis for a Mid-Viséan boundary - a preliminary report

By *Project Leader* - Dr Zdzislaw Belka, Geol.-Pal. Inst., Universität Tübingen, Sigwartstrasse 10, 7400 Tübingen, Germany

This report is based primarily on research by the author together with data provided by W.J. SANDO, P.L. BRENCKLE, J. KULLMANN, D. KORN and A.S. ALEKSEEV.

A stratigraphical "level" within the Viséan was one of the six intervals within the Carboniferous which were selected during the SCCS General Meeting in Provo at which to place a potential stage boundary within the future global subdivision of the Carboniferous System. The selection of these intervals was based on approximate correlations which produced a rather subjective coincidence of several evolutionary changes recognized in different fossil groups (BRENCKLE, 1990). There was no other way to produce a more objective picture of biotic breaks within the Carboniferous because of the different character of stratigraphic units and zonal schemes currently used throughout the world. The majority of these "pseudo-chronological" schemes, for example the classic Belgian scale or the British Early Carboniferous stages, have had their origin in the primary lithostratigraphic divisions of the Carboniferous sequences. It is true that the majority of these primary lithological units were subsequently defined by means of fossil markers but this in fact could not create zonal schemes of a chronostratigraphic character. Thus, the currently used divisions of the Lower Carboniferous reflect primarily the major sedimentary rhythms in particular depositional regions (see PAPROTH et al., 1983; CONIL et al., 1990) rather than objective evolutionary changes in the early Carboniferous biosphere. In principle, this is the main reason for the complexity of Carboniferous stratigraphy and the problems associated with intercontinental correlations.

The third interval (Project 3) nominated within the Carboniferous System for further detailed investigation and boundary studies contains several evolutionary changes in various fossil groups, that occurred approximately in the late Middle Viséan (late Meramecian). Although most of these biotic breaks can be observed throughout the world, their precise correlation with the currently used stratigraphic divisions is rather problematic. Most certainly we only know that these evolutionary events occurred during Viséan time (see BRENCKLE, 1990, Fig. 3). Therefore the potential chronostratigraphic level we want to delineate (if suitable for intercontinental correlation and future division of the Lower Carboniferous) will be temporarily termed the "Mid-Viséan" boundary.

The chronostratigraphic intervals targeted for further study during the SCCS Meeting in Provo were chosen on the basis of the number of relatively more important appearance events rather than just total number of events (BRENCKLE, 1990). Of course, each group of fossils could theoretically be used for the definition of a chronostratigraphic level, but in practice only nektic or planktic organisms are useful for global correlation. This is because species of the majority of benthic organism are endemic or they show a limited distribution, and their appearance usually depends directly on facies development. The history of stratigraphic investigations of the Carboniferous System (and the need for a new divisional scheme) provides several examples of boundaries defined by using crinoids, pelecypods, brachiopods, trilobites, and/or forams which work well regionally but with extreme rarity in intercontinental correlation. Benthic organisms, however, can be successfully used as additional markers and therefore the activities of Project Group 3 have not been limited to the evaluation of the evolutionary events of conodonts and/or cephalopods.

A "Mid-Viséan" interval has been selected for further study based on important appearance events in the following fossil groups:

AMMONOIDS: The first appearance of *Girtyoceras* and radiation of *Goniatites* s.s.

Comment: (based on information provided by D. Korn and J. Kullmann): This event does not represent any radical change in ammonoid evolution. It marks only the beginning of a series of goniatite ranges of relatively short duration. Although most of the new genera are cosmopolitan, all species are endemic or show limited distribution. Moreover, only a little is known about the phylogenetic relations within the Viséan ammonoids on the species level.

CONODONTS: The first appearance of *Gnathodus bilineatus*.

Comment: During the "Mid Viséan" interval, conodonts did not exhibit any evolutionary changes of significance. The appearance of *Gnathodus bilineatus* is used worldwide for definition of the *bilineatus* conodont zone but this entry does not reflect any evolutionary event in conodont development. The "significance" of *G. bilineatus* for Early Carboniferous stratigraphy in the past was primarily because of the worldwide distribution of this taxon and its relatively easy identification.

G. bilineatus can be utilized for the recognition of a boundary in a global stratigraphical scheme but the best known, first appearance of this taxon worldwide is an environmental and not evolutionary event. Pazukhin and Nigmadzhanov believe (P.L. BRENCKLE, personal communication) that the species appears earlier in Central Asia and Bashkiria than elsewhere. Unfortunately, no details are known as to which stratigraphic scheme was used as the primary framework for this correlation.

FORAMINIFERS: The appearance of Asteroarchaediscidae marks an important evolutionary event within the archaediscaceans during "Mid-Viséan" time.

Comment: BRENCKLE (1990) recommended this change in the foraminiferal assemblages as a potential level to divide the Lower Carboniferous globally. Although the entry of the Asteroarchaediscidae can be observed more or less synchronously worldwide, different assemblages of species are used to define this event in Eurasia and North America. To what extent this is the result of an endemic distribution of foraminiferal taxa remains unclear until the ancestor-descendant relationships within archaediscaceans can be recognized.

CORALS: During the "Mid-Viséan" interval, there was a dispersal event in the development of coral faunas on which the GCZ (Global Coral Zone) 3/4 boundary is based (SANDO, 1990) and which is observed in the Western Interior Province of North America.

Comment: There is a significant problem in the evaluation of coral data because the temporal distribution of coral ranges rests on a biostratigraphic framework based essentially on foraminifer zones. According to SANDO (pers. comm.), a major change in generic composition of the coral fauna takes place at about the middle of V3a (correlation using Mamet's foraminifer zonation) but this change is based on endemic genera, which cannot be used for global analysis. Moreover, it was not an evolutionary change but a dispersal event that always had at least a slightly diachronous character.

SPORES: During the "Mid-Viséan" interval there was no significant change in the palynoflora. Although the Early Carboniferous miospore assemblages are strongly affected by provincialism, there is a relatively large group of taxa showing cosmopolitan distribution. According to PLAYFORD (1990), the appearance of *Waltzispora polita*, a species which has a similar range in Australia and in the Northern Hemisphere, can be used for intercontinental correlation during "Mid-Viséan" time.

The preliminary evaluation of different fossil horizons within the nominated "Mid-Viséan" time interval demonstrates that no single major change in the fauna and flora happened during this time. The evolutionary events observed in particular fossil groups seem to occur independently (diachronous ?) and they provide good horizons more for local than intercontinental correlations. The main problem we are confronted with in the whole Early Carboniferous stratigraphy is a lack of stratigraphic markers based on the evolutionary appearances of species. For the definition of a boundary horizon, an evolutionary first appearance on the species level (not the genus level) within a recognized phyletic lineage is necessary. Moreover, both the boundary definer and its ancestor should have worldwide distribution.

The only level within the "Mid-Viséan" interval which meets the requirements for a chronostratigraphical boundary seems to be the appearance of *Gnathodus bilineatus*. This event, therefore, is here recommended as the most promising level at which the potential "Mid-Viséan" boundary can be placed. There are several advantages that favour this option. These are:

- the first evolutionary appearance of *Gnathodus bilineatus* (ROUNDY, 1926) can be precisely recognized. The species is part of a well documented phyletic lineage. The predecessor species is *Gnathodus praebilineatus* BELKA, 1985 in the early Viséan, and the successor is *Gnathodus bollandensis* HIGGINS & BOUCKAERT, 1968 (originally considered a subspecies of *G. bilineatus*) in the early Namurian.
- *Gnathodus bilineatus* is an easily recognizable conodont species and is distinguished from its ancestor, *Gnathodus praebilineatus*, by the quadrate shape of the outer cusp. A detailed description of the phyletic transition is given by BELKA (1985).
- *Gnathodus bilineatus* is widespread geographically, occurring in North America, Europe, North Africa, Central Asia, South China and Australia. Its worldwide distribution is documented in more than 60 papers (see RHODES et al., 1969; HIGGINS, 1975 and BELKA, 1985 - for review). Also its predecessor, *G. praebilineatus*, seems to be widely distributed. This species is known to occur in Poland (BELKA, 1985), Belgium (BELKA & GROESSENS, 1986; CONIL et al., 1988), Slowenia (RAMOVS, 1990), and in Morocco (BELKA, unpublished data). Specimens belonging to this species but originally classified as *G. bilineatus* or its morphotypes were reported from England (METCALFE, 1981), Austria (EBNER, 1977), Ireland (AUSTIN & HUSRI, 1974), Spain (HIGGINS & WAGNER-GENTIS, 1982), and from Canada (von BITTER & PLINT-GEBERL, 1982).
- *Gnathodus bilineatus* is a widespread taxon ecologically, occurring widely in neritic and pelagic facies.

The above presented recommendation is of a preliminary character and will, if accepted, create one chronostratigraphical mark within the "Mid-Viséan" interval for correlation and comparison of other fossil ranges. This is also the way to prove the biostratigraphic positions of Meramecian/Chesterian and/or V3a/V3b boundaries in order to incorporate some units of the currently used framework into the new division of the Lower Carboniferous (Mississippian).

In the next phase, it is intended to investigate several sections in the Cantabrian Mountains (Spain) where the successive connection of *G. bilineatus* with its predecessor can be observed. In this region the "Mid-Viséan" interval is represented by pelagic carbonates characterized by a rich conodont and goniatite fauna. However, other possible faunal and floral groups will also be studied.

Project Group 3 is open to anyone having other proposals and suggestions which can help to contribute to the precise documentation of the organic sequence across the critical interval.

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6.2.4 *Project Group 4:* A boundary at the base of G2: *Branneroceras branneri* Zone.

By *Project Leader* - Jürgen Kullmann, Geol.-Pal. Inst., Universität Tübingen, Sigwartstrasse 10, 7400 Tübingen, Germany

(Editor's note: Dr Kullmann was persuaded at a very late stage to undertake the leadership of this project. Since the investigation has only just commenced, there has been no significant progress to report at this time. Any members who wish to join with Dr Kullmann in the work of this Project Group should make direct contact with him as soon as possible)

6.2.5 *Project Group 5:* A boundary at the base of the *Protriticites* Zone (basal Kasimovian; basal Missourian; mid-Cantabrian)

By *Project Leader* - Dr Elisa Villa, Fac. de Biología, Unidad de Geología, Universidad de León, 24071 León, Spain. (Ed: Report submitted in May 1991, since when there have been substantial changes to the contributing membership of the Group. With the abandonment of the proposed Project Group 5 (Base of the *Fusulina-Beedeina* Zone), this Project has been renumbered from Project Group 6 to Project Group 5).

Following the 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 was not only 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 define the characteristic assemblages of this interval of time and to establish global correlations. Studies detailing palaeogeographical aspects and palaeoenvironmental changes would also be of interest.

More than a year has been devoted to organising the collaboration of specialists in several fossil groups, representing all the main Carboniferous areas of the world. 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

Invitations have been sent to other specialists to participate. The group is open to any other contributors who may be interested. Offers from specialists in fossil groups not yet represented (ammonoids, corals, etc.) are especially welcome as are those who are working in other Carboniferous regions, not yet represented.

Each investigator has been asked to coordinate research in their areas by organising local groups and studying 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. It is hoped 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 an SCCS meeting. In addition, I would like to publish a volume incorporating all the individual contributions, with a discussion and summary report.

6.3 Fossil Content of the Moscovian-Kasimovian Boundary in a Section of the Picos de Europa Area (Carboniferous, NW Spain)

By Villa, E.[1], Ginkel, A. C. van[2], Leyva, F.[3], Martínez-Chacón, M. L.[4], Méndez, C.[4], Rodríguez-González, R. M.[1], Rodríguez, S.[5] and Sánchez de Posada, L. C.[4]

[1]Universidad de León (Spain); [2]Rijksmuseum van Natuurlijke Historie (Leiden, Holland); [3]ENADIMSA (Madrid, Spain); [4]Universidad de Oviedo (Spain); [5]Universidad Complutense de Madrid (Spain) (Ed: Paper presented by Dr Villa at the 12th Carboniferous Congress in Argentina).

Introduction

Over the last few years the Subcommission on Carboniferous Stratigraphy (SCCS) has promoted studies of floristic and faunistic assemblages at several levels of the Carboniferous which could be of importance for a potential global subdivision of the system. One of the levels thought to deserve preferential attention is the base of the *Protriticites* Zone which is approximately coincident with the base of the Upper Carboniferous in the Soviet Union, the base of the Missourian in the USA and in the Mid-Cantabrian in Western Europe.

Shallow platform Carboniferous rocks are exposed in the Cantabrian Zone, one of the regions of the Hercynian Massif. The Kasimovian deposits of the Cantabrian Zone only appear in the three easternmost located, structural units: Ponga Unit, Picos de Europa Unit, and Pisuerga-Carrión Unit. There is now ample evidence that only in the Picos de Europa Unit might there be a continuous succession from the Moscovian into the Kasimovian in an undisturbed sequence. So far, we know of only two apparently continuous successions containing strata bridging the Moscovian and Kasimovian stages, i. e. the Las Llacerias and the Tabla de Lechugales, both of which are found in the Picos de Europa Unit near Covadonga and Potes, respectively.

The Las Llacerias section

This report shows the results of the study of the upper levels in the Las Llacerias section, comprising the uppermost part of the Picos de Europa Formation (equivalent to the Myachkovsky substage and the base of the Kreviakinsky) and the rocks above this (equivalent to the Kreviakinsky substage).

The Las Llacerias section is exposed along a small path near Covadonga (Asturias), which leads from the Covadonga-Enol road to the cattle sheds of Las Llacerias. This section, ranging in age from Tournaisian to Kasimovian, has already been studied by several authors.

A recent and more detailed investigation was restricted to that part of the section containing the base of the *Protriticites* Zone as well as the strata immediately above and below it. This interval includes the upper part of the Picos de Europa Formation and a succession of some 75 m of thin-bedded limestone and marly limestone which previous authors have attributed to the Puentellés Formation.

The stratigraphically lowest beds of the section (belonging to the Picos de Europa Formation) are limestones whose characteristics indicate that sedimentation developed in a platform-lagoon which later evolved towards a more open system in which mound-cores and organic build-ups could develop. The upper beds (belonging to the Puentellés Formation) show characteristics of cyclic tempestite deposits developed on a homoclinal platform-slope.

On the distribution of the fossils: a comparison with other regions

A number of fossil groups have been sampled. The characterictics of the section favour the study of foraminifera, which, especially fusulinids, seem to yield the most promising data for establishing the age and correlation of the levels in question. A number of spores, conodonts, brachiopods and corals containing samples, together with fusulinids, have been studied (Fig. 4).

(a) Spores

Two spore-containing samples yielded a rich association. The association in the lowest sample seems to be characteristic of the *Thymospora obscura - Th. thiessenii* Zone (OT Zone of CLAYTON *et al.*, 1977). The main component in this sample is formed by species that are characteristic of the Westphalian (*Reticulatisporites reticulatus, Crassispora kosankei, Cingulizonates loricatus*, etc.) along with some species occurring in the Upper Westphalian D and Lower Stephanian (*Savitrisporites camptotus, Vestispora fenestrata, Cheiledonites?* sp.). A rather surprising find is the presence of *Cingulizonates loricatus* associated with verrucose monolete spores of the genus *Thymospora*. According to several authors, the epibole of monolete verrucose miospores indicates the base of the Stephanian. In this sample the verrucose monolete spores are not extremely abundant, but they can be considered to constitute a common component of this assemblage.

The association in the higher sample (LL-9042) also shows a predominance of Westphalian miospores, which occur together with some Lower Stephanian elements. However, there are noticeable differences with respect to the sample LL-9031: a) Sample LL-9042 does not contain *Cingulizonates loricatus* and *Vestispora costata*; b) It contains several monolete or inaperturate species which are probably new, and are characterized by a very regular pattern of reticulated ornamentation resembling well-defined small meshes; c) The proportion of species of *Reticulatisporites* is comparatively higher in sample LL-9042. On the whole, this sample seems to be younger than sample LL-9031, although the assemblage does not contain elements indicating that the Zone ST of CLAYTON *et al.* (1977) might have been reached. On the contrary, the association rather suggests an intra-OT position, nevertheless with a larger number of new miospores.

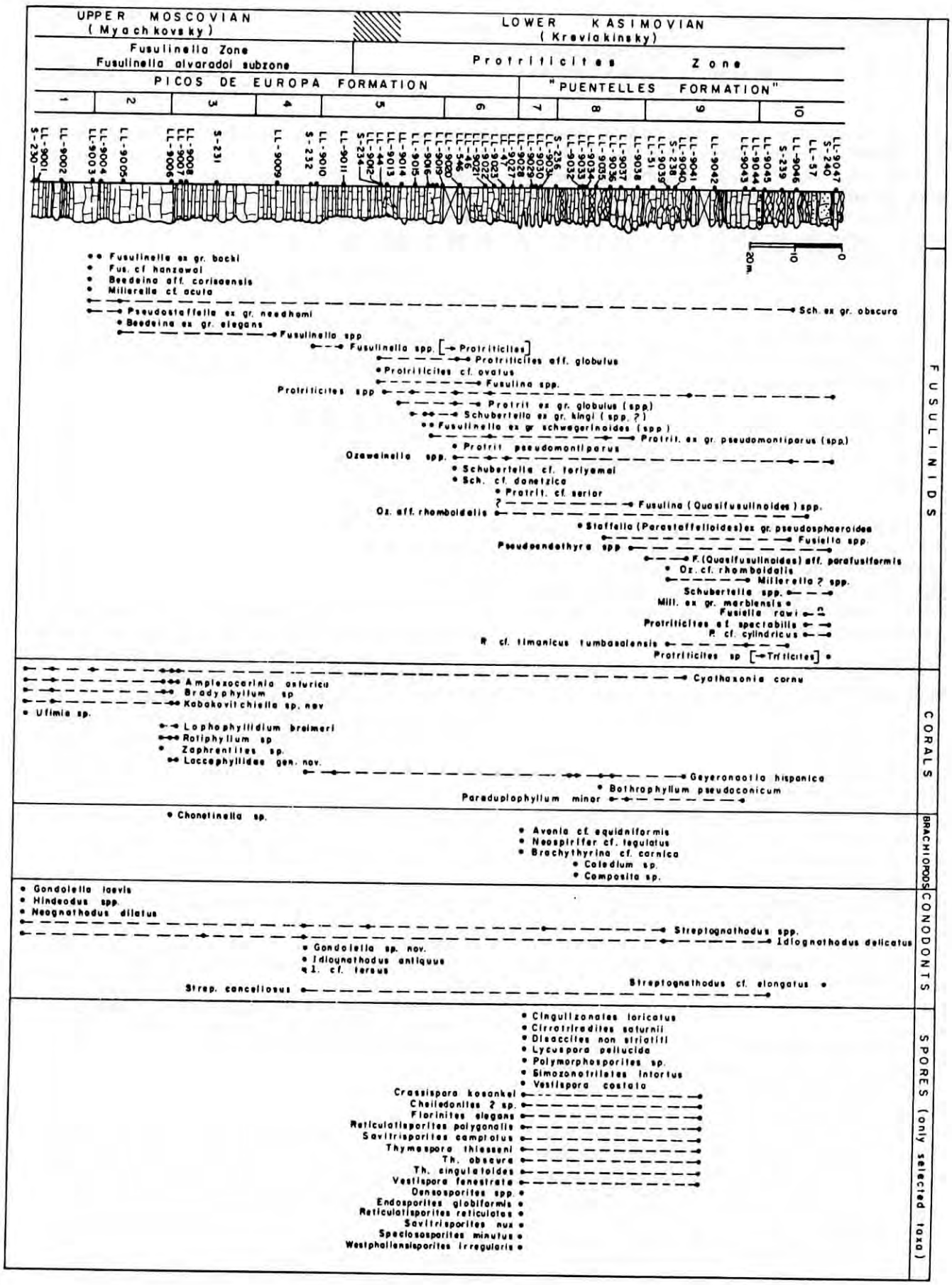

Figure 4: A stratigraphic column and faunal/microfloral range chart of the sequence exposed in the upper levels of the Las Llacerias section, comprising the uppermost part of the Picos de Europa Formation and the overlying Puentelles Formation. The section contains the top of the *Fusulinella* Zone and the base of the *Protriticites* Zone.

(b) Conodonts

The material investigated has yielded a modest number of conodonts of which only Pa elements have been studied.

Significant species are *Neognathodus dilatus* (Stauffer and Plummer), *Gondolella laevis* Kossenko and Kozitskaya, *Idiognathodus* cf. *tersus* Ellison and *Streptognathodus cancellosus* (Gunnell). *N. dilatus* and *G. laevis* are rather conspicuous elements of Desmoinesian conodont faunas in the USA. Both species are also present in the Carboniferous of the USSR. The first one extends from Moscovian into Kasimovian whereas *G. laevis*, as far as we know, has not been found above the uppermost Moscovian. This species seems to reach, both in the USSR and Spain, a slightly younger age than that in the USA, where it is an important component of Lower Desmoinesian assemblages.

Idiognathodus tersus ranges from Kasimovian to Gzhelian in the USSR and from Missourian to Virgilian in the USA. However, in the Las Llacerias section its first appearance seems to be slightly older.

The association between *Streptognathodus cancellosus* and *Idiognathodus delicatus* is reported in the USSR to be characteristic of the Myachkovsky. The first species persists in that area up to the Lower Gzhelian. Data from other areas indicate that the lower limit of its range can be considerably lower.

(c) Brachiopods

The lithological characteristics of the section do not favour an easy extraction of brachiopods. The only horizon in which it has been possible to identify species of a relatively varied association is the one from which sample LL-9029 was taken. Here, *Avonia* cf. *equidniformis* (Chao), *Brachythyrina* cf. *carnica* (Schellwien), and *Neospirifer* cf. *tegulatus* (Trautschold) occur together with other macrofauna. The former two brachiopod species are known to occur in beds of Upper Moscovian and Kasimovian age of the Cantabrian Mountains; the third species mentioned occurs in the same area in the Upper Moscovian. Outside this area all three species are present in the Upper Carboniferous of the Carnic Alps and in the Upper Moscovian and Kasimovian of Fergana.

(d) Corals

The section contains a relatively high number of beds with rugose corals. The associations found at the lower levels of the sequence correspond to the so-called *Cyathaxonia* fauna. Although traditionally considered to be typical of deep-water environments, this fauna is also present in carbonate-platform areas of shallow-water deposition with a very large proportion of terrigene clastics, or in sediments deposited under anaerobic conditions. These are the conditions that are inappropriate for colonial corals and rather unfavourable for solitary rugose corals with dissepiments. The above-mentioned fauna, when present in the Cantabrian Mountains, is frequently observed to occur in the upper part of the Picos de Europa Formation, in levels that bear a certain amount of lutaceous material, or in the massive, fine-grained limestones interpreted as having been deposited in an oxygen-poor environment.

The corals found at higher levels of the succession are solitary forms of considerable size, with dissepiments. The most representative species are *Geyeronaotia hispanica* Rodríguez and *Bothrophyllum pseudoconicum* Dobrolyubova. Their presence in the Puentellés Formation beds, interpreted as storm-generated deposits on a homoclinal platform, should be considered as being not *in situ* but brought down from more protected areas.

Some of the species found have a somewhat more restricted stratigraphic range. For instance, *Geyeronaotia hispanica* RODRÍGUEZ was apparently not present before the end of the Moscovian, and *Paraduplophyllum minor* (RODRÍGUEZ) has only been encountered so far in Kasimovian strata.

(e) Fusulinids

The fusulinid fauna found in this succession consists of the genera *Millerella, Ozawainella, Pseudostaffella, Fusiella, Schubertella, Fusulina, Fusulinella, Beedeina, Protriticites, Pseudoendothyra* and *Staffella*.

Representatives of the genus *Fusulinella* are still rather commonly present in the lower part of the succession. They belong to the groups of *Fusulinella bocki* von Moeller and *Fusulinella schwagerinoides* (DEPRAT). The lowermost part of the section, which we believe can be roughly correlated with the middle- and higher parts of the Myachkovsky, shows *Fusulinella* to be either associated with typical Moscovian genera such as *Beedeina* or slightly higher, having features that indicate the close relation with *Protriticites*. Even higher up in the section *Fusulinella* is completely replaced by its descendant genus *Protriticites*. The interval, comprising a lower part which may be either Myachkovsky or Kreviakinsky and an upper part of basal Kreviakinsky age, shows the concurrence of *Fusulinella* (of the *schwagerinoides* group) and *Protriticites*.

The genus *Protriticites* is the most conspicuous element of the fusulinid fauna in the upper part of the section; it occurs from LL-9012 to LL-9047, an interval which we consider, on the grounds of the distribution of the fusulinids, to be equivalent to the Kreviakinsky substage of the Moscow Platform, although not excluding the possibility that the lowermost part of this range is in the uppermost Myachkovsky. The lower and greater part of the vertical range of *Protriticites* in our section shows the presence of *Protriticites* ex gr. *pseudomontiparus* PUTRYA and *Protriticites* ex gr. *globulus* PUTRYA. Higher beds contain species which could be closely related to some species in the latter group, differing mainly in the more highly evolved wall with somewhat better expressed mural pores, and which, by the reduction of tectoria, resemble species usually assigned to *Obsoletes*. Of biostratigraphic importance is the finding here of a single specimen we informally classify as *Protriticites* sp. [*Triticites* (*Montiparus*)], which indicates that the top of the section could be very close to the limit of the Kreviakinsky-Khamovnichesky substages of the Kasimovian.

Correlation with the Moscovian-Kasimovian boundary of the USSR

The correlation of the levels studied with the Myachkovsky and the Kreviakinsky is mainly based on fusulinid foraminifera. It leads to the expectation that somewhere in this section occurs the boundary between the Moscovian and the Kasimovian stages, which in the USSR is the boundary of Middle- and Upper Carboniferous. One of the changes in the fusulinid fauna in the Moscow Platform in the USSR which coincides roughly with this boundary, is the gradual replacement of *Fusulinella* by its descendant genus *Protriticites*. The Las Llacerias section shows a somewhat comparable development. Here, in the interval studied, and from bottom to top, we find the oldest species reminiscent of *Protriticites* (seemingly still belonging to *Fusulinella*), the oldest *Protriticites* species, the last *Fusulinella* species, and the first *Obsoletes* (= *Protriticites* with reduced tectoria in this paper).

Stratigraphic schemes of the Moscow Platform Basin, including the boundary between the Moscovian and the Kasimovian, generally show this boundary as coinciding with the boundary between the *Protriticites pseudomontiparus/Obsoletes obsoletes* Zone and the underlying *Fusulinella bocki/Fusulinella eopulchra/Fusulina cylindrica* Zone. The boundary between the above-mentioned biozones in a complete, relatively thick, and undisturbed sequence such as that of the Las Llacerias section is often difficult to establish, which is of course due to the gradual evolutionary changes leading from one biozone to another, as well as to the regional differences in the faunal successions. Proposals affecting the limit of stratigraphic units in a type area, such as the Moscow Platform Basin, further complicate correlation. For instance a) the base of the Kasimovian is considered to coincide with the appearance of *Obsoletes* and a diverse fauna of *Protriticites*, or b) the base of the Kasimovian should be drawn where *Protriticites* appears (which is usually earlier than *Obsoletes* does), or c) the base of the Kasimovian should be drawn at the base of the Kreviakinsky as developed in its type-section (= Voskresensk, 80 km SE of Moscow), which is possibly at a slightly higher level than the first appearance of *Protriticites*. Obviously, the correlation of the Moscovian-Kasimovian boundary with some horizon of the Las Llacerias section is also dependent on our present decision as to which of the above-mentioned possibilities deserves preference.

We have come to the - still preliminary - conclusion, that the horizon at Las Llacerias, which correlates with the base of the Kasimovian (the latter base here is considered to coincide with the base of the Kreviakinsky in its type section) should lie somewhere in the interval enclosed by the LL-9011 level (the highest level that we consider still of Myachkovsky age) and the LL-9014 level (the lowest level that we consider of Kreviakinsky age).

Conclusions

The Las Llacerias section shows a continuous sequence of marine sediments along an interval which comprises the transition of Moscovian and Kasimovian. The spores found at various sites along the section, provide interesting information because they permit not only an age-determination in terms of the West European scale, but also allow comparisons with other areas in which the miospores play an important role in the fossil-associations. Moreover, they leave open the possibility to establish correlations between the West European scale and the marine scale of the USSR. The associations are comparable to those defining the OT Zone of CLAYTON *et al.* (1977) and point towards a middle to high position in this zone.

The macrofossils (mainly brachiopods and corals) are of interest because of their potential to indicate Carboniferous areas in the world showing close faunistic affinity with the Cantabrian Mountains. In this respect we note the conspicuous resemblance of corals as well as brachiopods from the Las Llacerias section with faunas from the Carnic Alps. Moreover, the coral associations reflect an abrupt change in the environmental conditions: the lower part of the section is characterized by the presence of solitary rugose corals without dissepiments (fauna of *Cyathaxonia*) whereas the middle and upper parts show the appearance of solitary corals with dissepiments.

The section has provided fusulinid foraminifera at many horizons along the entire interval studied. We did succeed in establishing the stratigraphic level representing the lower limit of the occurrence of *Protriticites*, a fact which may not only be of importance for long-distance correlations, but perhaps also for the establishment of a boundary in the Carboniferous System. The top of the sequence has provided *Protriticites* specimens showing a wall-structure transitional between *Protriticites* and *Triticites* (*Montiparus*). These findings of *Protriticites* at the lower side and *Protriticites* close to *Triticites* (*Montiparus*) near the top of the section, indicate that the *Protriticites* biozone, defined as an Interval Zone, is fully or almost fully present in the section. The study of the fusulinid fauna showed that the basal strata of the part studied in the section are Upper Moscovian (equivalent to the middle- or upper part of the Myachkovsky), whereas the strata at the top have a Lower Kasimovian age (probably equivalent to the top of the Kreviakinsky).

6.4 Conodonts and the Proposed Subdivision of the Carboniferous in Eastern Australia

By T.B.H. Jenkins - Dept of Geology & Geophysics, University of Sydney, Sydney NSW 2006, Australia

(Ed: Dr JENKINS kindly provided the editor with the following preliminary notes on conodonts of Viséan age in eastern Australia. For further details, please consult the full text and illustrations in the forthcoming paper by JENKINS, CRANE & MORY.)

The Mid-Carboniferous Boundary cannot at present be recognised in Australia by conodonts because they disappear below that level in the principal sequences with the only known Silesian fauna being that recorded by PALMIERI (1969) from Mt Murgon, Queensland. The problem is compounded by the absence of foraminifera and ammonoids in relevant sections. It therefore follows that the ***Project Groups 4-6*** can expect to have minimal or no input from Australian stratigraphy.

Project Group 1: (Mid- Late Tournaisian)

Conodonts are relatively abundant at these levels in eastern Australia and include cosmopolitan taxa that allow precise correlations with northern continents (JENKINS, 1974; MORY & CRANE, 1982). While continuous carbonate sections are unknown here, there is no difficulty in the Australian application of a decision on such a boundary, given that constraint.

Project Group 2: (Late Tournaisian - Early Viséan)

The appearance of *Scaliognathus anchoralis* is already widely documented in eastern Australia and early Viséan conodonts are described in detail in JENKINS, CRANE & MORY (in press). Viséan conodonts of eastern Australia include endemic and cosmopolitan taxa, the former providing an evolutionary lineage of patrognathids used as indices for the three Lower Viséan conodont zones, and the cosmopolitan taxa allowing broad correlations with the northern continents. Again, continuous carbonate sections across the Tournaisian-Viséan boundary are not available in eastern Australia and the application of such a stratigraphic boundary is, and has been, subject to that constraint.

Project Group 3: (Entry of *Gnathodus bilineatus*)

G. bilineatus is a rare species in Australia but it is known from five localities in Queensland and New South Wales (a possible ancestor occurs in our Middle Viséan). A boundary based on the appearance of *G. bilineatus* would therefore be recognisable in eastern Australia although not often directly diagnosed by the presence of that species. Indeed, JENKINS et al. (in press) have a zonal boundary marking the base of their *G. texanus* - *G. bilineatus* Zone (Zone 4) which could be regarded as an approximation to the Project 3 horizon. Continuous carbonate sections across that horizon are available in Queensland but are partly reefal and have provided conodonts only patchily.

JENKINS et al. (in press) have produced a correlation diagram showing conodont based correlations of Viséan and Viséan/Namurian sections in eastern Australia. This figure shows *inter alia* levels with identified brachiopod zones, which generally parallel four conodont zones (1-4) proposed for the Viséan, and ages (e.g. V1a, etc.) as deduced from ammonoids, algae and foraminifera by various authors. These zones will be referred to by nominate conodont species to be published in the forthcoming paper.

A second diagram revises the determinations of CRANE (1975) for conodonts from the Myall province in eastern New South Wales. These are the youngest conodont faunas from the Carboniferous of eastern Australia except for the Mt Murgon fauna of PALMIERI (1969) which seems to belong to a terrain distinct from that in which the principal Early Carboniferous sections are found.

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6.5 Global Subdivision of the Carboniferous System - The Gondwana Problem

By B. A. Engel, Department of Geology, University of Newcastle, Newcastle, NSW 2308 Australia

Studies reported on by JENKINS *et al.* (in press) have demonstrated the serious difficulty which confronts Carboniferous biostratigraphers in Australia, indeed Gondwana, when faced with formal subdivision of the Carboniferous sequence based upon evolving sequences of conodonts. A similar problem exists with other faunal groups such as fusulinids and ammonoids for which the Late Carboniferous record in Australia is critically deficient.

Since its formal definition at the 10th Carboniferous Congress in Madrid, 1983, it has been apparent that the Mid-Carboniferous Boundary cannot be accurately recognised in the Australian sequence because our modest conodont faunas of the Early Carboniferous disappear from the record before that stratigraphic level has been reached. In essence, the Subcommission has adopted a zonal scheme which is not directly ap-

plicable to those regions which were positioned outside the Carboniferous palaeoequatorial belt.

Progress reports on further subdivision, presented at the 12th Carboniferous Congress make it abundantly clear that the same trend will continue with the definition of further chronostratigraphic subdivisions which depend heavily upon the existence of conodont/foraminiferal faunas of Mid to Late Carboniferous age. Consequently the Gondwanic realm will need to resort to other means in order to define its chronostratigraphic framework and the Subcommission needs to address this issue in its future planning.

The Australian Record

Historically, the correlation of Carboniferous sequences in Australia with other parts of the world has at best been tentative because of a lack of common faunal and floral assemblages. In the Early Carboniferous sequences, the problem has not been quite so difficult because several elements of the fossil assemblages are essentially cosmopolitan in origin. In recent times, ROBERTS et al. (1991) have applied zircon dating techniques which suggest that many existing chronostratigraphic correlations may be in need of major revision. Despite this new development, JENKINS (see above) has made it apparent that the proposed Early Carboniferous global chronostratigraphic boundaries under investigation by the Subcommission have some prospect of being recognised in Australia.

This marginally acceptable correlation breaks down prior to the level at which the mid-Carboniferous Boundary has been defined. Essential definitive components such as conodont and foraminiferal faunas largely disappear, presumably as a result of major shifts in palaeogeography and palaeoclimate. The continent shifted away from the palaeoequatorial zone towards colder regions and consequently developed a unique organic assemblage of Carboniferous and Permian age now commonly regarded as being typical for the Gondwana land mass. The net consequence is that some other basis will need to be found to link Late Carboniferous Gondwanic assemblages to those of the palaeoequatorial realm, if global chronostratigraphic zonation remains the primary objective of the Subcommission.

Uncertainties of the global definition of the onset and decline of the Carboniferous System have always made it difficult to place these boundaries in Australia. The lower limit adopted historically has, with slight adjustment, been confirmed by zircon dating of samples taken from basal Carboniferous beds in Australia and from a bentonite situated close to the System boundary recently established by the Devonian-Carboniferous Boundary Working Group (ROBERTS et al., 1991). The situation is less clear with the Carboniferous-Permian Boundary which the same authors now suggest may have to be shifted downwards to incorporate into the Permian some beds which were previously considered to be of Late Carboniferous age.

Within the eastern Australian sequence nine faunal zones have been defined mainly by their brachiopod faunas in association with a modest conodont, ammonoid and foraminiferal content. Previously, these zones were distributed with some difficulty throughout the assumed Carboniferous interval, as it was then recognised. The above dating results now indicate that seven of these brachiopod zones are confined to the Tournaisian-Viséan interval (~30 Ma) leaving only one zone (*Levipustula levis*) in the Late Carboniferous (~40 Ma duration). This is longer than the entire interval left for the Permian of about 25 Ma (ROBERTS et al., 1991).

Given that these dates are confirmed by further global comparisons, it is apparent that Australia has a thick sequence of Late Carboniferous strata for which conventional methods of correlation are inappropriate. Accurate zircon age dating will be of major value in the establishment of a correlation scheme designed to link all regions both inside and beyond the Carboniferous Palaeoequatorial Zone, as must be other major global events which marked the separation of Gondwana from that domain. The new field of sequence stratigraphy with its possible relationship to global patterns of eustasy also needs to be considered. Use of the SHRIMP ion microprobe is expensive but the Subcommission must consider a program which includes this procedure if its ultimate aims are to be achieved.

REFERENCE

JENKINS, T.B.H., CRANE, D.T. & MORY, A.J. (in press): Conodont biostratigraphy of the Viséan Series in eastern Australia. *Alcheringa* (submitted September 1991).

ROBERTS, J., CLAOUÉ-LONG, J.C. & JONES. P.J. 1991. Calibration of the Carboniferous and Early Permian of the Southern New England Orogen by SHRIMP Ion Microprobe Zircon Analysis. *Carboniferous Newsletter 9*: 15-17 and *25th Newcastle Symposium on Advances in the Study of the Sydney Basin, April 1991*, 38-43.

Press Release

Baltimore, MD - Lifetime research by University of Illinois geology professor RALPH L. LANGENHEIM JR, at Arrow Canyon, NV, has shown that the duration of the Morrowan, Atokan and Desmoinesian intervals of the Pennsylvanian Period each span 4.5, 4.0 and 4.5 BILLION years. Langenheim announced the findings at the 26th Annual Meeting of the Northeastern Section of the Geological Society of America in Baltimore on 16 March 1991. His age determinations created considerable controversy amongst the 150 person audience because his results suggest that the age of the earth must be about 4.5 trillion years. On questioning by a member of the audience, Langenheim admitted that he made his calculations at 2:00 am, after a fire in his office building, and that he was getting old.

When questioned about Langenheim's discovery, George D. Klein, who has proposed a well-constrained Pennsylvanian time scale that is considerably shorter, said "Because it is bad form to discuss publicly either the professional work or personal state of one's faculty colleagues, I prefer not to say too much. I haven't even seen Langenheim's data to form an opinion". Klein is also a professor of geology at the University of Illinois.

Other audience members questioned about Langenheim's discovery considered it novel, intriguing, provocative and revolutionary. A universe 5 trillion years old will clearly give the creationists much to ponder!!

7.0 CONTRIBUTIONS FROM MEMBERS

7.1 Egyptian Carboniferous Studies

By Dr Mahmoud Kholief, Head of Exploration Division, Petroleum Research Institute, Cairo, Egypt

The sedimentary sequence of Carboniferous age occurs in surface and subsurface sections in several parts of Egyptian territory. Tectonic movements during the Mesozoic and Cenozoic eras resulted in a series of faults which uplifted oriented blocks of these ancient sediments on both sides of the Gulf of Suez, east of Egypt, while other blocks of the same age were thrown down in the sedimentary basins below the water mass of the Gulf and in some adjacent basins.

Carboniferous sediments are known also in the Western Desert of Egypt. They are exposed in the southern part of this area and it is possible to subdivide the whole section into Upper and Lower Carboniferous series. A preliminary report has also been prepared on the depositional facies of these units.

Definition of the boundaries at the top and bottom of the Carboniferous sequence remains problematic due to the lack of sufficient data on biozones and index fossils necessary to define these horizons. The clastic nature of the sedimentation, coupled with numerous erosional breaks, presents further difficulties.

The significance of Carboniferous sediments can be attributed to their relationship to mineral and fuel resources. Investigation of the sequence is currently planned with a technical group who will carry out a detailed study of the surface exposures around the Gulf of Suez. The research project will include field mapping with lithological description and laboratory based sedimentological/biostratigraphic studies. Personnel will come from the Egyptian Universities and the Petroleum Research Institute. Advisory consultation from abroad would be appreciated.

7.2 Contributions from Canada

BERNARD MAMET reports that he is presently working on intriguing mid Carboniferous Bolivian carbonates that yield good foraminiferal fauna. Originally attributed to the Permian, these limestones overly typical Gondwana Tournaisian-Viséan tillites. They are definitely warm temperate, with obvious affinities to the North American Realm. Practically nothing has been published on South American endothyrids and this represents a unique opportunity to tie together warm and cold water facies. Bernard would be most appreciative of any information concerning similar situations in Chile, Peru and Ecuador.

E.W. BAMBER reports that work is continuing with J. FEDEROWSKI on systematics and biostratigraphy of Upper Carboniferous (Moscovian to Gzhelian) colonial rugose corals from Ellesmere Island, Canadian Arctic Archipelago.

BAMBER, E.W. & SANDO, W.J. (in press): New information on the skeletal structure of the Viséan coral *Ankhelasma*. Contributions to Canadian Paleontology; *Geological Survey of Canada Bulletin*.

ERWIN L. ZODROW of the Department of Earth Sciences, the University College of Cape Breton, Sydney, Nova Scotia has reported on three aspects of his work:

1. Carbon 13 analyses of Carboniferous fern fronds

Fossil plants from the Sydney Coalfield in Nova Scotia, Canada almost invariably have cuticle preserved in them. This is due to the higher content of volatile components (35-37%) in the coalified fossil, a condition that favours cuticular preservation. Taking advantage of the situation, CLEAL & ZODROW (1989) showed how to study neuropterid fossils for use in taxonomic revision.

However, there are additional avenues of studying cuticular matter and one of them is the analysis of Carbon 13 by methods of nuclear magnetic resonance. The hypothesis (or wishful thinking at this point) is that the medullosean group of fern fronds can be distinguished from that of the marattialean, and further that species distinction is possible by Carbon 13 typing.

Presently, systematics of the analysis are being worked out. Included are minimum weight requirements in milligrams for obtaining reliable spectra both from the cuticle and the cuticle-containing coalified compression. For the Carbon 13 pilot study, *Macroneuropteris scheuchzeri* (HOFFMANN, 1827) CLEAL, SHUTE & ZODROW, 1990 specimens have been chosen.

Preliminary results indicate that, as expected, the cuticle-containing coalified layer yielded a spectrum that shows many more aromatic aspects than does that of the cuticle. The cuticle spectrum is as yet not stable due to the fact of insufficient sample matter. This is being rectified and some baseline results should be available within a year or so. The work is a tripartite effort involving Drs P.C. LYONS and W. OREM of the United States Geological Survey at Reston, Virginia.

2. Interpreting stomatal apparatuses

CLEAL & ZODROW (1989) reconstructed stomatal apparatuses of certain neuropterid foliage from the Sydney Coalfield, Nova Scotia, and Germany. As is customary, the investigation was completed with a light microscope. However, when the cuticles used in the 1989 case study were examined under a scanning electron microscope by Dr. Z. GAO, it was found that the new information obtained differed substantially from that

obtained by light microscopy. We raised the question of the value of the reconstruction of stomatal apparatuses based on light microscopy and suggest that scanning electron microscopy is the appropriate method of investigation. Details are forthcoming.

3. Would the real *'Sphenophyllum oblongifolium'* (GERMER & KAULFUSS) please stand?

The polyphyllous habit of *S. oblongifolium* has been recognised over the years by many Carboniferous paleobotanists, and the fossil has been used by biostratigraphers as an index fossil for Stephanian time. Recent finds in the Sydney Coalfield, Nova Scotia (ZODROW & GAO, 1991) have demonstrated that unattached and sterile *S. oblongifolium* leaflets may have been incorrectly identified. Typical *'S. oblongifolium'* leaflets were found attached to a plant that is reproductively different from *S. oblongifolium*. This is a rare situation in paleobotany. We named that plant *Leeites oblongifolis*, a new genus and species, generically named to honour Prof. LEE HSING-HSUEH (LI XINGXUE) of Nanjing Institute of Geology and Palaeontology, Academia Sinica, China. A necessary inference is that sterile foliage cannot be used to separate the two taxa and accurate identification can only be made when attached strobili are available for study. A possible mitigating circumstance is time separation between the two taxa; the Sydney material is basal Stephanian and the GERMER & KAULFUSS material is lower Permian.

CLEAL, C. & ZODROW, E.L. 1989. Epidermal structure of some medullosean *Neuropteris* foliage from the middle and upper Carboniferous of Canada and Germany. ***Palaeontology***, 32(4): 837-882.

ZODROW, E.L. & GAO, ZHIFENG, 1991. *Leeites oblongifolis* nov. gen. et sp., (sphenophyllaean, Carboniferous), Sydney Coalfield, Nova Scotia, Canada. ***Palaeontographica***, ABT. B, 223: 61-80.

PANGEA PROJECT

By Dr Benoit Beauchamp, Geological Survey of Canada, 3303, 33rd St., NW, Calgary, Alberta, T2L 2A7, Canada & Dr George D. Klein, Department of Geology, University of Illinois, 245 Natural History Building, 1301 West Green St., Urbana, IL 61801-2999, USA

PROJECT PANGEA, the newest initiative of the Global Sedimentary Geology Program (GSGP, an IUGS Commission) is under way. PROJECT PANGEA will look at the Earth's sedimentary record during the time of assembly of the supercontinent PANGEA, i.e. during late Paleozoic and early Mesozoic time, and its subsequent breakup and dispersal during latest Triassic and earliest Jurassic time, which led to the present-day disposition of continents. PROJECT PANGEA will focus on the most recent time of supercontinent accretion and dispersal when continents merge towards a geoid low. The sedimentary record of PANGEA represents an ideal interval of earth history from which one can evaluate the processes and magnitude of environmental variability and develop a predictive rationale for evaluating current environmental concerns. A multitude of research problems have been identified and will be dealt with through PROJECT PANGEA. Perhaps the most fascinating of these problems will be to assess the causes of large scale global climatic changes such as changes from an icehouse mode to a greenhouse mode as it happened during PANGEA time and as it is likely to happen in our immediate future. The biological and environmental changes that accompanied the end-Permian and end-Triassic extinctions will also be scrutinised.

A first meeting was recently held in San Diego, California, as part of the Annual Meeting of the Geological Society of America: PANGEA: ICEHOUSE PROCESSES, CLIMATES AND EVENTS ON A SUPERCONTINENT/GSA. 20 October 1991. This symposium brought together specialists with different backgrounds, from paleontologists to climate modellers, who tried to address various issues relating to the Carboniferous to Jurassic global environment of PANGEA. This first meeting was very well attended, confirming the vast interest for the new GSGP initiative.

An international WORKSHOP ON PROJECT PANGEA will be held in Lawrence, Kansas, 24-29 May 1992. This workshop is contingent on funding. A dozen keynote speakers will present papers, after which the workshop participants will be grouped into five working groups (WG) and will address specific aspects of PANGEA:

- WG-1 Paleogeography, plate tectonics and paleoclimate
- WG-2 Global synchroneity of the sedimentary record
- WG-3 Stratigraphic constraints on global synchroneity
- WG-4 Carboniferous to Jurassic resources
- WG-5 Synthesis

An international conference on ***Carboniferous to Jurassic Pangea: Resources and Environments*** will be held in Calgary, Canada, 15-19 August 1993. This conference, to be co-sponsored by the Canadian Society of Petroleum Geologists (CSPG), will be open to anyone interested in presenting their work relating to the Carboniferous to Jurassic time interval. Papers dealing with either global environmental aspects or global resources of PANGEA will be presented. Many field trips will examine the Carboniferous to Jurassic succession of the Canadian Rocky Mountains and that of the exotic terranes of the western Cordillera. The proceedings will be published in a high-quality memoir, the printing cost of which will be partly absorbed by the CSPG. A first circular will be mailed out soon.

If you are interested in PROJECT PANGEA, if you want your name to be added to the mailing list, or if you want more information concerning the Calgary Conference, please write to either: Dr Benoit Beauchamp, Geological Survey of Canada (TEL: (403) 292-7190; FAX: (403) 292-4961) or Dr George D. Klein, Department of Geology, University of Illinois (TEL: (217) 333-2076; FAX: (217) 244-4996).

Upper Paleozoic studies on Northern Ellesmere Island, Sverdrup Basin

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

The Geological Survey of Canada will send a team of geologists to Northern Ellesmere Island, Canadian Arctic, to examine Carboniferous and Permian strata, from late June to early August 1992. This area of Ellesmere Island displays some of the best exposures of

Bashkirian and Moscovian shelf carbonates (Nansen Formation) and their transition to slope and basinal shales, cherts and argillaceous limestones (Hare Fiord Formation). A reconnaissance survey in 1991 has revealed spectacular reef exposures, with individual buildups reaching hundreds of metres in thickness. The Bashkirian to Moscovian, shelf-to-basin transition will be the subject of an MSc thesis by COLLEEN SHERRY at the University of Ottawa. Some of the Moscovian reefs will be the subject of a post-doctoral study by FRANK BRUNTON, Queen's University, Kingston, Ontario. The Serpukhovian succession, of red-weathering conglomerates and sandstones, which was deposited in a series of rift-related tectonic depressions, will be examined in great detail by PIERRE THÉRIAULT of the University of Bergen, Norway. The various sequences forming the Carboniferous and Permian succession will be studied by BENOIT BEAUCHAMP, Geological Survey of Canada, with the help of a number of assistants. Emphasis will be on sequence boundaries, facies relationships, biostratigraphy, and sedimentology. Biostratigraphers attached to this project are: SYLVIE PINARD (small foraminifers), CHARLES HENDERSON (conodonts), JOHN UTTING (palynomorphs), RUI LIN (fusulinaceans), WALTER NASSICHUK (ammonoids) and WAYNE BAMBER (corals).

Age determination of new occurrences of evaporites, Sverdrup Basin, Canadian Arctic

By Sylvie Pinard, Institute of Sedimentary and Petroleum Geology, 3303 33rd St. NW, Calgary, Alberta, T2L 2A7 Canada

The age determinations - based on small foraminifera - of new occurrences of evaporites in the Sverdrup Basin is in progress. These evaporites occur in two sub-basins where they are interstratified with the marginal siliclastic deposits of the Canyon Fiord Formation in southwestern Ellesmere Island. They have been described by THÉRIAULT (1991). Preliminary identifications of small foraminifers indicate that one of the evaporite deposits is Lower Moscovian and the other is Upper Moscovian. The study of the fusulines by LIN RUI (ISPG) and the conodonts by CHARLES HENDERSON (University of Calgary) will supplement the age determinations.

The well documented evaporitic Otto Fiord Formation is slightly older and is probably Bashkirian in age. It lies at the centre of the basin, and commonly occurs as diapirs. This formation is exposed in normal stratigraphic position only in the Hare Fiord and Otto Fiord area, northwestern Ellesmere Island, where it overlies the Borup Fiord Formation and is overlain by the Hare Fiord Formation. Another evaporitic formation is the Mount Bayley which is restricted to west-central Ellesmere Island. Fusulines collected in the carbonate beds overlying and underlying this formation suggest an Early Permian age (THORSTEINSSON, 1974, p.48). Conodonts studied by HENDERSON (pers. comm., 1992) are believed to be Sakmarian in age; small foraminifera seem to confirm this age determination.

THÉRIAULT, P., 1991. Synrift sedimentation in the Upper Carboniferous Canyon Fiord Formation, SW Ellesmere Island, Canadian Arctic. Masters Thesis, University of Ottawa, 210 pp.

THORSTEINSSON, R., 1974. Carboniferous and Permian stratigraphy of Axel Heiberg Island and western Ellesmere Island, Canadian Arctic Archipelago. Geological Survey of Canada, Bull. 224: 113 pp.

7.3 Contribution To Carboniferous Geology and Palaeontology in Czechoslovakia

By J.Pešek, I. Chlupáč, J. Kalvoda, S. Opluštil, (Brno & Praha, Czechoslovakia)

In Czechoslovakia, especially in its western and central part, quite extensive occurrences of Lower and predominantly Upper Carboniferous and Permian rocks are preserved. These are the object of long standing systematic investigation and a number of papers was published during 1988-1991. Also two meetings were held: In 1990 the 4th Conference of the Mining Faculty at Ostrava and in 1991 the 6th Conference on Coal Geology at the Department of Economical Geology, Faculty of Science, Charles University (Prague).

Abstracts of some recently published papers include:

(a) Lower Carboniferous fauna

CHLUPÁČ, I. AND LANG, V. 1990: Find of a Devonian trilobite in Culm conglomerate of the Drahanská vrchovina Upland.- *Čas. Mineral. Geol.*, **35**, 1, 87-89. (In Czech, Engl. sum.).

An isolated thorax of partially enrolled trilobite of the typical pre-Carboniferous family Phacopidae was found in the Viséan conglomerate of the Drahanská vrchovina in Moravia. The redeposited trilobite remains point to a profound Lower Carboniferous erosion preceding the main effects of the Variscian Orogeny. This erosion affects even the rather deep-water Drahany Facies of Devonian deposits now known only from the deep basement of Culm sediments.

KALVODA, J. 1989: Tournaisian events in Moravia and their significance.- *Cour. Forsch.-Inst. Senckenberg.* **117**, 353-358. (Engl.).

The most important Tournaisian events in Moravia recognized at the Devonian-Carboniferous, at the Lower-Middle Tournaisian and at the Middle-Upper Tournaisian boundaries seem to be a manifestation of worldwide events which coincide with important changes in benthic assemblages of calcareous foraminifera. They are supposed to be climatically induced. At the Frasnian - Famennian and Devonian - Carboniferous boundaries, a cooling of the tropical-subtropical temperature caused the extinction of sensitive foraminifers and, less pronounced, eurytopic ones. The conodont extinctions seem to be connected with the changes of oceanographic parameters.

KALVODA, J. 1990: Foraminiferal zonation of the Upper Devonian and Lower Carboniferous in Moravia (Czechoslovakia).- *Acta Mus. Moraviae, Sci. nat.*, **75**, 71-93. (Engl.).

Thirteen foraminiferal zones are defined in the Upper Devonian and Lower Carboniferous of Moravia. These zones are correlated with standard conodont and ammonoid zonations as well as with regional zones based on tabulate and rugose corals and stromatoporoids.

The correlation with other foraminiferal zonations, both in the Tethyan and North American realms, is proposed and the data from Moravia are discussed.

KALVODA, J. 1990: Late Devonian - Early Carboniferous paleobiogeography of benthic foraminifera and climatic oscillations.- Kauffman, E.G., Wallisar O.H., eds, Extinction Events in Earth History. *Lecture Notes in Earth Science*, 30, 183-187, Springer-Verlag, Berlin. (Engl.).

The Late Devonian - Early Carboniferous palaeobiogeographic pattern is characterized by the immigration - emigration events of Tethyan tropic - subtropic foraminiferal faunas which are believed to reflect major climatic oscillations. A certain regularity points to periodicity of initial events. The extinction at the Frasnian - Famennian and Devonian-Carboniferous boundaries appears to be stepwise affecting preferentially tropic-subtropic faunas which are gradually replaced by the temperate ones (the similarity with Cretaceous/Tertiary and Eocene/Oligocene extinctions is apparent).

(b) Upper Carboniferous fauna

ZAJÍC, J. 1988: Remains of Permocarboniferous vertebrates in the borehole DB-1 (Dolní Bousov, Mnichovo Hradiště Basin, Central Bohemia).- *Věst. Ústř. Úst. geol.*, **63**, 1, 47-52 . (Engl.).

ZAJÍC, J. 1988: Acanthodian (Acanthodii) jaws from the borehole Sa-2a.- *Věst. Ústř. Úst. geol.*, **63**, 4, 221-225. (Engl.).

ZAJÍC, J. 1989: Remains of Permo-Carboniferous vertebrates from HK-1 borehole (Horní Kalná, Krkonoše Piedmont Basin, east Bohemia).- *Vest. Ústr. Úst. geol.*, **64**, 5, 287-295. (Engl.).

The author systematically describes the discovery of fresh-water Permo-Carboniferous vertebrates from boreholes in Central and North-eastern Bohemia. Representatives of sharks (*Xenacanthus* sp., *Expleuracanthus* sp.), acanthodians (*Acanthodes* sp.) and palaeoniscid fishes (*Sphaerolepis* sp., *Watsonichthys* sp.) were found. Stratigraphical value of described fauna is discussed.

(c) Upper Carboniferous flora

PURKYNOVÁ, E. 1990: About biostratigraphy on Carboniferous of the Doubrava Member in the Upper Silesian Coal Basin.- *Cas. Slez. Muz. Opava /A/*, **39**, 213-224, (In Czech, German sum.).

The author presents new palaeobotanical data from the uppermost part of the Carboniferous preserved in the Czech part of the Upper Silesian Coal Basin (the Doubrava Member). A list of the representatives of Pteridophylla is given. According to stratigraphically important species, the present author assigns the age of the Doubrava Member to late Westphalian A. This unit may be correlated with the Zaleze Member in the Polish part of the Upper Silesian Coal Basin. The index fossil *Lyginopteris hoeninghausii* occurs mainly in the lower part of the Doubrava Member. *Neuralethopteris schlehanii* is abundant in the whole unit. *Lonchopteris bricei* appears at the lowest coal seam No. 16 and higher successively further new species as *Neuropteris doubravica, N. heterophylla, N. ghayei, Alethopteris davreuxi, Sphenopteris herbacea, S. sauveri, S. idelbergeri, Fortopteris andraeana* are recorded.

ŠIMŮNEK, Z. 1988: Varieties of the species *Alethopteris grandinoides* Kessler from the Kladno Formation (Westphalian C,D, Bohemia).- *Čas. Mineral. Geol.* **33**, 4, 381-394. (Engl.).

A detailed description of morphological features and cuticles of three varieties of *A. grandinoides* occurring in Czechoslovakia is presented. *A. g.* var. *grandinoides* is known from the Radnice Member (Radnice and Lubná group of coal seams, Westphalian C) and from the basal part of the Nýřany Member (Mirošov Horizon, Westphalian D). *A. g.* var. *distantinervosa* occurs in the whole range of the Radnice Member and *A. g.* var. *kettneri* is confined to the Nýřany group of coal seams in the lower part of the Nýřany Member. Presumed relationship of *Alethopteris grandinoides* is outlined.

ŠIMŮNEK, Z. 1989: Stephanian and Permian species of *Alethopteris* from Bohemia and Moravia.- *Sbor. geol. Ved-R. Paleont.* **30**, 123-158. (Engl.).

Detailed taxonomical and stratigraphical analysis of Czech and Moravian findings showed the presence of four species: *A. bohemica* (found only in the Stephanian B in Bohemia), *A. zeilleri* (Stephanian B and C of Bohemia, Stephanian C and Autunian of the Boskovice Furrow, Moravia). From the last mentioned locality the author also reports occurrences of *A. schneideri* (Lower and Middle Autunian) and *A. moravica* (Lower Autunian).

ŠIMŮNEK, Z. (In press): The Carboniferous Alethopterides of the Karviná and Žacléř Formations (Czechoslovakia).- *Sbor. geol. Věd-R. Paleont.*, **33**. (Engl.).

The described species of *Alethopteris* come from two regions of the Bohemian Massif: Upper Silesian Basin (Karviná Formation, Namurian B - Westphalian A) and Intrasudetic Basin (Žacléř Formation, Namurian C - Westphalian C).

Alethopteris davreuxii (Brongniart) Goeppert, *A. decurrens* (Artis) Frech, *A. urophylla* (Brongniart) Goeppert and *A. valida* Boulay are all present in both the Upper Silesian and Intrasudetic Basins.

In the Upper Silesian Basin the following species occur: *Alethopteris jongmansii* Šusta and *A. havlenae* Šimůnek sp. n. (*A. densinervosa* of Havlena 1984). Specific for the Intrasudetic Basin are: *Alethopteris* cf. *grandinii* (Brongniart) Goeppert, *A. idae* Šimůnek, *A.* cf. *lancifolia* Wagner, *A. lonchitifolia* Bertrand, *A. pilosa* Šimůnek sp. n., *A. refracta* Franke and *A.* aff. *valida* Boulay (probably a new species). Cuticles have been studied from 10 species.

(d) Carboniferous geology and stratigraphy

PEŠEK, J. 1987: Deposits of Bituminous Coals of Czechoslovakia.- *Folia Mus. Rer. Natur. Bohem. Occident., Geol.* **26**, 66 pp. (Engl.).

Review of all significant bituminous coal deposits of Czechoslovakia is given. It includes elementary geological, stratigraphical, palaeontological, structural and tectonic characteristic of the basins. There is also review of technological parameters of coals, and informations about coal mining and resources.

DUDEK A. AND PEŠEK, J. 1989: Geological structure of the basement of Permo-Carboniferous limnic basins in the Bohemian Massif.- *Folia Mus. Rer. Natur. Bohem. Occident., Geol.* **29**, 32pp .(Engl.).

This paper deals with the structure of the basement of all Permo-Carboniferous limnic basins of Czechoslovakia. Geological maps showing opinions of both authors have been constructed on the basis of evaluation of more than 1000 boreholes penetrating up to the basement of Permo-Carboniferous.

PEŠEK, J. AND TÁSLER, R. 1989: Volcanism and volcanogenic rocks in the Upper Paleozoic limnic basins of the Bohemian Massif.- *Folia Mus. Rer. Natur. Bohem. Occident., Geol.* **30,** 55 pp. (Engl.).

Volcanogenic rocks and intensity of their occurrence in each unit of limnic Permo-Carboniferous from Namurian C up to Autunian are described. Products of acid volcanism predominate. Generally, they are transported by wind or by water. Effusive and intrusive volcanites are much rarer.

SKOČEK, V. 1989: Indications of Early Carboniferous events in Palaeozoic sequences of Moravia,Czechoslovakia.- *Čas. Mineral. Geol.*, **34,** 373-384. (Engl.).

The analysis of Early Carboniferous sequences in the Moravo-Silesian region has revealed a possible relationship between the lithological boundaries and changes and the most significant transgression-regression events in both the predominantly marine deep-water and deltaic hemipelagic deposits and the dominantly shallow-water complexes of marginal and platform parts of the basin. Particularly prominent is the regressive phase which is placed in the early Viséan and the transgressive phase in the lower late Viséan (approximately zone Goα). Additionally, in both basinal and platform sequences evidence has been provided of periodical depth changes, which may be interpreted as due to global eustatic oscillations.

KUMPERA, O. 1990: Geological and structural development of the Upper Silesian Basin.- *Sbor. vědecko-vyzkumnych prací VŠB Ostrava,* 1989, 37 pp. (In Czech, Engl. sum.).

The author distinguished three geotectonic stages in the development of the Upper Silesian Basin and of its basement (Cadomian, Variscan and Neoidic structural layer).

HOLUB, V. AND PEŠEK, J. 1991: The proposal of a stratigraphic division of the late Palaeozoic basins in the Central and Western Bohemian region.- *Věst. Ústř. Úst. geol.*, **66,** 31-41. (In Czech, Engl. sum.).

The authors define with more precision lithostratigraphic division of the Late Palaeozoic basins in Central and Western Bohemia.

HOLUB, V. AND PEŠEK, J. 1991: On the biostratigraphy of the Late Palaeozoic of the Central Bohemian area .- *Čas. Mineral. Geol.*, **36,** 137-141. (in Czech, Engl. sum.)

There are different views on the precise age of some lithostratigraphic units in the Central Bohemian area. The basal unit (the Radnice Member) belongs to the Westphalian B to C or only to the Westphalian C. The Nýřany Member is placed in the Westphalian D to Cantabrian interval while the sediments occurring at the base of this unit are mostly regarded as lower to middle Westphalian D in age. WAGNER (1977) expressed the view that the sedimentation, approximately between the Chotíkov and Nevřeň groups of coals, could have been interrupted, with the gap lasting for the whole of the lower Cantabrian. In the same paper WAGNER correlates the Tynec Formation with the upper Stephanian B, whereas ŠETLÍK (1970) and other authors emphasize a continuous passage of the Westphalian flora into the Stephanian. According to WAGNER (1977), between the Nýřany Member and the Týnec Formation a relatively long-lasting hiatus existed, encompassing the upper Cantabrian up to the lower Stephanian including the Stephanian B. There are no doubts about the age of the Slaný Formation (upper Stephanian B), however, there is no unity of opinion on the age of the upper portion of the Líně Formation. Some geologists correlate uppermost part of the sediments of the latter unit with the Permian deposits of the neighbouring areas.

OPLUŠTIL, S. 1991: Upper volcanic layer in the NW part of the Kladno Depression (Upper Carboniferous, Kladno Basin).- *Věst. Čes. Geol. Úst.*, 379-385. (Engl.)

There are several volcanic layers in the Radnice Member (Westphalian C) in the Kladno Basin. One of the most significant marker horizon is the so-called "green tuff" (Upper volcanic layer) which is a layer several tens of centimetres thick. The silty - clayey to fine grained, overlying horizon, with a volcanic admixture, ranging from 1 - 3 metres thick, was recently found in the Kačice coal deposit (8 km NW of the town of Kladno). Its mineral composition and some sedimentary features (lamination) are very similar to those of the rocks of the Whetstone Horizon, intercalated between the Upper and Lower Radnice Coals.

IGCP Project 216 (Global Bioevents)

In terms of the Working Group on the Devonian-Carboniferous boundary, CHLUPÁČ (Charles University, Prague) prepared together with BRAUCKMANN (Fuhlrott-Museum, Wuppertal, Germany) and FEIST (Université de Montpellier, France) a review of stratigraphic significance of trilobites near the Devonian-Carboniferous boundary with characteristics of latest Famennian and early Tournaisian faunas (for the final volume on the Devonian-Carboniferous boundary).

KALVODA (Masaryk University, Brno) finished a review of world-wide correlations of the Upper Devonian and Lower Carboniferous foraminiferal zones and their relations to conodont and ammonoid zonations. He also completed (partly in cooperation with other workers) a detailed study of the Devonian/Carboniferous reference section at Lesní lom in the Moravian Karst area near Brno. In terms of the IGCP Project 216, he provided a comparative study of palaeobiogeography of benthic foraminifera in relation to climatic oscillations and related phenomena.

7.4 Biostratigraphy of the Late Devonian and Carboniferous of the Timan-Pechora Region

By Dr A.V. Durkina, Timan-Pechora Branch, Oil and Geological Prospecting Institute (VNIGRI TPO), ul. Pushkina 2, 169400 Ukhta, Russian Federation

Specialists including A.V. DURKINA, M.V. KONOVALOVA, P.K. KOSTYGOVA (VNIGRI TPO, Ukhta) and V.I. AVKHIMOVICH (Bel NIGRI, Minsk) have continued to work on the biostratigraphical subdivision of the Late Devonian, Carboniferous and Early Permian deposits of the Timan-Pechora region. A.V. DURKINA has studied foraminifers from near the Devonian-Carboniferous boundary in the key section of the Malozemelsk-Kolguev Monocline (Narian-Mar borehole) and also from borehole N174, West Soples section of the Middle Pechorian transverse high.

Ten foraminiferal zones have been defined:

- 1 - *Septaglomospiranella primaeva - Septatournayella rauserae*
- 2 - *Quasiendothyra communis evoluta - Q. bella*
- 3 - *Q. communis venusta*
- 4 - *Q. regularis*
- 5 - *Q. eokobeitusana - Q. radiata*
- 6 - *Q. kobeitusana*
- 7 - *Q. dentata - Q. kobeitusana grandis*
- 8 - *Septatournayella njumylga - S. potansa*
- 9 - abundant *Bisphaera malevkensis - B. irregularis*
- 10- primitive *Eochernyshinella disputabilis*

These foraminiferal zones have been correlated with the miospore zones of AVKHIMOVICH (1988, 1992). Foraminiferal zones 1 and 2 correspond to the upper part of the *Cornispora varicornata* Zone; zones 3 to 7 correspond to the *Lepidothys* Zones (*Retispora, Lepidophyta typica - tenera - minor*); in zone 8, rare *Vallatisporites pusillites* is present (zonal species of the Kalinovskian strata of Bellorussia); zones 9 and 10 correspond to the *Tumulispora malevkensis* and *Apiculiretusispora septalia*. The same succession of foraminiferal and miospore zones exists in the key sections of the Upper Pechorian depression and on the southeastern slope of South Timan (previous investigations see A.V. DURKINA, 1984).

The standard conodont zones established by KHALYMBADZHA (1980) in the Upper Pechorian depression have also been correlated with the foraminiferal and miospore zones. In the interval of foraminiferal zones 1 to 9, the following conodont zones can be traced: *Palmatolepis marginifera, Scaphignathus velifera, Polygnathus inornata - Siphonodella sulcata.*

P.K. KOSTYGOVA (1991) has continued her foraminiferal research on the Tournaisian-Viséan boundary of the borehole sections of the Kosju-Rogovskaja depression and the Varandei-Adzva structural zone (northeast of the Timan-Pechora Province). Five foraminiferal associations belonging to the Kosvinskian, Radaevskian, Bobrikovskian, Lower Tulskian and Upper Tulskian horizons of the Lower and Middle Viséan have been defined.

Foraminiferal studies of the Upper Serpukhovian and Lower Bashkirian as well as the definition of the boundaries for Lower and Middle Carboniferous are also being investigated. Recent papers published on this problem include A.V. DURKINA (1990) on stratigraphy of the Serpukhovian stage of the Timan-Pechora Province.

Results of the study of fusulinids and biostratigraphy of the Upper Carboniferous and Lower Permian have just been published by M.V. KONOVALOVA (1991).

KONOVALOVA, M.V. 1991: Stratigraphy and fusulinids of the Upper Carboniferous and Lower Permian of the Timan-Pechora oil and gas-bearing province. *Nedra Publishing House, Moscow*, 201 pp., 44 pls.

7.5 Carboniferous Ammonoidea in the Database System GONIAT

By Dieter Korn and Jürgen Kullmann, Institut für Geologie und Paläontologie, Sigwartstr.10, D-7400 Tübingen, Germany

GONIAT is designed as a tool for investigations of the systematics of ammonoids, their palaeogeographic distribution and biostratigraphic range. This database management system will provide not only determinations on basic morphological characteristics but also information on occurrence, geological range, literature and phylogenetic relationships of every taxon at the generic and species level.

GONIAT has been established using the software package dBASE IV, equipped with a supplementary program GONIAT. It is arranged in a "relational model" according to the procedures used in the concept of a relational database structure. It consists of six independent databases connected by three link information files. These are: TAX for taxonomy, MORPHA/MORPHB for all distinctive morphological characters in adult or early and middle growth stages, LIT for literature, LOC for localities, BOUND for biostratigraphy. In order to achieve relevant time planes which can be used on a worldwide scale, the radiometric time scale is used as well as biostratigraphic names of global or regional importance. The morphology is described in two MORPH databases (for different growth stages); because of the linkage of these with TAX and BOUND the user does not recognize the separate parts of GONIAT.

The database system can be used in various ways. The data of each separate database can be looked up on the screen, either one record after another, or as a list. The linkage of the databases enables the user to switch from one database to another. If viewing TAX, the user can

look up the taxonomy and morphology of each taxon, and switch over to a list of the localities and publications connected with that taxon. While examining LOC, the user can immediately produce a list of all species which have been found in a particular layer, and of all publications which describe this goniatite locality. In LIT, the user can look up the records of the taxa or their localities described in a special publication. The search command enables the user also to search for special characters of the morphology, e.g. characteristics of shell form, ornamentation, suture. Each search condition can be combined with questions concerning the time range.

GONIAT will contain all ammonoid species and genera of the Devonian, Carboniferous and Permian. In the actual version (2.20), most of the Devonian and Carboniferous species are included, with 3339 TAX, 3952 LOC and 687 LIT records. Future versions will include generic descriptions and figures of cross sections and suture lines.

The computer requirements are: an IBM PC or AT compatible, a high density floppy disk drive, and at least 10 Mb space on a harddisk; dBASE IV is not required.

7.6 Carboniferous Studies in SW Spain

By Dr Sergio Rodríguez, Depto de Paleontologia, Facultad de Ciencias Geológicas, Complutense University of Madrid, 28040 Madrid, Spain

The Carboniferous research group of the Complutense University of Madrid is currently studying some Carboniferous areas in Sierra Morena (South West Spain). During the last four years we have studied the Los Santos de Maimona Basin which contains volcanic rocks and terrigenous and calcareous sedimentary rocks of Viséan age. We divided them into eight lithostratigraphic units (RODRÍGUEZ et al., in press), and identified abundant foraminifera, algae, corals and brachiopoda. Partial results of this research have been published during the last two years. Other papers were given during the 6th Fossil Cnidaria Symposium and the 12th International Carboniferous Congress and are now in press. Currently we are working on a monograph containing general stratigraphic, sedimentologic and paleontologic results of the research carried out during the last few years.

The research group is composed by Prof. S. RODRÍGUEZ, Prof. E. MORENO, Dr A. PEREJÓN, Prof. M.J. COMAS-RENGIFO, Prof. J.A. De La PEÑA, Prof. M.E. ARRIBAS of the Complutense University, Prof. MARTÍNEZ-CHACÓN of the Oviedo University and post-graduate students J.L. SÁNCHEZ, P. GEGÚNDEZ and S. FALCES.

For the next four years we plan to initiate similar research in the Guadiato Basin, one of the largest Carboniferous areas in South West Spain. For this purpose our research group will increase with the participation of Dr R. H. WAGNER, Botanic Garden of Córdoba and Prof. E. VILLA, Oviedo University. Prof. J. KULLMANN, Tübingen University and Prof. G. HERBIG, Marburg University will also collaborate.

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7.7 Reflections on Carboniferous Chronostratigraphy

By Robert H. Wagner, ENCASUR, Peñarroya-Pueblonuevo, Córdoba, Spain

Having been involved with IUGS-SCCS for almost thirty years, during which time this body has become progressively more international in membership and scope, I have naturally given some thought to the aims, achievements and limitations of this subcommission of the Commission on Stratigraphy.

We all know the general story of how a regional Northwest European stratigraphic classification evolved and how this became correlated with other regional classifications in North America and in the former Soviet Union. Although common knowledge, it is not generally acknowledged that these quite elaborate classifications are all based on biostratigraphic information from low latitude palaeoequatorial areas with highly diversified warm water faunas and rich tropical/subtropical floras. There is a striking loss of diversity when one moves to the higher palaeolatitudes, i.e. to the Gondwana and Angara areas. This means that the detailed chronostratigraphy developed in the palaeoequatorial belt area cannot be applied directly to the Gondwana and Angara regions, a problem that is particularly serious for the higher Carboniferous. Although primarily a palaeoequatorial belt worker,

I have had first hand experience with the Gondwana Carboniferous and this has allowed me to draw certain conclusions with regard to the strategy to follow when it comes to producing a general framework for worldwide Carboniferous chronostratigraphy.

It is realistic to admit that the efforts made by Gondwana specialists to fit their successions in either a West European or a North American chronostratigraphic framework have largely failed. Although there is room for debate, the problem is not so serious for the lower Carboniferous which still has a number of taxa of worldwide occurrence. Climatic differentiation undoubtedly had started already during the early Carboniferous, but it is the later Carboniferous which saw such extreme conditions that the Gondwana and Angara faunas and floras became very different from those in the palaeoequatorial regions. This means that biostratigraphic zonations developed for the palaeoequatorial belt will not be directly applicable to the Gondwana and Angara regions in the southern and northern high latitude areas, respectively.

It seems that this fact is not apparent to the majority of SCCS members. Although the problems of stratigraphic correlation between Gondwana and the palaeoequatorial belt were raised during the SCCS meeting in Madrid, 1983, Subcommission members have only recently had the opportunity to participate in field trips organised in the Gondwana area. The first meeting organised in Argentina to show SCCS members the Carboniferous of southern South America was unfortunately rather poorly attended, but the 1991 Carboniferous/Permian Congress in Buenos Aires has provided a more generalised contact with Gondwana Carboniferous stratigraphy. It is possible, of course, that SCCS members attending these meetings have merely drawn the conclusion that fossils are scarce in the Gondwana region, but a check of the literature will have shown that it is not a matter of collecting failure but a genuine loss of faunal and floral diversity at the higher palaeolatitudes.

This means that a purely biostratigraphic approach to Carboniferous chronostratigraphy will produce a detailed workable scheme for the palaeoequatorial belt regions with its highly diverse warm water faunas and tropical/subtropical floras, but will be inapplicable worldwide. A glance at the map will suffice to realise that the former high latitude regions of Gondwana presently occur over a large part of the world. The high latitude Angara region is more remote to the majority of Carboniferous workers, but is also rather large.

Of course, SCCS is in the business of finding a general chronostratigraphic classification for the entire world, and obvious limitations to achieving this aim should be avoided. Putting it bluntly, a purely biostratigraphic approach based on warm water faunas, on the Devonian model, cannot be the right one for the Carboniferous. The simple equation of chronostratigraphy = biostratigraphy if the right kind of fossils (marine nekton and plankton) are used (re the classical work by WEDEKIND and SCHINDEWOLF), does not work for the climatically diverse Carboniferous. Apart from the fact that all fossil groups have their advantages and drawbacks (depending on the purpose for which they are used), it will be the climatic response of the different groups that should be examined for a chronostratigraphy of worldwide validity, particularly in the higher Carboniferous. Of course, it is not only fossil faunas and floras that will respond to climatic differentiation and climatic fluctuations within a climatically diverse world, but there are also physical markers such as eustatically controlled sea level changes (e.g. the famous marine bands of the Northwest European paralic coal belt and the North American Midcontinent cyclothems), diamictites and widespread lacustrine intervals with dropstones in the colder regions, etc. From the biostratigraphic point of view, it may well be the climatically sensitive fossil groups that can be of greatest importance. These are not necessarily the ones that are commonly selected as sensitive evolutionary indices in the warm water faunas. Anyway, any preselection of what are regarded the "right" fossils will contain an element of dogma.

The highly successful search for a "Mid-Carboniferous Boundary" which has led to the recognition of a basic subdivision of the Carboniferous into two main units can be easily interpreted as finding the biostratigraphic expression of a worldwide climatic change of major importance. Shallow water faunas of the warm palaeoequatorial seas may well show changes produced by opportunistic taxa taking advantage of the disruptions provoked by sea level changes, and this faunal change is matched by the rather sudden impoverishment of both shallow marine faunas and continental floras in the higher latitude areas of Gondwana and Angara (i.e. the Ostrogian cooling event of Meyen in Angaraland). This event is sufficiently important to arouse a considerable measure of sympathy with the American workers who placed a systemic boundary at the top of the Mississippian which coincides with a very widespread regression due, most likely, to a substantial fall in sea level.

Picking up similar, climatically induced events in the higher Carboniferous demands more ingenuity, but should not be regarded as impossible. It is certainly a factor to be considered for the positioning of the Carboniferous (Pennsylvanian)- Permian Boundary.

It would probably be wise to concentrate at present on finding a suitable boundary within the higher Carboniferous, focusing on the different biostratigraphic changes detected at a level approximating to the Moscovian/Kasimovian and Desmoinesian / Missourian boundary, or, perhaps, at a lower level, within the highest Westphalian where climatically sensitive floras show substantial changes in certain environments of the palaeoequatorial belt.

It is also useful to give recognition to the fact that Russian workers (as well as such early chronostratigraphers as Munier CHALMAS and de LAPPARENT, 1893) found it useful to distinguish three major divisions. It is clear that a middle/ upper boundary is not nearly as important as the lower/middle boundary that has been selected as a subsystemic boundary by SCCS, but it may be more important than a number of the preselected

biozonal boundaries agreed on at Provo (preselection is always a doubtful procedure, anyway).

It may be recalled that SCCS, at its meeting in Moscow, 1975, recommended for worldwide use an informal division into lower, middle and upper. This recommendation which has been adhered to for the IUGS-SCCS sponsored series on *The Carboniferous of the World*, has never been revoked (and should not be, because it never does to change horses in mid-stream - the Series is still being published).

There is also an ongoing commitment to refine and formalise (by the selection of stratotypes) the existing stages in the various major regional chronostratigraphic classifications. Of course, it would be wise to adjust some of the major boundaries in these regional schemes to worldwide series boundaries. Work on the regional chronostratigraphic schemes should not be abandoned, if only because Geological Surveys in various parts of the world are generally willing to adjust boundaries but not to abandon units made familiar by long use and represented on geological maps. Progress is made by a fuller understanding and better definition of existing chronostratigraphic units; not by a wholesale change to completely new units which are likely to be unacceptable to organisations as well as individuals.

7.8 Regional West European Chronostratigraphy: Westphalian D - A Progress Report

By Robert H. Wagner, ENCASUR, Peñarroya-Pueblonuevo, Córdoba, Spain

There is an ongoing commitment to redefine and formalise the stages within the regional chronostratigraphic classification of the Carboniferous in western Europe. Three out of the four stages of the Westphalian Series have officially recognised boundary stratotypes in England, and have also been formally named, viz. Langsettian, Duckmantian and Bolsovian (*Newsletter 7*). The fourth stage, the Westphalian D, still has no formal stratotype and is only known by its informal connotation (D). Its conceptual stratotype is in Lorraine (France), a part of the Saar-Lorraine Basin. There are several reasons for making this area unsuitable for harbouring the stratotype, viz. (1) the relevant strata are not exposed on the surface in Lorraine (only in the subsurface) and the Westphalian D of Saarland is incomplete; (2) an important regional unconformity separates it from the overlying Stephanian and the top of the Westphalian D succession is truncated at different levels in different parts of the area; (3) the succession is entirely non-marine which imposes an important restriction on its fossil contents. Throughout Northwest and Central Europe the Westphalian D is non-marine, and within western Europe it is only in the Carnic Alps and in NW Spain that marine as well as terrestrial strata are developed in this chronostratigraphic interval.

Northwest Spain contains the most complete succession of Westphalian D strata and has the additional advantage of showing gradual transitions downwards into Bolsovian and upwards into Cantabrian (i.e. the basal stage of the Stephanian Series). Since the original concept of Westphalian D was linked to the ranges of certain floral elements, it is obviously important to select a stratotype that permits correlation with Lorraine on the basis of floral ranges. Since J.P. LAVEINE presented a general report on Westphalian D during the field and general meeting of SCCS in Czechoslovakia (1973 - Proceedings published in 1977), three floral zones have been distinguished within the Westphalian D interval (CLEAL, 1984). These three floral zones have been recognised also in NW Spain and linked most recently to well defined stratigraphic successions in the Central Asturian Coalfield and in the Guardo and La Pernía coalfields of northern Palencia. The detailed stratigraphy of these coalfields is known through the work of a number of specialists in stratigraphy, sedimentology and palaeontology. Both areas are well exposed on the surface and possess additional information as a result of coal mining and borehole campaigns. Both the Central Asturian Coalfield and the Guardo-La Pernía area contain a variable proportion of marine strata which are predominant in some parts and which have yielded diverse faunas including fusulinid foraminifera.

A recent summary of the information has been published by WAGNER and ALVAREZ-VÁZQUEZ (1991), who analysed the floral biozones essential for the correlation with Lorraine, and who mentioned faunal data from the literature. The Westphalian D commences at about mid-Podolsky of the Moscovian and reaches into the Myachkovsky which ends at the top of the lower Cantabrian.

No proposals are formulated as yet for a boundary stratotype of the Westphalian D in the Central Asturian Coalfield and for a unit stratotype made up of sections in the Asturias and in Palencia (both in the Cantabrian Mountains).

Consultations have started on putting together a research team in NW Spain with the specific aim to propose fully studied stratotypes, taking advantage not only of new palaeontological information but also of recent sedimentological work which has much improved our understanding of the Central Asturian Coalfield area and its corresponding basin of sedimentation.

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7.9 IGCP Project 272: Late Palaeozoic and Early Mesozoic Circum-Pacific Events (1991-1992)

By *Project Leader* - Dr J.M.Dickins, Bureau of Mineral Resources, P.O.Box 378, Canberra, A.C.T. 2601, Australia

Project 272 is a successor to Project 203: *Permo-Triassic events of East Tethys and their intercontinental correlation*. It aims to correlate, integrate and publish information on faunal-floral, climatic, sedimentary, volcanic-magmatic, tectonic, sea-level, palaeomagnetic and geochemical and metallogenic events especially around the Pacific.

In addition to the events well-known to be associated with the Permian-Triassic boundary, other important changes are known to be associated with the Carboniferous to Permian (base of Asselian), mid-Permian (Kungurian to Ufimian of twofold Permian subdivision), Lower to Middle Triassic, Middle to Upper Triassic and Triassic to Jurassic. Study of events associated with these boundaries are part of the project as well as consideration of other events of the Upper Palaeozoic and Lower Mesozoic.

Meetings and field visits have now taken place in three of the four sectors of the Pacific: Australia (New South Wales and Tasmania), New Zealand, Japan, and South America (Argentina and Brazil). Working Group meetings and field studies in 1991 were held in association with the 10th Gondwana Symposium, Hobart, in June; the Permian Congress in Perm, Russia, in August; and the 12th International Congress on Carboniferous and Permian Geology and Stratigraphy, Buenos Aires, Argentina in September. The fourth sector will be covered in 1992 with a meeting in North America in association with the North American Paleontological Convention in Chicago, 28 June to 1 July followed by a field visit to north-western U.S.A, 2-12 July. In addition a meeting and symposium will be held during the International Geological Congress, Kyoto, Japan, 24 August-3 September, 1992, followed by a meeting in Vladivostok and subsequent field visit in the Primorye Region, 6-12 September.

Important scientific results during 1991 include data leading towards better understanding of the Carboniferous-Permian Boundary. There is increased support for placing the boundary at the base of the Asselian of the Ural stratotype, corresponding apparently to a distinct biological change, a strong sea-level change, and a marked change in world climate. These conclusions suggest the top of the Pennsylvanian (top of the Virgilian) in the U.S.A. is older than the base of the Asselian and that, accordingly, the lower part of the Wolfcampian generally taken to be basal Permian, should be regarded as Carboniferous.

Western Argentinian faunal relationships are of particular interest. The Middle Carboniferous has close relationships with eastern Australia and shows evidence of glacial action. The Upper Carboniferous is warm without glaciation and has faunal relationships apparently with the Northern Hemisphere. Lower Permian has close faunal relationships on the other hand with Western Australia and the Northern Hemisphere and there is little evidence of the glaciation indicated in eastern South America (Parana and Sauce Grande Basins) and in other parts of the world in the Early Permian. In the Parana Basin it has been suggested that rather than a single icesheet, a number of areally discrete icefields were present, which may have implications for other Gondwana areas.

Study has progressed on the mid-Permian which is marked by the beginning of a major orogenic folding and magmatic event in many parts of the world, called in eastern Australia the Hunter-Bowen Orogeny and generally in South East Asia the Indosinian (it has other names in other parts of the world). Its beginning at the mid-Permian can now be identified in Australia, New Zealand, South and North America, Greenland, Europe and various parts of Asia including Himalayas, Thailand, Malaysia, China and Japan. It corresponds to important sea-level and biological changes.

An important outcome of the project has been recognition of the significance of the Midian-Dzhulfian boundary dividing the traditional Upper Permian into two parts. This corresponds to an important tectonic and magmatic event of the Hunter-Bowen (Indosinian) Orogeny and is characterized by distinctive biological and sea-level change. In Japan, it corresponds to the traditional Japanese boundary between the Middle and Upper Permian and in China to the traditional Chinese boundary between the Lower and Upper Permian.

Publications containing material concerned with the project are

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Kotaka, T., Dickins, J.M., McKenzie, K.G., Mori, K., Ogasawara, K., Stanley Jr., G.D., and Saito Ho-on Kai, (Eds) 1991. Shallow Tethys 3. *Museum of Natural History, Sendai, Japan, Special Publication No. 3.*

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JOHN ROBERTS[1], BRIAN ENGEL[2], AND JOHN CHAPMAN (EDITOR)

With contributions by

J.Beckett, G.A.Chapman[3], L.T.Etheridge
G.G.Holmes, S.Lawson[4], M.Lennox[5],
N.L. Markham, L.N.Morris[2], P.S.Roy,
and M.J.Sniffin

1. Department of Applied Geology, University of New South Wales
2. Department of Geology, University of Newcastle
3. Soil Conservation Service of New South Wales
4. Department of Water Resources
5. Ocean Resources N.L.

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By J. Roberts, B.A. Engel, and J. Chapman (ed). 382 pp., 69 Figs, 13 Tables, 47 Photographs, 3 Coloured Maps. NSW Geological Survey, Sydney, 1991. (ISSN 0728-9901)

This publication contains a detailed, well illustrated, comprehensive overview of Carboniferous geology in eastern NSW, Australia. It provides details of the stratigraphy, geological structure, palaeogeography and geological history of the Hunter-Myall region, leading to an assessment of the geological development of the southern portion of the New England Fold Belt in eastern NSW. The volume presents a summary of existing stratigraphic terminology, with detailed stratotype logs, for the Carboniferous (and limited Permian) sequences which are exposed over an area of about 8,000 square kilometres on the three accompanying 1:100,000 coloured geological maps.

Most of the research for this project was the result of joint studies carried out by the Universities of New South Wales and Newcastle, NSW during the period from 1970 to 1985. In compiling three 1:100,000 geological sheets with explanatory notes, the authors have incorporated all published geological mapping, the results of their own investigations, large amounts of previously unpublished data from graduate and postgraduate theses held in the libraries of the above institutions, and from unpublished mapping held at the Department of Minerals and Energy, NSW.

The Hunter-Myall region is situated at the southern end of the New England Fold Belt and consists mainly of the southeastern extension of the Tamworth Fold Belt (Figure 6). Within the region sedimentary rocks of Devonian and Carboniferous age are the principal exposures with limited occurrences of late Early Permian granitoids and overlying Tertiary basalt flows. Permian sediments of the northern Sydney Basin are exposed in the southwestern corner of the mapped area and there are outliers of Permian sediments within two major synclines in the eastern region.

During the latest Devonian and the Carboniferous, the Hunter-Myall region was part of a shallow to relatively deep water shelf area which was bordered to the west by a dacitic volcanic chain and to the east by a deepwater slope and basin province. Sediments within the Tamworth Belt therefore vary from continental volcanogenic sandstones and conglomerates in the west, through shallow marine sandstones, oolitic limestones, and mudstones, to relatively deep water mudstones with interbedded turbidites in the east.

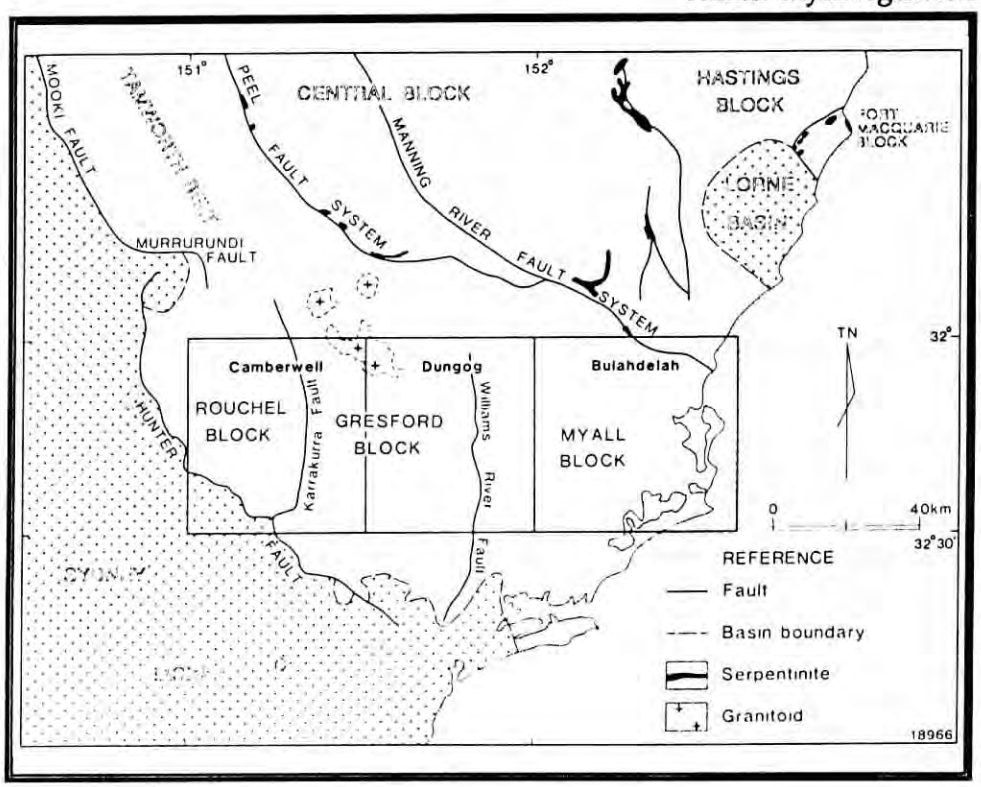

Figure 5: Major structural elements of the southern New England Fold Belt. The Hunter-Myall region (within the box) is subdivided by major faults into the Rouchel, Gresford and Myall Blocks, and the Sydney Basin. [Original figure from Roberts, Engel & Chapman, 1991, fig. 4, p.13].

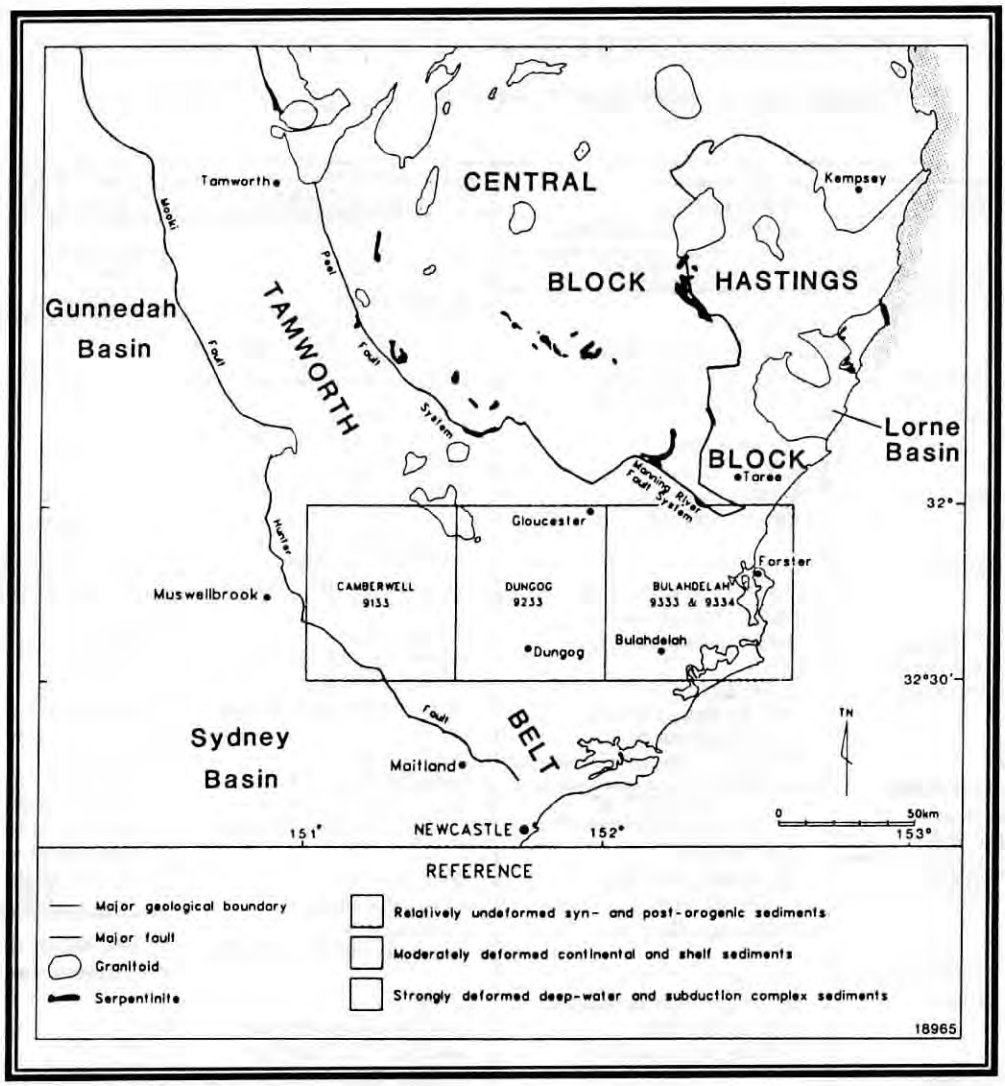

Figure 6: Generalised geological map indicating the relationship of the Camberwell, Dungog, and Bulahdelah 1:100,000 map sheet areas to the remainder of the southern New England Fold Belt and the Sydney Basin. [Original figure from Roberts, Engel & Chapman (Ed.), 1991, figure 3, p.12].

This publication constitutes the first comprehensive overview of the geology and palaeontology of the Carboniferous System in eastern Australia and as such represents a landmark publication of major significance to the understanding of Gondwanan stratigraphy as developed in eastern Australia. Students of global Carboniferous stratigraphy will find it an essential reference source. The 22 pages of bibliographic references provide a comprehensive guide to eastern Australian Carboniferous geology.

The publication with the three maps is available by pre-paid, direct order from:

The Publications Officer
Department of Mineral Resources
P.O. Box 536
St Leonards, NSW 2065 Australia

The volume of Explanatory Notes (382 pp.) and the three coloured maps are priced by the NSW Geological Survey at AUS$30 each, making a total cost of AUS$120 for the set. Postage by Economy Air Mail from Australia is AUS$19.50 for China & Japan; AUS$22.50 for North America; and AUS$24.50 for all other countries.

All direct orders must be accompanied by pre-payment with either a bank draft or a credit card authorisation (MasterCard or VISA) in *Australian dollars*.

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All enquiries shoud be addressed to:

Dr. B.A. Engel
SCCS Secretary & Editor
Department of Geology
University of Newcastle
Newcastle, NSW 2308, Australia

SCCS VOTING AND CORRESPONDING MEMBERSHIP LIST, 1992

Please check your entry and report any changes to the Secretary

ARGENTINA

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

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

Dr Carlos R. Gonzalez
Fundacion Miguel Lillo
Miguel Lillo 251
4000 Tucumán, ARGENTINA

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

Dr Nora Sabattini
Div. Paleozoologia Invertebrados
Museo de Ciencias Naturales
La Plata 1900, ARGENTINA

AUSTRALIA

Dr N. Archbold
Fac.Appl.Sci., Victoria College
Rusden Campus, 662 Blackburn Rd
Clayton VIC 3168, AUSTRALIA

Dr J.M. Dickins
Bureau of Mineral Resources
P.O. Box 378
Canberra,A.C.T. 2601, AUSTRALIA

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

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

Dr P.J. Jones
Bureau of Mineral Resources
P.O. Box 378
Canberra,A.C.T. 2601, AUSTRALIA

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

Dr G. Playford
Dept.Geology & Mineralogy
University of Queensland
St.Lucia,QLD 4072, AUSTRALIA

Dr J. Roberts
School of Applied Geology
University of NSW, P.O. Box 1
Kensington,NSW 2033, AUSTRALIA

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

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

AUSTRIA

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

Dr Franz Kahler
Rotkreuz Strasse 2
A-9300 St. Veit a. Glan,
Carinthia, AUSTRIA

Dr K. Krainer
Institut für Geowissenschaften
der Universität, Innrain 52
A-6020 Innsbruck, AUSTRIA

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

BELGIUM

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

Dr A. Delmer
Service Géologique de Belgique
16 Av Col Daumerie
B-1160 Bruxelles, BELGIUM

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

Dr Luc Hance
Service Géologique de Belgique
13 rue Jenner
B-1040 Bruxelles, BELGIUM

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

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

BRAZIL

Dr U.G. Cordani
Instituto de Geosciências
Universidade de São Paulo
São Paulo, SP 01498, BRAZIL

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

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

BULGARIA

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

CANADA

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

Mr Sedley Barss
506-6095 Coburg Road
Halifax, NS, B3H 4K1, CANADA

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

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

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

Dr W.R. Danner
University of British Columbia
Dept.Geol., 6339 Stores Rd.
Vancouver B.C., V6T 2B4, CANADA

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

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

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

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

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

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

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

CZECHOSLOVAKIA

Dr J. Dvořák
Ceský geologický Ústav
Leitnerova 22
65869 Brno, CZECHOSLOVAKIA

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

Dr Jiří Pešek
Dept.Geol.Min.Depos.,Fac.Science
Charles University
128 43 Praha 2, Albertov 6
CZECHOSLOVAKIA

DrIng. G. Weiss
Bachmacska 23
Ostrava 1, CZECHOSLOVAKIA

EGYPT

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

FRANCE

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

Dr J. Coquel
UFR Sciences de la Terre
Univ. Sci. Techn. de Lille
F-59655 Villeneuve d'Ascq, FRANCE

Dr J. Doubinger
Université L. Pasteur
1 rue Blessig
F-67084 Strasbourg Cedex, FRANCE

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

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

Dr M. Legrand-Blain
Tauzia, Rte de Bayonne
F-33170 Gradignan, FRANCE

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

Dr M. Lys
Lab.Géol.Historique, Fac.Sciences
Université Paris-Sud
F-91405 Orsay, FRANCE

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

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

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

Dr D. Vachard
Univ.des Sciences et Techniques
Science de la Terre
F-59655 Villeneuve d'Ascq, FRANCE

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

GERMANY

Dr Z. Belka
Inst.und Mus.für Geol.und Paläont.
Universität Tübingen, Sigwartstr. 10
D-7400 Tübingen 1, GERMANY

Dr C.G. Brauckmann
Fuhlrott Museum
Auer Schulstrasse 20
D-5600 Wuppertal 1, GERMANY

Dr G. Hahn
Inst.für Geologie und Paläontol.
Philipps-Universität Marburg
Hans-Meerwein Str.
D-3550 Marburg, GERMANY

Dr Chr. Hartkopf-Fröder
Geologisches Landesamt NW
Postfach 1080
D-4150 Krefeld, GERMANY

Dr H.G. Herbig
Inst.für Geologie und Paläontol.
Philipps-Universität Marburg
Hans-Meerwein Str.
D-3550 Marburg, GERMANY

Dr Hans Kerp
Westfälische Wilhelms-Universität
Abt.Paläobot.am Geol-Pal.Inst.u.Mus.
Hindenburgplatz 57-59
D-4400 Münster, GERMANY

Dr J. Kullmann
Inst.und Mus.für Geol.und Paläont.
Universität Tübingen
Sigwartstr. 10
D-7400 Tübingen, GERMANY

Dr E. Paproth
Schönwasserstr. 103
D-4150 Krefeld, GERMANY

Dr A. Rabitz
Geol.Landesamt Nordrh.-Westfalen
Postfach 1080, de Greiff Str.195
D-4150 Krefeld, GERMANY

Dr M. Schmidt-Thomé
Bund.für Geowissen.und Rohstoffe
Stilleweg 2, Postfach 51 01 53
D-3000 Hannover 51, GERMANY

Dr M. von Sperber
WBK Westfal. Berggewerkschaftsk
Postfach 102749
D-4630 Bochum, GERMANY

Dr D. Stoppel
Bund.für Geowissen.und Rohstoffe
Stilleweg 2, Postfach 510153
D-3000 Hannover 51, GERMANY

Dr K.A. Tröger
Mendelejewstr. 40
D-9200 Freiberg, GERMANY

Dr D. Weyer
Löwestr. 15
D-9200 Berlin, GERMANY

Dr Matthias Zeller
Geol.Landesamt Nordrh.-Westfalen
Postfach 1080, de Greiff Str.195
D-4150 Krefeld, GERMANY

Dr W. Ziegler
Senckenbergisches Museum
Senckenberganlage 2
D-6000 Frankfurt 1, GERMANY

HUNGARY

Drsc. Heinz Kozur
Rézeü u. 83
H-1029 Budapest, HUNGARY

IRELAND

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

JAPAN

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

Dr Masayuki Ehiro
Dept.Earth Science
Fac.General Education
Tohoku University
Sendai, JAPAN, 980

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

Dr H. Goto
Dept. Earth Science
Fac. General Education
Kobe University
Nada-ku, Kobe, JAPAN, 657

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

Dr T. Hamada
College of Arts & Sciences
University of Tokyo, Komaba
Tokyo, JAPAN, 153

Dr Y. Hasegawa
Dept Earth Sci., Fac.Gen.Education
Niigata University
Niigata, JAPAN, 950-21

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

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

Dr T. Ishibashi
Dept. Earth & Planetary Sciences
Fac. Science, Kyushu University
Hakozaki, Fukuoka, JAPAN, 812

Dr K. Ishida
Dept.Earth Sci., Coll.Gen.Educat.
Tokushima University
Tokushima, JAPAN, 770

Dr H. Ishiga
Dept. Geol., Fac. Science
Shimane University
Matsue, Shimane, JAPAN, 690

Dr K. Ishii
4-12-10, Aobadai
Suita City, Osaka, JAPAN, 565

Dr Kunihiro Ishizaki
Inst.Geol.& Paleont.,Fac.Science
Tohoku University
Sendai, JAPAN, 980

Dr Y. Isozaki
Dept.Geol.& Miner.,Fac.Science
Yamaguchi University
Yamaguchi, JAPAN, 753

Dr A. Kaneko
1-5-7, Fukaehon-cho
Higashinada-ku, Kobe, JAPAN, 658

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

Dr M. Kato
Inst. of Geology & Mineralogy
Fac.Science, Hokkaido University
Sapporo, Hokkaido, JAPAN, 060

Dr M. Kawamura
Dept. Earth Science, Miyagi Univ.
Aoba, Sendai, JAPAN, 980

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

Dr F. Kobayashi
7-9-20-203, Okamoto
Higashinada-ku, Kobe, JAPAN, 658

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

Dr K. Konishi
Dept.Earth Sci., Fac. Science
Kanazawa Univ., Kanazawa,
JAPAN, 920

Ms. Yuko Kyuma
3-450-24 Kogakura-cho
Nagasaki, JAPAN, 850

Dr N. Minoura
Inst. Geology & Mineralogy
Fac.Science, Hokkaido University
Sapporo, Hokkaido, JAPAN, 060

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

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

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

Dr K. Nakamura
Inst. Geology & Mineralogy
Fac.Science, Hokkaido University
Sapporo, Hokkaido, JAPAN, 060

Dr K. Nakazawa
Koyama Shimouchikawara-cho 28-2
Kita-ku, Kyoto, JAPAN, 603

Dr I. Niikawa
Dept.Earth Sci., Fac. Gen. Educat.
Niigata University
Niigata, JAPAN, 950-21

Mr S. Niko
Dept. Environmental Studies,
Fac.Integ. Arts & Science,
Hiroshima University
Hiroshima, JAPAN, 730

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

Dr Yuji Okimura
Inst.Geol.Miner., Fac. Science
Hiroshima University
Hiroshima, JAPAN, 730

Dr M. Ota
Kitakyushu Museum Nat.History
Yahatahigashi-ku
Kitakyushu, JAPAN, 805

Dr Tomowo Ozawa
Dept.Earth Science, Fac.Science
Nagoya Univ., Chikusa-ku
Nagoya, JAPAN, 464

Dr Kimiyoshi Sada
Dept.Environ.Studies, Fac.Arts & Sci.,
Hiroshima University
Hiroshima, JAPAN, 730

Dr S. Sakagami
Dept. Earth Sci., Fac.Science
Chiba University, Chiba, JAPAN, 260

Dr K. Sashida
Instute of Geosciences, U niv. Tsukuba
Tsukuba, Ibaraki, JAPAN, 305

Dr D. Shimizu
Inst. Geol. & Mineral., Fac.Sci.
Kyoto University, Kyoto, JAPAN, 606

Mr A. Sugimura
Akiyoshi-dai Museum Nat.History
Akiyoshi-dai
Yamaguchi, JAPAN, 754-05

Dr T. Sugiyama
Dept.Geol., Fac. Science.
Fukuoka University, Jonan-ku
Fukuoka, JAPAN, 814-01

Dr K. Suyari
Dept.Earth Sci., Fac.Gen.Educat.
Tokushima University
Tokushima, JAPAN, 770

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

Dr K. Ueno
Inst. Geosciences, Tsukuba University
Tsukuba, Ibaraki, JAPAN, 305

Dr Kozo Watanabe
1-12-12, OSK-601
Shinjuku, Shinjuku-ku
Tokyo, JAPAN, 160

Dr N. Yamagiwa
Dept.Earth Science
Osaka Kyoiku University
Tennouji-ku, Osaka, JAPAN, 543

Dr Juichi Yanagida
Dept.Earth & Planet.Science
Fac.Science, Kyushu University
Hakozaki, Fukuoka, JAPAN, 812

NEW ZEALAND

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

NORWAY

IUGS Secretariat
Leiv Erikssons vei 39
P.O.Box 3006 Lade
N-7002 Trondheim, NORWAY

Dr R. Sinding-Larsen
IUGS Sec.Gen., Geological Survey
P.O. Box 3006 Lade
N-7002 Trondheim, NORWAY

PEOPLES REP.CHINA

Dr Gao Lianda
Institute of Geology
Chinese Acad.Geological Sciences
Beijing, P. R. CHINA

Dr Guo Hongjun
Changchun College of Geology
6 Ximinzhu Street
Changchun, Jilin, P. R. CHINA

Dr Li Xingxue
Nanjing Inst. Geol. Paleont.
Academia Sinica, Chi-Ming-Ssu
Nanjing 210008, P. R. CHINA

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

Dr Wu Wang-shi
Nanjing Inst. Geol. Paleont.
Academia Sinica, Chi-Ming-Ssu
Nanjing 210008, P. R. CHINA

Dr Yang Jingzhi
Nanjing Inst. Geol. Paleont.
Academia Sinica, Chi-Ming-Ssu
Nanjing 210008, P.R. CHINA

Dr Yang Shipu
China University of Geosciences
Chengfu Lu
Beijing 100083, P. R. CHINA

POLAND

Dr Jerzy Fedorowski
Polska Akad.Nauk,Zaklad Paleoz.
ul. Mielzynskiego 27/29
61-725 Poznan, POLAND

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

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

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

PORTUGAL

Dr M.J. Lemos de Sousa
Min. Geol. Fac. Ciências
Universidade do Porto
Praça de Gomes Teixeira
4000 Porto, PORTUGAL

Dr J.T. Oliveira
Serviços Geológicos de Portugal
rua da Academia d.Ciências 19,2
Lisboa 1200, PORTUGAL

SOUTH AFRICA

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

Mr Barry Millsteed
Palaeont.Sect.,Geological Survey
Private Mail Bag X112
Pretoria 0001, SOUTH AFRICA

SPAIN

Dr A. Garcia Loygorri
Inst. Geol. y Minero de España
Rio Rosas 23, Madrid 3, SPAIN

L.F. Granados
EN ADARO Invest.Min.
Doctor Esquerdo 138
Madrid 28007, SPAIN

Dr M.L. Martinez Chacón
Depto de Geologia
University of Oviedo
Arias de Velasco s/n
33005 Oviedo, SPAIN

Dr Sergio Rodrigues
Depto de Paleontologia
Facultad de Ciencias Geológicas
28040 Madrid, SPAIN

Dr L.C. Sanchez de Posada
Depto. Geologia
University of Oviedo
Arias de Velasco, s/n
33005 Oviedo, SPAIN

Dr E. Villa
Unidad de Geologia, Fac.Biologia
Universidad de Leon
Leon 24071, SPAIN

Dr R.H. Wagner
ENCASUR
Peñarroya-Pueblonuevo
(Córdoba), SPAIN

SWITZERLAND

Dr J. Remane
Inst.de Geol.,Univ.de Neuchatel
11 rue Emile-Argand
Neuchatel 7 CH 2000
SWITZERLAND

THE NETHERLANDS

Dr H.W.J. van Amerom
Rijks Geologische Dienst
Geologisch Bureau, Postbus 126
6400 AC Heerlen,
THE NETHERLANDS

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

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

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

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

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

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23 High Bond End, Knaresborough,
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British Petroleum Res. Centre
Chertsey Rd, Sunbury-on-Thames
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Department of Geology
University of Durham
Durham DH1 3LE, U.K.

Mr M. Mitchell
11 Ryder Gardens
Leeds, W. Yorks. LS8 1JS, U.K.

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British Geological Survey
Keyworth, Nottingham
Nottingham NG12 5GG, U.K.

Dr W.H.C. Ramsbottom
Brow Cottage
Kirkby Malzeard
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Dr N.J. Riley
British Geological Survey
Keyworth, Nottingham
Nottingham NG12 5GG, U.K.

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

Dr W.J. Varker
Department of Earth Sciences
The University of Leeds
Leeds LS2 9JT, U.K.

U.S.A.

Dr John Aaron
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P.O. Box 919,
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Dr John Baesemann
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956 National Center
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Dr F.R. Ettensohn
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University of Kentucky
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210 Petrie Hall
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U.S. Geol.Survey, Fed.Center
Bldg 25, Box 25046, M.S. 919
Denver, CO, 80225-0046 U.S.A.

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Department of Geology
University of Iowa
Iowa City, IA, 52242 U.S.A.

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501 Westlake Park Blvd, Rm 1086W3
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254 N.B.H.,1301 W. Green St.
Urbana, IL, 61801 U.S.A.

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Western Washington University
Bellingham, WA, 98225 U.S.A.

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U.S. Geological Survey
Box 25046, MS 940,Federal Center
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ul. Sulejmanovoj 33
700017 Tashkent, Russian Federation

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630090 Novosibirsk,
Russian Federation

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252054 Kiev, Russian Federation

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Shosse Entusiastov 36
105275 Moskva, Russian Federation

Dr V.A. Chermnykh
Inst.Geol.,Komi Scientif.Centre
ul. Pervomayskaya 54
167000 Syktyvkar, Russian Federation

Dr G.E. Chernyak
Sev. Mor. Geol.
nab. Mojki 120
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Dr B.I. Chuvashov
Inst. Geol.& Geochem.,Urals Branch
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620219 Ekaterinberg (Sverdlovsk)
Russian Federation

Dr Marina Durante
Geological Institut AN USSR
Pyzhevsky per. 7
109017 Moskva, Russian Federation

Dr A.V. Durkina
V.N.I.G.R.I T.P.O.
ul. Pushkina 2
169400 Ukhta, Russian Federation

Dr O.P. Fissunenko
Pedagog. Inst., Oboronnaja 2
348011 Voroshilovgrad
Russian Federation

Dr V.G. Ganelin
V.S.E.G.E.I., Sredni pr. 74
199026 Leningrad
Russian Federation

Dr N.V. Goseva
Geological Institut AN USSR
Pyzhevsky per. 7
109017 Moskva
Russian Federation

Dr V.S. Gubareva
V.N.I.G.N.I.,
Shosse Entusiastov 36
105275 Moskva
Russian Federation

Dr T.N. Isaxova
Geological Institut AN USSR
Pyzhevsky per. 7
109017 Moskva, Russian Federation

Dr R.M. Ivanova
Inst. Geol.
Pochtovyj per. 7
Sverdlovsk, Russian Federation

Dr N.V. Kalashnikov
Inst.Geol.,Komi Scientific Cent.
Uralian Branch,Acad.Science USSR
167000 Syktyvkar, Russian Federation

Dr L.I. Kononova
V.N.I.G.N.I., Shosse Entusiastov 124
105275 Moskva, Russian Federation

Dr M.V. Konovalova
Geological Expedition (U.G.R.E.)
ul. Geologov 2
169400 Ukhta-2, Russian Federation

Dr R.I. Kozitskaya
Inst.Geol. Nauk AN USSR
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252054 Kiev, Russian Federation

Dr S.S. Lazarev
Paleontol. Inst.
Profsoyuznaya ul. 123
117321 Moskva, Russian Federation

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T.T.P. "Centzgeologia"
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Inst. Geol. Nauk, Kalinina 69A
480100 Alma Ata, Russian Federation

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

Dr T.I. Nemirovskaya
Inst. Geol.,Ukrainian Acad.Sci.
ul. Chkalova 55b
252054 Kiev 54, Russian Federation

Mrs M.V. Oshurkova
V.S.E.G.E.I., Sredni pr. 74
199026 Leningrad
Russian Federation

Dr V.I. Poletaev
Inst. Geol. Nauk AN USSR
ul. Chkalova 55b
252054 Kiev, Russian Federation

Dr A.V. Popov
Leningrad University, 16 Linia, 29
199178 Leningrad, Russian Federation

Dr B.V. Poyarkov
Yaroslavl Pedagogic Institute
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150000 Yazoslavl, Russian Federation

Dr M.I. Radchenko
Inst. Geol. Nauk, Kalinina 69a
480100 Alma Ata,K.SSR
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109017 Moskva, Russian Federation

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Inst. Geol. Komi Scientific Centre
ul. Pezromayaskaya 57
167000 Syktyvkar, Russian Federation

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Dr A.K. Shchegolev
Inst. Geol. Nauk AN USSR
ul. Chkalova 55b
252054 Kiev, Russian Federation

Dr O.A. Shcherbakov
Polytechnical Institute
Komsomolskiy Avenue 29a
614600 Perm, Russian Federation

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Polytechnical Institute
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614600 Perm, Russian Federation

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Geological Inst. AN USSR
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ul. Fersmana 50
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Dr Boris J. Chuvashov
Institute of Geology & Geochemistry
Acad. Science USSR, Pochtoviji Per.7
620129 Sverdlovsk
Russian Federation

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Geological Inst. AN SSSR
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109017 Moskva, Russian Federation

Dr J. Thomas Dutro Jr
U.S. Geological Survey
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U.S. Geological Survey, Fed.Center
Bldg 25, Box 25046, MS919
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Dr H.Richard Lane
Amoco Production Co. USA
501 Westlake Park Blvd, Rm 1086, W3
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Houston, Texas 77253, U.S.A.

Dr Jean Pierre Laveine
Lab.Paléobot. UFR Sci.de la Terre
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Nanjing Inst. Geol. Palaeontology
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University of Montreal
Montreal, P.Q. H3C 3J7, Canada

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Fayetteville, AR, 72701, U.S.A.

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Schönwasserstr. 103
D-4150 Krefeld,
Germany

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Brow Cottage
Kirkby Malzeard,
Ripon, N.Yorks., HG4 3RY,
United Kingdom

Dr John Roberts
School of Applied Geology
Univ.of N.S.W., P.O. Box 1
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Instituto de Geociencias
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Nationaal Natuurhistorisch Museum
Postbus 9517, 2300 RA Leiden
THE NETHERLANDS

Dr Yang Shipu
China University of Geosciences
Chengfu Lu
Beijing 100083,
Peoples Republic of China

POSTSCRIPT

Stratigraphy and Correlation of the Carboniferous Coal Sediments of Bulgaria

ByYanaki Tenchov and Tatyana Dimitrova, Geological Institute of the Bulgarian Academy of Sciences, "Acad. G. Bontchev" str., bl. 24, 1113 Sofia, Bulgaria

Carboniferous sediments in Bulgaria are known from outcrops and deep drillings. The Svoge Anthracite Basin (Namurian A - Westphalian C, continental sediments) and a number of small basins are located in the northwestern part. The outcrops of Stephanian C - Early Permian continental sediments with thin coal interbeds are established to the north of Svoge Basin. The Dobrudzha Coal Basin (Upper Viséan - Cantabrian), covered with more than 1400 m of sediments, is located in northeastern Bulgaria. In central northern Bulgaria, Upper Viséan terrigenous sediments with thin coal interbeds were established.

Y. TENCHOV has worked for many years on the problems of the lithostratigraphy and biostratigraphy of the megaflora following the establishment of the basins. He has published data on the Svoge Basin and those on the Late Stephanian basins with lithostratigraphic and biostratigraphic characteristics of the supporting sections and their megaflora. Over 10,000 samples on the megaflora were processed from the Carboniferous basins in Bulgaria. The doctoral thesis of T. DIMITROVA (1990) deals with the stratigraphy and correlation of Carboniferous sediments from the Dobrudzha Coal Basin by miospores. On the basis of the rich palynological material isolated miospores from more than 50 boreholes were studied. A zonal scheme by spores and pollen of the basin was made, and the biostratigraphic zonation was compared with analogues from the Carboniferous basins of Western Europe. Right now the research work of DIMITROVA is concerned mainly with the taxonomy, morphology and stratigraphy of the Namurian palynological assemblages. Both researchers are working towards the establishment of the Lower/Upper Carboniferous boundary in the Dobrudzha Coal Basin.

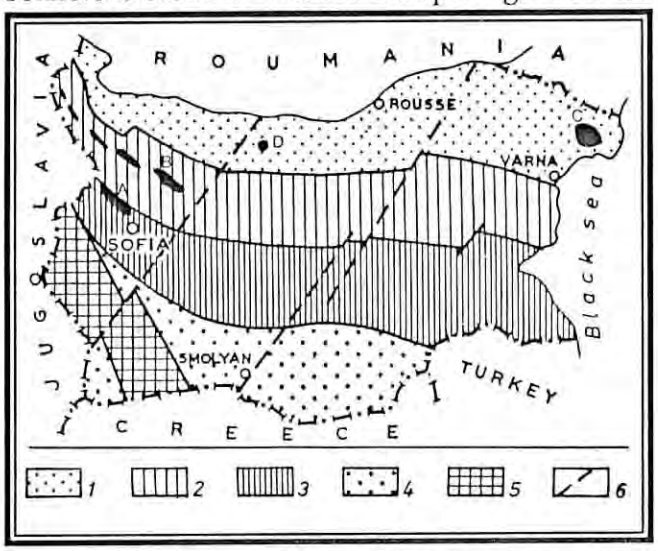

Figure 7: Late-Alpine structural plan of Bulgaria (after E. Boncev, 1982, simplified).

1- Moesian Platform; 2 - Balkanids; 3 - Srednogorie; 4 - Massifs; 5 - Kraiste. A - Svoge; B - Stephanian; C - Dobrudzha; D - Borehole with Viséan sediments.

Austrian Carboniferous

By Hans P. Schönlaub, Geologische Bundesanstalt Rasumofskygasse 23, A-1031 Wein, Austria

Following the paper on **"Lower Carboniferous Paleokarst in the Carnic Alps (Austria, Italy)"** in the journal *Facies*, volume 25, 1991, a special volume of the *Jahrbuch Geol.B.-A.* was dedicated to the Paleozoic of the Alps and particularly to various topics of the Carboniferous and the Devonian/Carboniferous boundary. With regard to the latter, four papers summarised the biostratigraphy (conodonts, ammonoids, trilobites), biofacies, sedimentology, microfacies and geochemistry of the boundary passage of sections Kronhofgraben and Grüne Schneid in the central Carnic Alps of Austria. The authors unanimously agreed that the Grüne Schneid section fulfils all requirements to serve as an excellent stratotype for the D/C boundary even though La Serre section in southern France has already been chosen as the global type section. A joint contribution on the Grüne Schneid section was submitted to the expected D/C boundary volume to be edited by E.PAPROTH and G.SEVASTOPULO.

This year in the Carnic Alps much effort will be spent unravelling problems of Carboniferous litho- and biofacies and their correlation with Eastern Europe and Middle Asia, e.g. the Donets Basin, the Urals and Fergana. For this correlation conodonts are most promising, occurring in fairly high numbers in rocks of Viséan and Serpukhovian age and also in the equivalents of the late Moscovian and Kasimovian Stages. Recently, the biogeographic relationship between these and other areas with the Carnic Alps has been thoroughly discussed by the present writer. In addition, the author and PROF.A. FENNINGER from Graz University intend to publish the comprehensive results of their 25-years of research activity in the Carboniferous of the Carnic Alps from which an entirely new revision of the bio- and lithostratigraphical framework of this region has emerged.

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